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Environment Management Plan for the Geo Thermal Zone of the Tansa River Basin

DESIGN CELL - KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES

ACKNOWLEDGEMENTS

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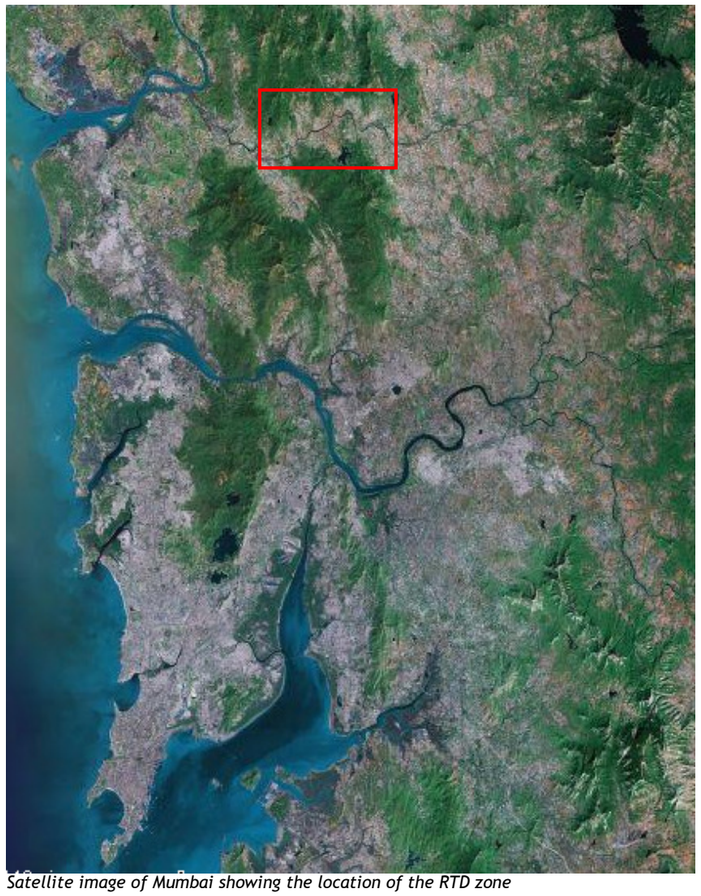
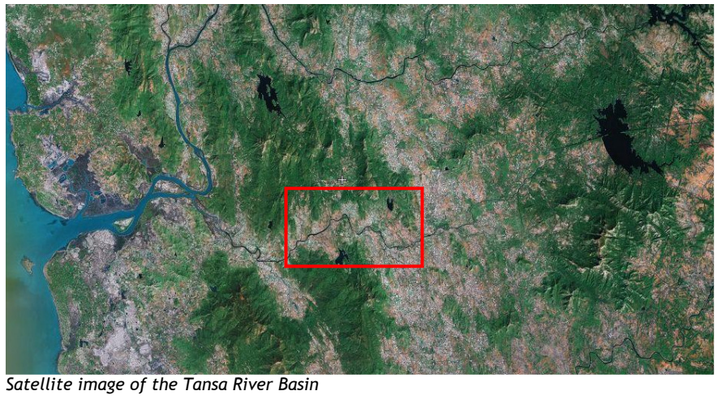


Satellite image of Mumbai showing the location of the RTD zone



Satellite image of the Tansa River Basin

CHAPTER 1
INTRODUCTION

1.1 Background and Area of Interest

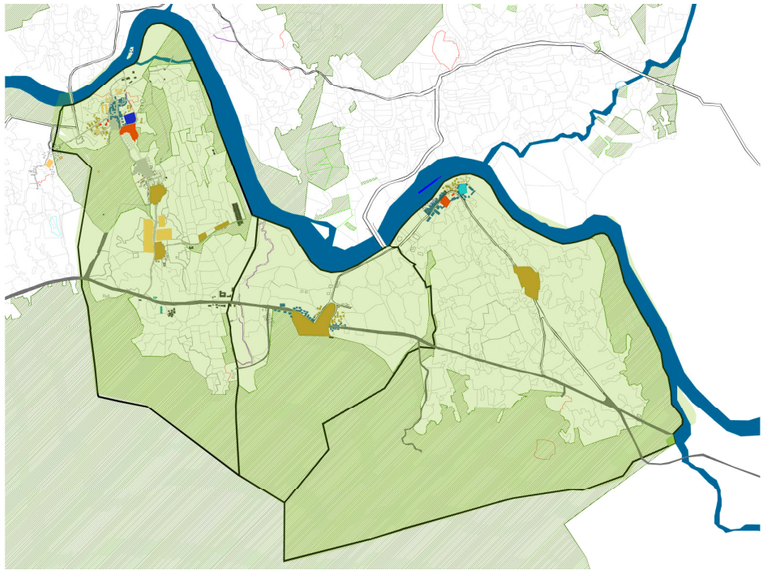
The study focuses on the three villages of Vajreshwari, Akloli and Ganeshpuri, situated 30 kilometres from Vasai, in the Bhiwandi Taluka of Thane District, which has been designated as the Recreation and Tourism Development (RTD) Zone in the Mumbai Metropolitan Region Development Plan 1996-2001. The proposed Tourism Development Zone lies within the Tansa River Basin in the northern periphery of the MMR region. The river originates from from the Tansa Lake in the hills at Igatpuri in Nashik, Maharashtra, in the North Eastern Part of the Thane district in the Sahyadri Ranges. The river further flows downstream through part of Shahapur, Wada, Bhiwandi, Palghar, and Vasai Talukas to the Arabian Sea. In 1892 A.D, the Tansa Dam was constructed in Shahapur Tahsil to supply water to Mumbai.

The Tansa River Basin is equidistant from the three urban agglomerations of Wada, Vasai and Bhiwandi. It is well connected by road from all three agglomerations with a public transport system in the form of the Maharashtra State Transport Bus system.

The region exhibits geo-thermal activity and the official records report the presence of 300 thermal springs presently of which one sixth can be located based on local sources and other studies. The hill to the North of the Tansa River called Mandagni is said to be a dormant volcanic site. Along the river basin are situated many forests, including the Tungareshwar and Tansa Wildlife sanctuaries. The forests are rich in both floral and fauna bio-diversity as well as support several trial communities.

The proposed Recreation and Tourism Development (RTD) Zone is composed of these three villages comprising of 947 hectares of which approximately 416 hectare is under forest cover[1]. The remainder is predominantly farmland. The villages along the Tansa watershed, characterized by the presence of temples, curative hot springs, forests and protected areas with rare wildlife, makes this region particularly attractive tourist spot not just for pilgrims, but also for wildlife enthusiasts and for picnickers. The economy is primarily agrarian and is slowly transforming into tourism-based services in response to the demand. The historic Swami Nityanand Temple has been the generator of local tourism based services catering to pilgrims from the surrounding areas. However in more recent times the Siddhapeeth Trust has been developing a new form of spiritual tourism which is focused on a global audience and is sustained by global capital.

[1] Village Map, Gram Panchayat



Map showing the proposed RTD Zone in the Villages of Akloli, Vajreswari and Ganeshpuri

Tourist activity related informal growth around the Akloli Hot Spring. A polluted and drying pool

1.2 Concerns

The area has two levels of concerns some of which are immediate and located within the RTD Zone, and others that are regional in nature concerning the Tansa River Basin as a whole. For this study we would like to bring forth the concerns at both scales.

Some of the immediate concerns are:

- Due to the influx of a large floating population attracted by the temples, hot-springs, ashrams and trusts, new forms of tourist activity have proliferated in the region, such as resorts, hotels, motels, spas, etc. The region has always attracted people but on special days such as Guru Purnima, and Jatra of the goddess Vajreshwari almost a lakh of pilgrims generally congregate over 3 days and transform the otherwise rural setting into a pilgrim centre. On the weekends too, there is an influx of picnickers and pilgrims. However there has been no planned improvement of infrastructure for these activities. There is no adequate parking facility which is provided in this area which can cope with the load during peak seasons. Even the movement of people during the peak seasons is disorganized. For the huge numbers of floating population who come here during the peak season there are inadequate garbage collection and sanitation facilities. These create stresses on the immediate environment, composed of the river, its flood plain and the forests.

- The large number of informal facilities for tourists, organized by the immediate village community and also by migrant communities, has been detrimental to the eco-system. To exemplify the point above, there have been informal shacks set up in the flood plain of the river to cater to tourists using the hot springs.

- There has been a growing tendency of the religious trusts situated in this region to accumulate vast areas of agricultural land from the villagers. This can be detrimental in this ecologically sensitive zone as resources such as the hot springs and geysers which ought to be in the public domain get privatized. This has been observed in a study done by Collective Research Initiatives Trust (CRIT) for the Collector of Thane[2].

- After initial conversations with the village communities it is observed that there has been a predominant shift in the area from the primarily agrarian local economy to that of tourism. For a community which was once connected to the immediate environment composed of the river and forests for their livelihood it leads to a changed relationship which can be detrimental to the environment. Also, neglecting the local economy for a fickle, low-end tourism industry can have disastrous effects as reported by studies conducted all over the world.[3]

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2 Akloli, Vajreshwari and Ganeshpuri: Tourism Development Plan (2004), Collective Resources Initiatives Trust

3 The study on Coastal Tourism, Environment, And Sustainable Local Development with the tourism related impacts in Goa as a case states that “Such.. (tourism related).. development is accompanied by many conflicts, for instance lobbying for real estate expansion versus the protection of agricultural, forest, and natural spaces from tourism activities, which frequently trigger significant changes in existing flora and

Tourist activity related informal growth around the Vajreshpuri Hot Spring.

The Agrarian economy spread on the banks of River Tansa

Thus, on the one hand recognizing the tourism potential of these villages as spiritual centres deeply associated in myth and tradition to the curative hot-springs and forests in the region, and on the other hand observing the above concerns, the area was proposed to be developed as a Recreation and Tourism Development Zone in the the draft Development Plan of Mumbai Metropolitan Region 1996-2001. The present study has been initiated by the MMR Environment Society to comprehend the sensitive ecosystem of the place and devise environmental strategies, which while allowing synergizing of the above potentials, can also address the above concerns.

While the concerns mentioned above are immediate in nature with respect to the surrounding villages, it is important to note that this zone is a part of a bigger environmental eco-system that is composed of the Tansa River Basin. The Tansa watershed, of which, the three villages are a part is composed of diverse and mixed forests systems, with different types of ecosystems starting from the riverine ecology to the mangroves. There are certain concerns which effect the over all ecosystem, which this study needs to comprehend as it would impact the study area. Some of the key concerns are:

- There are a large number of varied activities that occur all along the Tansa watershed which are industrial, agrarian (farming transforming into brick kilns and sand dredging activities), religious, recreation etc. Some of these activities, i.e. agrarian activities, primarily economic in nature, use the rich environmental resources of the region to sustain themselves. While other activities, such as the industries, have been introduced into this region. The impact of all these activities on the existing topography, surface - water, ground water, air, and biodiversity is a cause for concern.
- Also of concern is the effect of all the above activities on the social systems of the region. It is important to understand the relationships between the local communities of tribals and villagers and their immediate environment as these are transformed by the changes in livelihoods and activities.

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fauna. The impacts are also considerable—environmental, socio-cultural, and economic, particularly in coastal areas and rural destinations. Impacts of tourism activity and alter the biophysical environment in different ways, consume natural spaces and agrarian landscapes, and throw into disarray spatial distributions of population, labour, and income."
Coastal Tourism, Environment, And Sustainable Local Development,Editors:Ligia Noronha,Nelson Lourenco,Joao Paolo Lobo-Ferreira,Ana Lleopart,Enrico Feoli,Kalidas Sawkar,Adiveppa Chachadi, TERI.

In the *Case Study On The Effects Of Tourism On Culture And The Environment , RACAP Series On Culture And Tourism In Asia , Nepal Chitwan-Sauraha And Pokhara-Ghandruk* by Ram Niwas Pandey, Pitambar Chettri, Ramesh Raj Kunwar and Govinda Ghimire, UNESCO Principal Regional Office For Asia And The Pacific Bangkok, 1991, the loss of agricultural labour and lowering of agricultural production, growth in prostitution are reported as some of the effects of tourism on the socio-economic patterns within the study areas.
They also report to the increase in pollution. due to several factors such as the following: (a) lack of hygiene, (b) lack of facilities for proper sanitation, particularly for local people, porters and guides, (c) lack of facilities for litter, (d) lack of environmental awareness, (e) ineffective rules and regulations, (f) and lack of monitoring of environmental health.

T. Aranganathan, in "*Tourism a Social Aspect"*. Indian Commerce Bulletin, vol.2, August 1998, Commerce Association of Kerala, "The exclusive use of common resources like water and electricity by the tourist may be at the expense of the local people. The influx of tourism increases prices and impoverishes local communities. Hotel and tourist complexes may grab agricultural land. Social tension and illegal activities may occur. Over exploitation undermining local culture for the lure of foreign exchange, mismatch of culture between the host and foreign tourist, etc., may happen as the negative aspects of tourism."

Several other s also cited the seasonal nature of tourism and the fluctuations due to natural disasters, political problems as associated risks embedded within tourism economies.

View of the interiors of Vajreshwari Village

1.3 Need for the Study

With a view to boost the tourism potential of the sacred sites and thermal springs within the area comprised of the villages of Vajreshwari, Ganeshpuri and Akloli, the area has been delineated as a Recreation and Tourism Development Zone (RTD). However unplanned development may trigger-off pressures on the natural resources and impact this ecologically sensitive zone as well as have social and economic implications for the local communities. The concerns mentioned above which are at the micro as well as the macro scale clearly indicate that they are environmental in nature. Also of concern is the relationship of local communities to their immediate environment which is being impacted by the transforming nature of activities. With present nature of tourism proving a threat, the need of the study would be to comprehend the environmental footprint of the place and evolve a set of environmental strategies which can allow the above activity to be carried in a sustainable manner.

1.4 Objective of the Study

In keeping with the need of the study, the following are the objectives of the project.

- To map the present conflict arising out of the developments in the RTD zone of Vajreshwari, Akloli and Ganeshpuri located within a larger eco-sensitive zone of the Tansa River Basin.
- Drawing out an Environmental Management Plan of the Recreation Tourism Development Zone to promote sustainable tourism in the place.

1.5 Delineation of the Study Area

The RTD zone lies within a larger ecological influence zone, the watershed of the Tansa river basin was delineated as the area for the regional study.

1.6 The Scope of Work

Since the delineated area lies within the macrocosm of the Tansa River watershed it becomes imperative to include it as part of the study for a macro level understanding and then focus on the RTD zone comprising of the four villages. Thus the study has been staged in three parts of which the first part examines the region in order to prepare an ecological base map for the Tansa River Basin. The next stage focuses on the Recreation and Tourism Zone and identifies the threats there and in the third stage focuses on the formulation of the environmental strategies for the Recreation and Tourism Zone.

Stage I - Preparation of Regional ecological base map and Situation Analysis (3months)
Situation analysis of the region to identify resources and determine their significance

Part A- Regional context

- Regional study of the area, location, geographical boundaries, administrative boundaries linkages, settlement patterns and adjacencies.

Part A1–Environmental Aspects

- Climate
- Mapping the physiography, geomorphology, hydrology and ground water of the region.
- Geology, patterns of geothermal activity and the influence zones in the region
- Mapping the ecological habitats including vegetation and flora- fauna to define critical wild life corridors.

Part-B Socio-Economic and cultural aspects

- Understanding the historical background and significance. Study of the local histories and culture of the region and association with the environment.
- Land use maps Study of the existing Development plans for the region and identifying the various planning and implementation agencies in the region.
- Mapping the settlement characteristics of the region and analyzing and understanding the nature of economic activities carried on in this region. Demographic studies with future projections and identifying occupational shifts in the region

Part-C - Delineating the ecological influence area for the RTD zone

Stage II – Identification of environmental threats (2 months)

Part-A Identification of the environmentally fragile areas in the delineated ecological zone of the RTD area.

- Critical analysis of the ecological base maps to identify the environmentally fragile areas and stressed environments in the RTD region
- Mapping the community-environment interface to identify local practices, community institutions and cultural associations with the environment
- Identification of the environmentally incongruent activities in the RTD zone
- Identification of potential environmental challenges and opportunities due to tourism

Part B Identification of stressed environments

- Defining Indicators and levels of vulnerability for stressed environments
- Identifying the areas that are intrinsically fragile stressed and potentially stress prone.
- Identifying the actors, agencies and institutional arrangements currently influencing the vulnerable environments.
- Identifying future development trends and zones of influence of pressures, through a pressure-state analysis

Stage III - Formulation of strategies for environmental protection

- Recommendation of projects and regulations for the protection of environmentally fragile and vulnerable areas.
- Identification of priority projects and their implementation strategies through design guidelines, resources required and implementation agencies.
- Guidelines for managing the projected opportunities and challenges due to pressures of Tourism and other societal pressures due to development
- Specific development control guidelines for environmental protection

1.7 Methodology of study

The study intends to approach the above concern by exploring the relationship between the environmental resources of the region and the economic activities/livelihoods of people in this region. It recognizes that some of the activities are closely linked to the environmental resources of the region but in sustainable ways while other activities which might have been introduced over time might have exploited the existing resources to have a negative effect on the environment. Thus these two aspects will be superimposed on each other to locate the stress point in the environment. This is clearly the method adopted to conduct this study. The following plate explains this relationship diagrammatically.

The study as elaborated in the scope has three parts to it for which the methods adopted for each part would be to collect data from secondary and primary sources, leading to an analysis. The final part of the study would us the analysis to suggest recommendations. The data collection would primarily be done through secondary sources, photographic documentation and meeting with stakeholders.

the project

STAGE 3 *Proposals*

Physical Strategy, Development Control Regulations and Projectisation

STAGE 2 *Analysis*

Env. Sensitive Areas
Ownerships & Tenures
Land Use and Activities

Land & Environment

Economic gains & losses
Stakeholders & Networks of Economic Activities
Community Patterns like composition, level of literacy access to social infrastructure

Socio-Economic Implications

Provision and Access to:
Solid Waste
Drainage
Water Supply

Implications on Physical Infrastructure

Government Organisations
Trusts
Community Based Organisations

Institutions & Capacities

C R I T I C A L F O C U S A R E A I D E N T I F I C A T I O N

Implications

Environmental Resource Base

R I V E R B A S I N R E G I O N

Demography and Economic Base

STAGE 1 *Base line Studies*

Environment

Economy

STUDY AREA

Methodology

Given the scope of this study, it neither might be possible to carry on detailed sample testing, or surveys of any kind. This study has had to rely heavily on surveys which have been carried on by other government or academic agencies. The table below details out the various methods used to acquire information on various aspects of the project.

Methods Adopted / Data Collected	**Agencies Interacted / Sources referred**	**Information Procured**
Secondary Sources of Data		
1. Meeting Agencies who have data on this area for various aspects		
Topography	MMRDA	Topography Maps (1:25000) scale; 20 m contour interval
	Dept of Geography, Mumbai University	Topography Maps (1:50000) scale;20 m contour interval
	Google Earth	Satellite images which have been captured and joined.
Geo thermal Activity	Dept of Earth Sciences Indian Institute of Technology	Studies on geothermal zone of Tansa basin and west coast belt. *Geothermal Atlas of India*, Geological Survey of India, Special Publication, 1991.
	Geological Survey of India, Alandi, Pune.	Geological Map for Thane District and District resource map
Vegetation	Survey of India, Topographical Maps, Satellite Imagery.	.Analysis of satellite remote sensed data to generate landcover maps.
Climatic data	India Meteorological Department, Colaba.	Rainfall data from 2002- 2007.
Hydrology	Central Groundwater Survey Department.	Topography sheets of Bhatsol sub-basin Topography sheets of Tansa basin Topography sheets of Vaitarna basin
	Tata Institute of Social Sciences	Report and study on tribal communities in the Tansa protected areas.
Socio Economic Data	Census Office	
	Block Statistical Office, Thane	District Census for the years 1981, 1991, 2001.
	Maharashtra Pollution Control Board	
Water Pollution	Maharashtra Pollution Control Board	Projects on Tansa and Vaitarna basins.
Industrial Pollution	Maharashtra Pollution Control Board	Hazardous Waste Generating Industries in the region.
Ground Water Data	District Ground Water Control Board, Thane	Ground water levels for the last fifteen years, and ground water pollution data.
Flooding	District Disaster Management Cell, Collector, Thane district	Areas prone to occasional and regular flooding.
2. Exploring secondary sources on these aspects		
History	*Heritage of Tansa Valley*, A.K. Sharma, 2004.	Local history of the region, heritage sites and their significance.
Bio-diversity	*Human disturbance and forest diversity in the Tansa, Valley, India, Biodiversity and Conservation*, Kluwer Academic Publishers, 2003. *District Gazetteer, Thane District*	Biodiversity index and stresses on biodiversity in the region.
Global, National and Regional Environmental Policies affecting this region.	Draft Regional Plan, MMRDA	
Photographic Documentation of Site		
Broad Activities and Land use		Photographs of brick kilns, sand dredging, tourism related activities, industry related activities.
Ecological Features		
Flora and Fauna		Photographic documentation of types of vegetation
Environmental Conflicts		
On Site Interviews and Meetings		
	Dy. Collector, Thane District Divisional Forest Officer, Thane	Research and study by IIRS on Tansa Forest zone. Maps of Forest area around the Tansa basin and Tansa Lake. Fauna of the region
	Talati ,Vajreshwari, Thane	
	Block Development Authority, Bhiwandi	
	Sarpanch, Ganeshpuri Gram Panchayat.	

1.8 Analysis

The collected data was overlapped and analyzed using standard techniques like slope analysis, identifying watersheds, mapping soil characteristics, vegetation characteristic on geographical maps to generate maps/ diagrams of environmental patterns. Also, census data was analyzed to generate maps on demographic characteristic, for the region. Broad land use patterns were generated through correlating Google Earth satellite image with observations and photographic documentation done on site. A landcover map was generated from satellite imagery using remote sensing and GIS. The environmental threats were then mapped on to the geographic space from data collected by various agencies. These patterns were then overlapped with data on environmental pattern to establish the stressed areas.

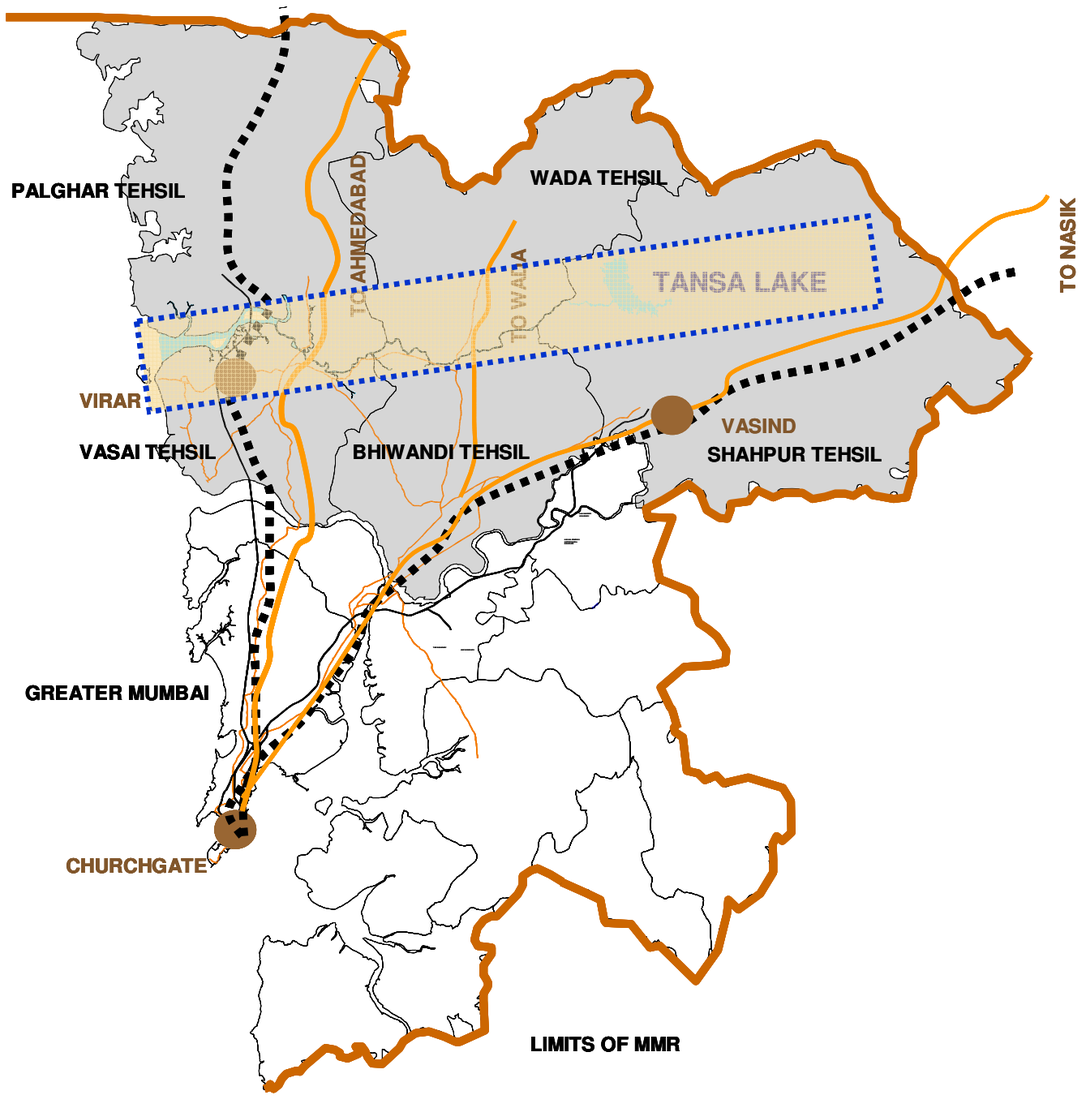
The stresses in Vajreshwari, Akloli, and Ganeshpuri have been identified and further detailed documentation of these areas will now be carried on.

1.9 Strategy Formulation

The analysis will lead to strategies that need to be formulated and the action plans that need to be adopted. This will be done in the next phase of the study.

The strategies will be formulated at two scales:

1. Detailed strategies for the RTD Zone and its immediate ecological influence zone.
2. Broad strategies for the larger influence zone consisting of the watershed of the Tansa.



Map indicating the adjacencies and linkages

CHAPTER 2 SITUATION ANALYSIS

2.1 Regional Context

2.1.1 Location

The Tansa watershed lies in the Thane district, the Northern-most district of the Konkan, arising in the Sahyadri range of mountains, which lies adjoining the Arabian Sea in the north-west of Maharastra State. The watershed extends between 18˚42' and 20˚20' North latitudes and 72˚ 45' and 73˚ 45' East longitudes.

2.1.2 Geographical boundaries

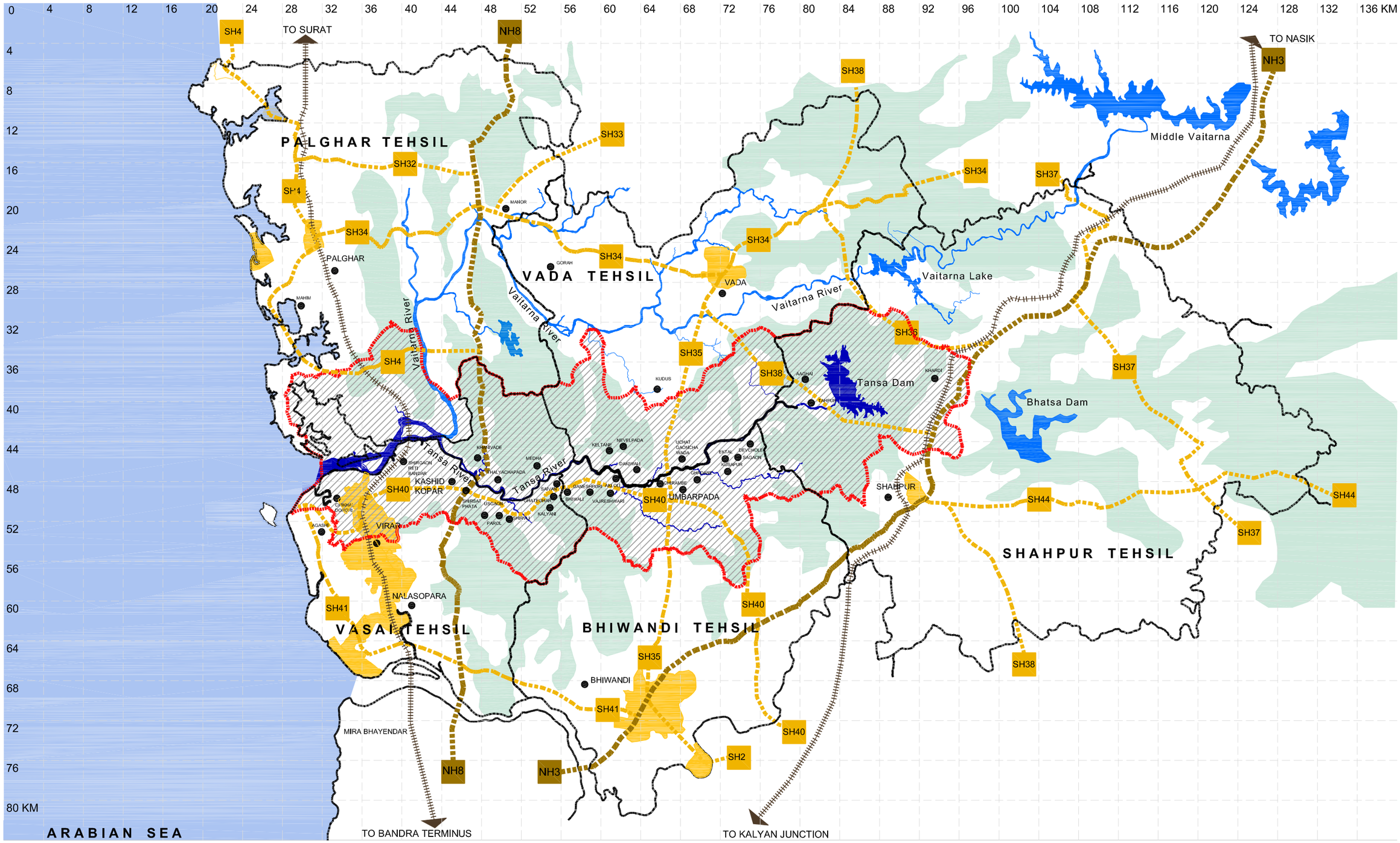
The region is characterized by the 30-60 km wide Konkan coastal strip traversed by a number short swift rivers rivulets, of which Tansa is one, which rise in the western ghats and flow into the Arabian sea. The Tansa River basin is important on account of being an outlier of the main Western Ghats mountain chain and in effect sheltering a pocket of forest. On the basis of its topography, the region shows distinctive landscape and settlement characteristics: the eastern portion with the Sahyadri range, comprising of mainly forest areas with tribal settlements, the central plains and river valleys that sustain mainly agricultural villages , and western parts of the coastal area with fishing villages and horticultural plantations. The region is also characterized by the Deccan flood basalt volcanism that extends over the area; the major tectonic feature along the coast being the West Coast Fault, which runs parallel to the Konkan coast for a length of about 500 to 600 km.

2.1.3 Administrative Boundaries

The Tansa River lies within the administrative boundaries of Thane District, across the Talukas of Shahapur, Wada and Palghar and Vasai and Bhiwandi. It forms the Northern boundary of the Mumbai Metropolitan Region. Most of the River basin within the MMR falls within the Green and Forest Zones, a portion of it towards the coast falls within the urbanisable zone under the Municipality of Vasai, and within the Recreation and Tourism zone of the villages of Vajreshwari, Ganeshpuri, and Akloli.

2.1.4 Adjacencies and Linkages

The Tansa River basin has an East-West connector the SH40, called the Shirsad–Ambadi Road, approximately 50km in length running parallel to it till Umbarpada which then turns south towards Bhiwandi. The SH40 connects the Western Express Highway at the Shirshad Phata and the Mumbai-Nashik Road at Ambadi Naka. From Umbarpada, from where the highway turns South, there is a kutcha village road which runs up to the Tansa Dam. Along the Shirsad–Ambadi Road there are village roads in the North-South direction joining SH34 in the Wada Tehsil. There are a number of village settlements located along the Shirsad-Ambadi road with primarily agricultural economies, surrounded by tracts of farmland.



LEGEND:

- TEHSIL BOUNDARY
- ARABIAN SEA
- TANSA RIVER
- VAITARNA RIVER
- STUDY AREA BOUNDARY
- STUDY AREA
- NH3 NATIONAL HIGHWAY
- SH4 STATE HIGHWAY
- RAILWAY LINE
- MUNICIPAL BOUNDRY
- HILLS & FOREST AREAS

INTRODUCTION: LINKAGES

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2.1.5 Climate

The climate of this district is characterized by high humidity nearly all the year round, an oppressive summer season and well distributed and heavy rainfall during the South-West monsoon season. The year may be divided into four seasons. The cold season from December to February is followed by the Summer Season from March to June. The South-West monsoon season is from June to September, October and November constitute the post-monsoon season. The average annual rainfall is 2247mm. Maximum rainfall is 3052 mm and 1734 mm respectively.

In summer and in June before the onset of the monsoon, day temperature may sometimes go above 37degreesC while in the interior it may be a couple of degrees higher. From the beginning of October when the monsoon withdraws the temperature increases. In November the temperature decreases and in January which is the coldest month, the mean daily maximum temperature is 27.7 degrees C and the mean daily minimum temperature is 16.8 degrees C. In the cold season cold waves sometimes affect the district when the night temperature may go down to less than 10 degrees C.

Relative humidity varies from 32 % in March to 89% during August.[1]

Winds are generally moderate except in the monsoon months when they are stronger. During May and monsoon months they are from South West to North West. Thunder storms occur in the latter part of summer and in October.

[1] The rainfall data for the region was obtained from Meteorological Department of India, and the broad climatic characteristics were obtained from the District Gazetteer, Thane District.

2.2 Resource Mapping

2.2.1 Introduction

This chapter establishes the resource base of the region in terms of environmental and socio-economic resources, and establishes the continuity or interrelationships between environmental economic and social systems.

A systematic mapping of the environmental and socio-economic and cultural resources was carried out. Each resource was further analysed to delineate areas or resources of significance or sensitivity to inform recommendations at the regional scale with regards to the management of the entire river basin in the second phase.

Historical geology and climate have interacted, creating the basin form. From the environmental mapping the various physiographic regions and geomorphic units become clearly evident. The current morphology, with climate and lithology can be used to explain the pattern of rivers and streams, the distribution of ground water, relative quantities and physical properties which in turn explains the movement of sediments, by fluvial processes and deposition revealing the pattern, distribution and properties of soils. When the climate, geology, topography, water regimen and soils were mapped it helped to explain the incidence of plants as individuals and as communities. The distribution and occurrence of animals and wild life is all directly or indirectly related to the distribution of plant communities, their age and condition and habitats whether in terrestrial, aquatic or semi aquatic environments. Natural resources mineral deposits, soils etc occur where they do for reasons that derive from physical and biological processes and geological history.

Settlements occur in areas which are accessible by transportation routes having well drained productive soils and availability of water and other resources. Various communities are dependent upon these resources. Physiographic and geological formations and the presence of unique features have also acquired historic, religious and, social / cultural values and associations.

The Methodology for environmental and cultural resource mapping involved a comprehensive layered mapping and description of environmental and cultural resources of the region; each layer dependent upon the underlying ones and each augmenting the explanation. A sequence was followed by beginning with the oldest evidence and proceeding towards the present. The various communities within the study area have important historic, economic and cultural associations with the environment. These associations form in themselves a resource base that can be mobilized into any plan for environmental management or development within these areas.

The historical background was studied in order to delineate sites and areas of historical importance within the study area and to understand cultural associations of communities with the environment.

The socio-economic characteristics of the region were analysed to understand patterns of dependency of populations on environmental resources such as communities and livelihoods. The data was used to assess levels of infrastructure and capacities of communities within the regions. The data would also indicate possible stresses on the environment and stressed areas within the study area through pressures of urbanization.

The various Environmental factors mapped were – Geology, Geo-morphology, Physiography, Hydrology, Ground-water, Vegetation & Habitats and Biodiversity.

The socio-economic factors included Proposed Land Use, Existing land cover and activities, demographic and occupational patters, and sites of historical interest.

2.2.2 Evaluation of Natural and Cultural Resources of the Region and Establishing Their Significance

The following criteria have been used to evaluate resources for environmental and cultural significance.

1) **Areas of Environmental sensitivity and vulnerability:**
   - These are areas of ecological sensitivity and areas prone to natural hazards like floods, steep slopes prone to landslides, erosion and,
   - Areas of ecological sensitivity[2] including habitats and ecosystems with low resilience, which once destroyed are difficult/impossible to regenerate.

2) **Areas or resources that are critical for natural processes and ecological functions:**
   - These are functional areas important for the maintenance of critical ecological functions,
   - Processes that provide environmental services such as ground water recharge, soil and moisture conservation, environmental quality, etc.

3) **Areas or resources of uniqueness /rarity:**
   - Resources that are extremely rare/scarce, non-renewable/ impossible to regenerate such as:
     - Rare endemic and endangered species
     - Specialized ecosystems high biodiversity areas, special breeding sites, and wildlife corridors.
     - Unique geological/ geo-morphological features, landforms, natural features significant peaks, thermal springs

4) **Areas or resources that provide economic sustenance or act as common property resources-**
   - These are environmental resources that sustain livelihoods or have an important economic value to local communities. These include water resources, streams, ground water, wells, tanks, talaos productive soils or agricultural lands, fishing areas, common property resources, biomass, fuel, etc.

5) **Areas or resources of Cultural Significance**
   - These include historic/cultural sites and landscapes such as thermal springs, historic buildings, sacred groves, etc. associated with local traditions and cultures.
   - Resources and landscapes which have a visual/ aesthetic quality which include :
     - Natural landscapes such as beaches, bays, headlands, mangroves, forests, hilly areas.
     - Manmade landscapes such as agricultural lands, plantations, sites of landscape interest/ scenic corridors,

[2] Ecological sensitivity can be defined as the response level of an ecosystem to the adverse impacts beyond permissible limits with respect to one or more measurable parameters

2.2.3 Geology[3]

The Deccan flood basalt volcanism extends over an area of about 5, 00,000 sq km, covering almost the entire area of Maharashtra State and some parts of Gujarat.

The geology of the region is characterized by dark coloured volcanic flows and laterites. During the closing stages of the Mesozoic era 80-100 million years ago, an enormous amount of basic lava erupted. The eruption took place through fissures in sub-aerial environment forming a thick pile of lava flow. The individual flows vary greatly in thickness from a few feet to as much as 75ft or even more although the average thickness is about 40 ft. In a single hill a number of flows, sometimes as many as ten or twenty can be seen resting horizontally one above the other. Twenty flows are delineated around Vajreshwari in a vertical column of about 500mts and nineteen flows around Sativali and Koknere in a 300 m column. Many of the flows are thin and most of them do not have much laterite extent. Because of their dominantly basaltic composition and the tendency to form flat topped plateaus the lava flows are termed as plateau basalts. As the basaltic lava flows cover an extensive region in the Deccan and give a step like appearance to the hills and ridges, they are known as Deccan traps. (Refer Map 2.2)

The Deccan trap has been divided into three major groups. The basalts are usually dark grey to grey to bluish grey in colour hard, compact, tough and fine to medium grained in texture. At places they exhibit a prophyritic texture. The Deccan traps in the Thane area have been grouped with the upper flows. They generally form the hill tops, plateau and cliffs, and show well developed columnar and prismatic jointing. Next to this common variety of trap is found the comparatively softer angydular and scoriaceous traps, purple to greenish in colour, usually showing rounded and elongated or tubular cavities geodes with in fillings of secondary quartz like agate, jasper, chalcedony etc. These generally occupy the lower portions of the ridges and their slopes and usually the valleys and plains. Associated with these common basic lava flows are also found at times acid lava flows represented by light coloured trachyte, rhyolite etc. Tuffaceous beds, volcanic ash and breccias beds are also noticed at places. A red clayey bed, often termed as “red bole” representing an altered ferruginous flow, is occasionally present interbedded with trap flows.

Beds of laterite, usually formed by the mechanical and chemical disintegration brought about by the atmospheric agencies, on the underlying trap, cap the several peaks and lofty ridges in the district. They are also found at places in the lower regions. The beds vary in thickness from five to fifty feet or more. The rocks are usually mottled, reddish to reddish or yellowish brown in colour and show vermicular and tubular cavities often stained with dark brown ferruginous solution. The rocks are soft and show bright colour when freshly cut but become very hard and dull on exposure to the atmosphere. The outer surfaces of the beds have a dark to dirty brown colour and a very rugged pitted appearance. Laterites are porous.

The rocks wither by exfoliation into massive, spheroidal boulders which are usually seen as hill slopes and foothills.

Sandwiched between two trap flows, thin beds of grey to dark grey and dirty green argillaceous and calcareous shades of clays and friable sandstones are sometimes known to be present in the trappean areas. These are known as inter-trappean beds representing the sediments deposited in shallow lakes during the quiescent periods of volcanic eruptions.

Petrologically the lava flows of the area are extraordinarily uniform in their composition and texture, corresponding to a dolerite or basalt, with an average specific gravity of 2.9. In composition the basalts are composed of abundant labradorite feldspar, enstatite, angite and interstitial glass. Magnetite is the most common accessory mineral though at times, a fair amount of olivine is also present.

The thickness of the basalts reaches up to 3000m in the West Coast and Lava flows are dissected by numerous North-South trending faults and dyke swarms, some of which must have fed the earlier flows. The major tectonic feature along the coast is the West Coast Fault, which runs parallel to the coast for a length of about 500 to 600 km. This structure was formed during the melting of the continental crust prior to the volcanism, and was reactivated after the Deccan volcanism. The presence of several Sympathetic faults aligned parallel to the West Coast Fault, indicates flexuring of the lava flows along the Coast. All these faults and dykes are parallel to the regional fault system developed during the break-up of the Gondwana Land. The Koyna earthquake (1967 was the most powerful earth quake) and continued tremors in west coast area suggest that the area is seismically and tectonically active.

There are numerous dykes crisscrossing the study area. The general trend however is north-northwest south south-east and north north east south south west. The thickness seldom exceeds six meters. The dykes send out off shoots of different sizes, at places enclosing lenticular wedges of country rock. Chilled margins are seen along the dykes flow contact. The dykes vary from coarse dolerite to fine grained basalt. Most of the dykes are prophyritic with phenocrysts of feldspars.

2.2.3.1 Geothermal Activity

Upper mantle and crustal disturbances during the late tertiary quaternary times resulted in the emplacements of several large plutonic bodies (pertaining to a class of igneous rocks that have solidified far below the earth’s surface), along the well defined zones at variable depths within the crust, which may still be cooling and acting as heat source under favorable circumstances, to give rise to the elevated geo-isotherms and heat flow values. These in turn support the presence of the thermal springs and extensive areas with elevated ground water temperature found at many places.

The thermal springs are confined along structural controlled distinct lineaments along the NNW – SSE trending lineament parallel to west coast of Maharashtra extending from north of Bombay to Ratnagiri. Thermal springs

[3] The data on geology of the study area was compiled from *Heritage of Tansa Valley*, A.K. Sharma, Bharatiya Kala Prakashan, 2004., which contains detailed explanations of geological history of the region and the *Geothermal Atlas of India,* Geological Survey of India, Special Publication, 1991 which contains a detailed study of the geothermal activity in the Ganeshpuri area.

along the west coast of Maharashtra have been studied by detailed geological, geothermal and geophysical surveys[4] to explore the deep geothermal aquifers, which are likely to be in the pre- trappean formations. Most of the springs are seen on the fringes of dykes. A rough calculation puts the depth of origin of these thermal springs below 820 meters. (Refer Map 2.3)

In the Vasai Taluka near the villages of Akloli, Ganeshpuri, Nimbavli and Vajreshwari, several hot springs are located in the bed of and near the river Tansa. Majority of springs are confined in a zone, aligned N10˚E, S10˚W, along the western margins of a medium to coarse-grained, 80m wide dolerite dykes.

The temperature of these surface discharges varies from 42˚ to 59˚ C. Fluctuation of water table of surrounding groundwater does not affect these springs.

The waters are mainly saline consisting mainly of Chloride of Sodium 12.41; Chloride of calcium 7.07; sulphate of lime 2.08 and silica 0.88. Most of the springs are sodium chloride type.

The culminative discharge from all these springs is copious and invariably emits feeble gas with sulphorous smell. Nitrogen is the major component in the gases which accompany these thermal waters. Significant helium concentration in some of these hot springs is considered to be due to long residence time of these waters at depth. Other gases include carbon dioxide, hydrogen, methane, ammonia, hydrogen sulphide, oxygen and argon[5].

- **Thermal springs within the study area**

The following thermal springs fall within the Tansa river basin, as delineated in our area of interest. The Ganeshpuri group of thermal springs is located 108 km from Bombay via thane Bhiwandi and is spread over a length of about 900 m on the banks and the bed of Tansa River.

Vajreshwari group :

(i) Ganeshpuri area (19°29'N : 73°01E).-- There are thermal springs, most of these occurring on medium to coarse grained dykes trending N 10° E-S 10° W.

(ii) Akloli area (19°29' N 73°02'E).—There is a linear cluster of six thermal springs near the left bank of Tansa river. They occur on the eastern margin of fine grained dolerite dykes trending N 10° W-S 10° E dipping 75° towards east.

(iii) Nimbavli area- Just across the Tansa river near Ganeshpuri are located at least 3 hot springs.

The area around Ganeshpuri is covered by sparsely porphyritic (Containing relatively large isolated crystals in a mass of fine texture) to non porphyritic pahoehoe flow (Lava with a smooth ropy surface), intruded by dolerite (a coarse grained variety of basalt) dykes. The dyke, which is branching at places, has a total width of 80m and dips steeply towards east. The flow displays joints along NW-SE and N-S directions. The Anasuya Kunds are the northern most thermal springs situated on the right bank of Tansa River. The Agni Kund and other small spouts which occur in the river bed, emanate from the western margin of the dyke. On the same alignment the Kothawala spring is located on the south bank of Tansa River and about 130 m further south is the main Bhimeshwar Kund.

Areas of Geological Significance

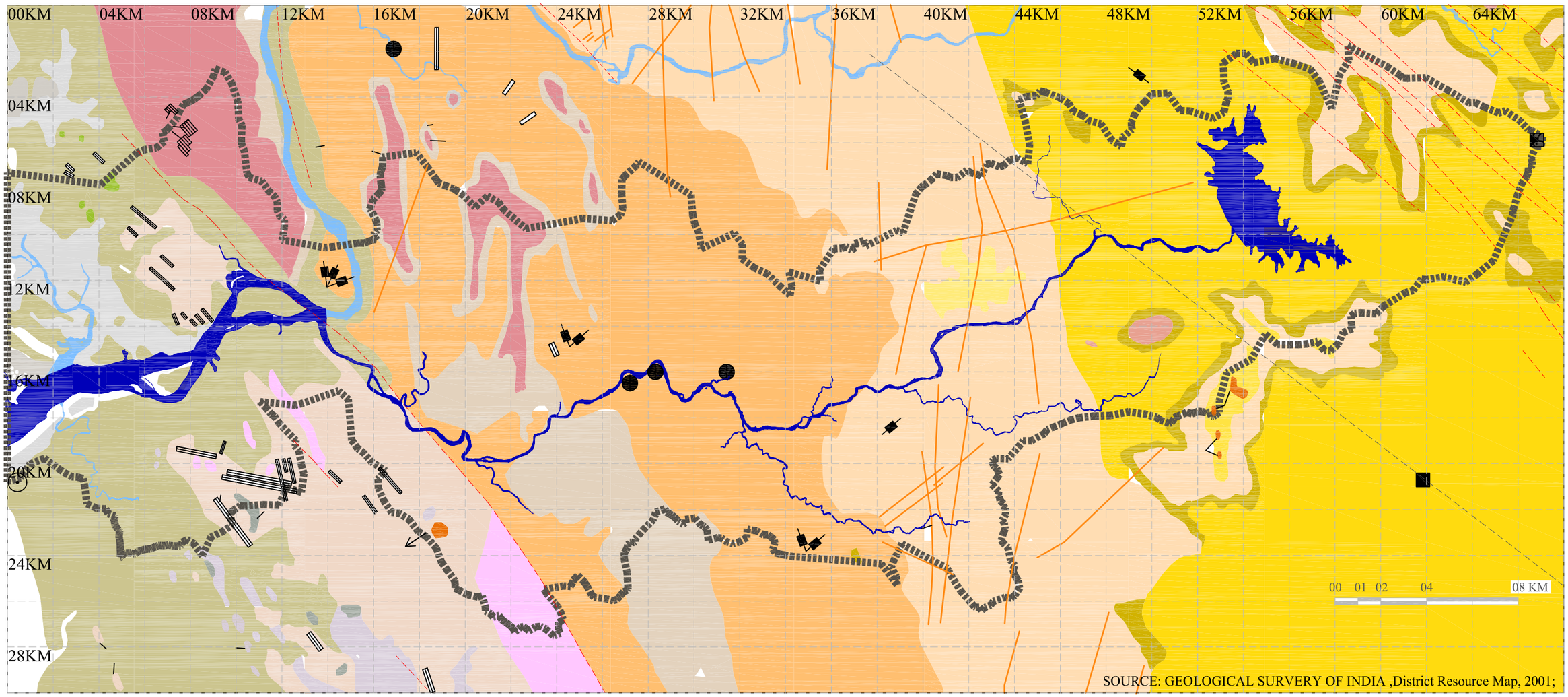
- The cluster of thermal springs associated with the dyke formations around Ganeshpuri create a distinctive zone of geothermal activity and delineate a Geo-Thermal Zone within the Tansa river basin.

- The thermal spring waters are proven to have therapeutic values and this is the reason that thousands of people visit these springs. Most of the spring areas have been converted into religious spots and temples have been built near them since ancient times.

- The study by the Geological Survey of India states with regards to utilization avenues of the thermal springs at Ganeshpuri, that, low to medium grade geothermal resources can be expected in this belt and that considering their proximity to Bombay most of the geothermal areas in the west coast could be developed as health resorts, sanatoria, tourists and holiday resorts. The report also states that animal husbandry, poultry fresh water fish farming, mango pulp, cashew processing industries, mineral water bottling plants, brewing of low percentile alcoholic beverages could be some other utilizations avenues for geothermal energy.

4 Geothermal Atlas of India, Geological Survey of India, Special Publication, 1991.

[5] The data on geomorphology of the study area was compiled from *Heritage of Tansa Valley*, A.K. Sharma, Bharatiya Kala Prakashan ,2004., which contains detailed explanations of geomorphological history of the region.



The Tansa River Basin area is covered extensively by Deccan Basalt of Upper Cretaceous to Paleogene age except for the alluvium occurring in the river valley. The frequency of dykes is much more in the north western part where the N-S trending dyke is very conspicuous. Dykes trending in NW-SE, NE-SW, and E-W are also observed. Laterite of the Cainozoic age occur as small isolated cappings on top of Tungar hill, Mahuli peak.

LEGEND:

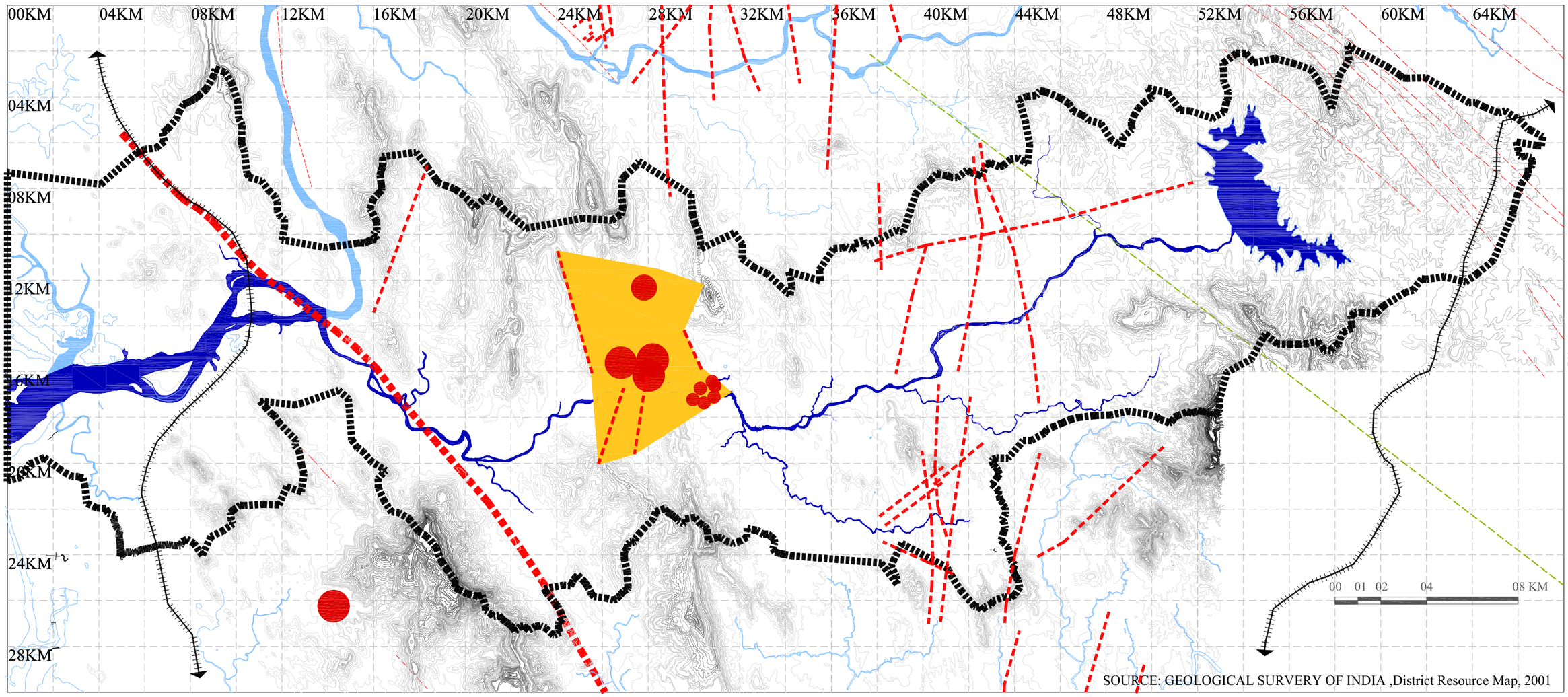
- TANSA RIVER BASIN
- ALTITUDE OF JOINT
- FAULT WITH DOWNTHROW
- LINEAMENT
- FLOW GRADIENT
- 5 AA FLOWS
- TANSA RIVER
- ROAD
- MUD
- ALLUVIUM
- LATERITE
- BASIC INTRUSIVES, DYKE, SILL
- VAITARNA RIVER
- DIORITE / INTERMEDIATE INTRUSIVE
- AGGLOMERATES / TUFTS / INTERTRAPPEANS
- AA FLOWS
- PAHOEHOE FLOWS
- 5 AA FLOWS
- HOT SPRING CLUSTERS
- 11 FLOWS
- 6 MAINLY COMPOUND PAHOEHOE FLOW
- MEGACRYST FLOW (M2) (25 MTRS)
- 7 MOSTLY COMPOUND PAHOEHOE FLOWS
- MEGACRYS FLOW (M1) 60 MTRS

ENVIRONMENTAL RESOURCE BASE: GEOLOGY

00 01 02 04 08 KM

2.2

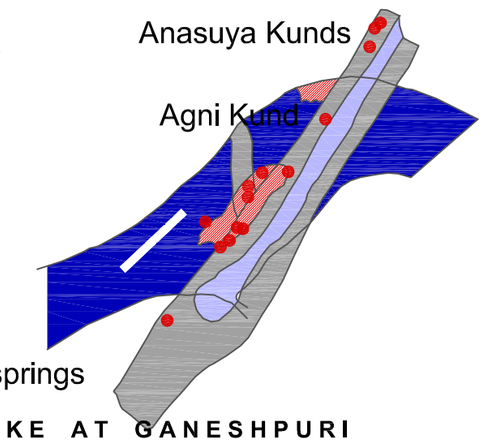
ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in



Methodology-
The sources for the identification and location of the dykes and hotsprings were as follows-
1) Map showing the Geology of the Thane Region, District resource Map, Thane District.
2) The Geothermal Atlas of India which has detailed information on the association of the dykes and hot spring activity in the Ganeshpuri area.
3) Analysis of Satellite Imagery to locate the dyke formations in the study area.

IDENTIFICATION OF GEO-THERMAL ZONE
The occurrence of hot springs shows a association with the dyke formations in the area.
The geo thermal zone was identified as the zone lying between two primary dykes between which the thermal springs are concentrated, in the area around Ganeshpuri.

The area is covered by dykes that extendd in the N_S directions. Majority of springs are confined in the zones aligned to the margins of the dykes. Lower to medium grade resources can be expected in this belt.



DETAIL OF DYKE AT GANESHPURI

LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- RIDGE DIVIDE
- DYKES
- TANSA RIVER
- VAITARNA RIVER
- HOT SPRING CLUSTERS
- ENV. SENS. G. THERMAL ZONE
- SOIL COVER
- DOLERITE DYKE

0 TO 60 M	320 TO 380 M	640 TO 700 M
80 TO 140 M	400 TO 460 M	720 TO 780 M
160 TO 220 M	480 TO 540 M	800 TO 860 M
240 TO 300 M	560 TO 620 M	880 TO 940 M

ENVIRONMENTAL RESOURCE BASE: GEOTHERMAL ZONE

00 01 02 04 08 KM

2.2.4 Geomorphology[6] and Physiography

The Konkan region is bounded in the east by the almost perpendicular escarpment of the Western Ghats and to the west by the Arabian sea. The region is hilly due to a number of spurs radiating west from the escarpment.
The Tansa river located in the coastal plains but transects a number of geomorphic zones. The geomorphology of the region is characterized by slightly-highly dissected basaltic plateaus, structural hills over traps, lateritic plateaus and denudational hills. The hydrogeomorphic classification based on slopes observed in the area, divides the area into the following geomorphic units:

- Easterly situated highly undulating rugged topography forming major run off zone.
- Centrally situated moderate dissected plateaus forming recharge zones.
- Westerly coastal plains forming storage zones.

The region forms part of the Deccan Trap country, west of the Sahyadri, the main basic lava flows, horizontal and undisturbed, have given rise to a succession of broad plateau levels, descending from the scarp of the Sahyadri one below the other. The hill ranges in the area are predominantly aligned north-south, and have more or less steep escarpments, basalt flows, popularly known as Deccan traps, form the predominant formation. It is capped by laterite on a few high plateaus and covered by shore sands along the coast. Numerous dyke intrusions, within the lava flows, on differential erosion stand out, often over long distances, as ridges, most of them running north-south, parallel to the coast, but in cases east-west as in Vada and Shahapur. These ridges rising by even slopes from the plateau floor have sharp crest lines unlike the flat, mesa-topped ridge, developed by the basic lava flows.

Geomorphological studies have shown that the last 30000 years have considerably influenced development of the coastal land forms of Konkan. The quaternary period witnessed frequent rise and fall of the sea level which has influenced coastal forms. Only when the sea level was high there could have been an aggradation (accumulation of sediment in rivers and nearby landforms.) When the sea level fell the rivers began to erode.There was a low sea level in the terminal Pleistocene (C.20000-C10000 B.P.)when the streams were flowing 8-10m below their present level and the region experienced weak south west monsoons. The sea level started rising after 10,000 yrs BP and reached its present level around 6500 B.P. (Refer Map 2.4)

The present coastal landscape is a product of these sea level changes and humid climate of the last 10,000 years. The Pleistocene formations in western India are of fluvial. aeolin and marine origins The coastal landscape is primarily the result of land and sea interaction. The coastal regions witnessed some effects of eustatic and tectonic activities. The records of eustatic changes in Konkan are in the geomorphic features like laterite planation surfaces and low fluvial terraces. The Holocene changes are observed in terms of karal or beach rocks.

[6] The data on the geomorphological processes of the region was sourced from *Heritage of Tansa Valley*, A.K. Sharma, Bharatiya Kala Prakashan ,2004, and the *District Resource map, Thane District,* Geological Survey of India,2001.

The gulf that runs from Kolaba to Bassein must have stretched further inland than it now stretches. The villages aroung Bassein, Sopara nearly as far as within 3-5 kms of the Vaitarna estuary formed the islands of Bassein. The backwater that separated this strip of coast from the mainland opened south-west –ward into the Bassein creek forming the Sopari creek.

The coast with its headlands promontories, mesas and active and abandoned cliffs, provides evidence of changes in the sea level in the geological past. The coast exhibits alternately rocky outcrops and sand spills, dunes and bars in protected reaches behind headlands,sandy beaches punctuated with promomtories that jut into the sea and river mouths. The silt and nutrients that the streams bring in have given rise to mudflats.

2.2.4.1 Physiography[7]

Topographically, the region can be divided into 3 parts; the hilly area to the west, the central region of the basin composed of the floodplains of the Tansa River, where the land is flat and widens as it meets the Vaitarna as it flows into the sea at Vasai and the western coastal belt which is largely marshy. (Refer Map 2.5)

The Sahyadris runs parallel to the western coast in the North–South direction but as it approaches Thane District it has a north-west by south-west trend. These local trends stand in sharp contrast to the regional north-south trend of the Sahyadri and is due to recession of the scarp eastwards under the active headward erosion of the swollen monsoon torrents, Kalu, Bhatsai and their source tributaries.

As the Sahyadris approach the Tansa Basin it moves westward in the south of the basin till it touches the limits of the Vasai-Virar sub-region. From the northern limit adjoining Gujarat the Sahyadris run parallel to the coast and are subdued with heights of around 600 m.

In the wide Thane basin area the Sahyadris have spurs which shoot off west-wards into low-lands and plateau Most of these are narrow rarely wider than 2 km, with steep slopes on either sides and rise to considerable heights abruptly. Many of them carry on their crests small plateaus which are often densely forested. This type of hill range territory with intervening deep gorges of stream valleys is mostly met in the central parts of the Wada and Jawhar talukas. Besides the main range and the western spurs of the Sahyadris, a number of hills and isolated peaks dot the whole countryside. The long axis of these ranges runs north-south. They appear to be erosional remnants of the dyke ridges which have withstood the denudational processes that have planed the rest of the region.

2.2.4.2 Topographic features

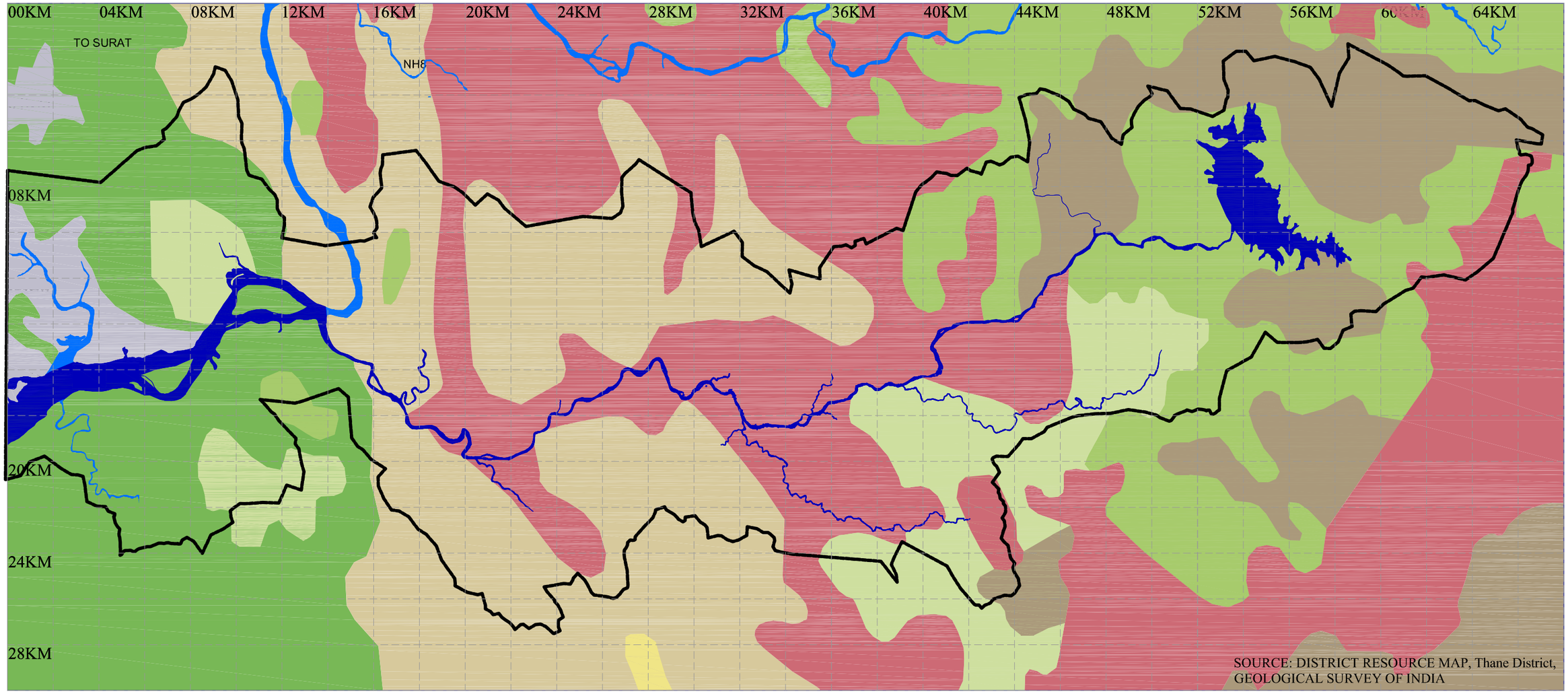
Topographic features like the Tungar Hills, the Dyari Hills, the Mahuli Mountain are located south of the basin and on the east is the Choura Hill and the Jawahar Range. Also on the northern side there are thick forest areas with topographic features like the Takmak Peak, the Mandagani Peak and the Dauze Hill. The loftiest peaks are the Takmak (609 m), the Tungar (662 m) and the Kamandurg (652 m) in the East, Gambirgad (995 m) in the north and Bawa malang (791 m) in the south. The highest peak in this area is the Mahuli Fort Mountain which has an elevation of 954 metres. The flat laterite capped Tungar , with well wooded sides is to the west of Ganeshpuri. It commands a magnificient view of the with the Tansa to the North and the Vasai creek to the south. Kamandurg is to the south of Ganeshpuri. The most rugged terrain of the district is belt of about 15-25 kms broad that runs parallel to the coast at a distance of 15-20 kms from the shore. To the north of Tungar there is a cluster of hills of which Baronda, Jivdhan and Nilemora are the most marked peaks and on an offshoot of the Takmak range to the east of the Tansa are two heights known as Kala and Dhamni. To the North East across the Tansa, rises the steep peak of Takmak with its two fine basalt horns. Parallel to this western coastal range that runs from Kanheri to Takmak, about 15 kms further east runs another line of hills from Bhiwandi, and cut into two by the Tansa river, runs north almost upto Manor. In this line about twelve kilometres north of Bhiwandi rising gently from the west is the hill of Dyari (525m) and across a saddle back ridge, lies the old Maratha fort of Gotara (584m) on a peak that falls sharply to the Tansa river just above Vajreshwari. Across the Tansa about 15 kms further the Keltan hill is separated by a narrow valley from Takmak. This range ending in the Jagmandi peak and running south to north together froms a barrier turning the Vaitarna many kms north of its course. To the west between the railway line and the Surya River, the unbroken chain of hills whose chief peak is Kaldurg, stretches about 25 km parallel to the coast carrying on its top 3 hill forts, Tandulwadi at the extreme south, Kaldurg opposite to Palghar railway station and Asava near Boisar. (Refer Map 2.6)

About 13 km south of Manor, across the Vaitarna from Keltanand Takmak stands the solitary fortified hill of Kohoj rising abruptly from the plains and visible from considerable distance from all around. To the south of Wada is Davja hill, very steep below and sloping above and with two spurs appearing like a three peaked hill.

Significance of Physiographic features

- The geomorphological processes have given rise to distinct physiography and landforms which have influenced the Landscape and vegetation characteristics.
- The plateau and hill chains form the catchment areas of rivers, reservoirs and tanks.
- Hilly areas with vegetation cover fulfill important ecological functions. And help in regulating the microclimate. Vegetation cover in hilly areas is also important for flood control.
- The ridges, and hilly areas are critical for recharging groundwater.
- The hills are places of interest, scenic value, culturally significant with associated places of historic importance such as forts and temples.
- Certain physiographic features such as peaks, plateaus ridges, escarpments, are unique and distinctive land forms.
- Steep lands and ridges are prone to erosion due to the high velocity of runoff and are therefore unsuitable for development.

[7] The data on physiography of the study area was compiled from *Heritage of Tansa Valley*, A.K. Sharma, Bharatiya Kala Prakashan, 2004., which contains detailed descriptions and histories of the various important peaks, forts and *District Gazetteer, Thane District*



The geomorphology of the region is characterized by slightly-highly dissected basaltic plateaus, structural hills over traps, lateritic plateaus and denudational hills. The region forms part of the Deccan Trap country, west of the Sahyadri, the main basic lava flows, horizontal and undisturbed, have given rise to a succession of broad plateau levels, descending from the scarp of the Sahyadri one below the other. . The hill ranges in the area are predominantly aligned north-south, and have more or less steep escarpments, basalt flows, popularly known as Deccan traps, form the predominant formation. It is capped by laterite on a few high plateaus and covered by shore sands along the coast. Numerous dyke intrusions, within the lava flows, on differential erosion stand out, often over long distances, as ridges, most of them running north-south, parallel to the coast, but in cases east-west as in Vada and Shahapur. These ridges rising by even slopes from the plateau floor have sharp crest lines unlike the flat, mesa-topped ridge, developed by the basic lava flows

LEGEND:

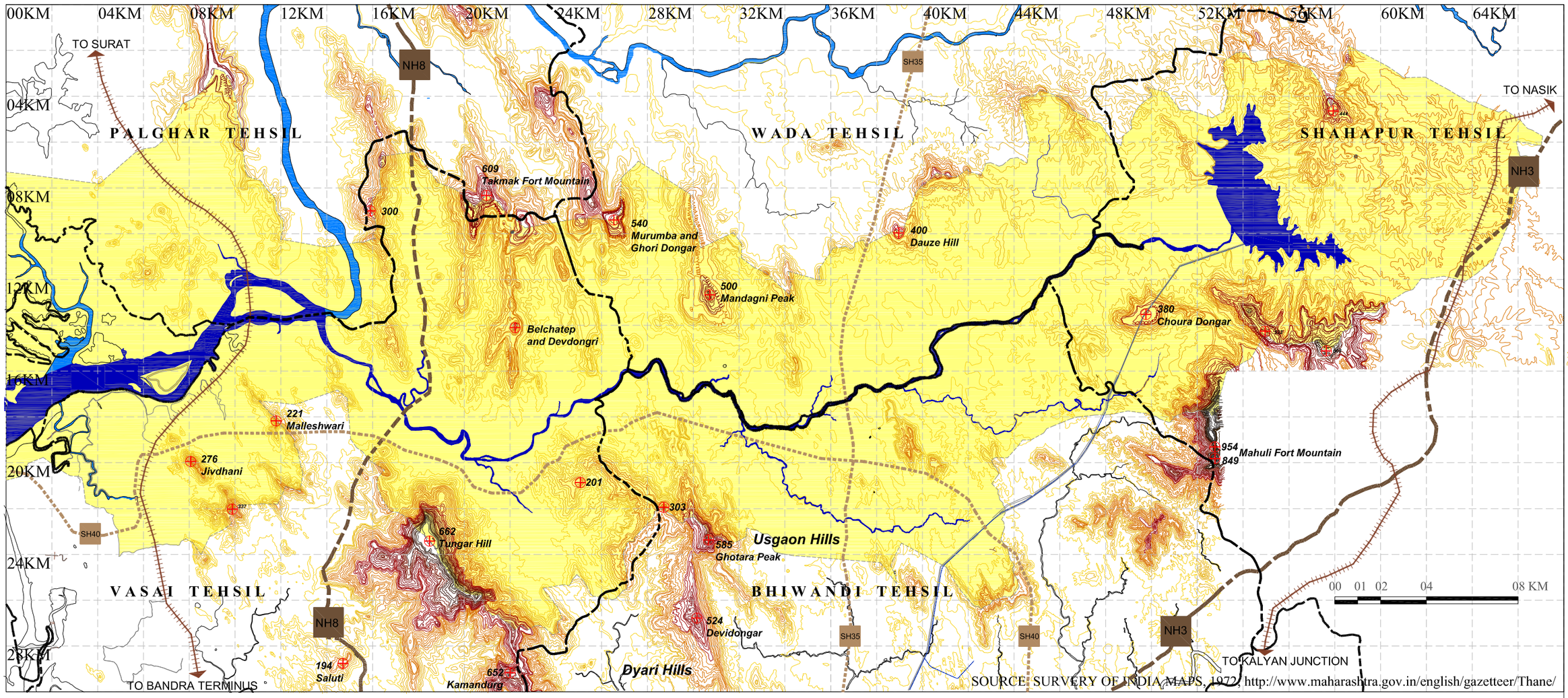
- TANSA RIVER
- RIDGE DIVIDE
- TANSA RIVER
- ALLUVIAM / VALLEY / BEACH SAND / CHANNEL BAR / SWAMPS -FLUVIAL ORIGIN
- SLIGHTLY DISSECTED BASALTIC PLATEAU
- MODERATELY DISSECTED BASALTIC PLATEAU
- HIGHLY DISSECTED BASALTIC PLATEAU- STRUCTURAL ORIGIN
- LATERITE PLATEAU
- DENUDATIONAL HILL
- STRUCTURAL HILLS OVER TRAPS
- COASTAL WETLANDS

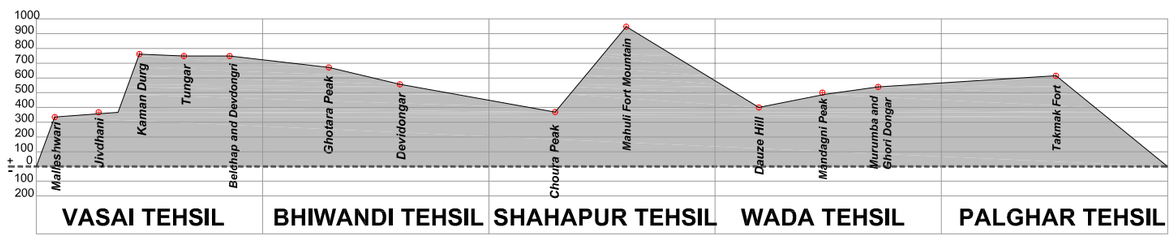
ENVIRONMENTAL RESOURCE BASE: GEOMORPHOLOGY

00 01 02 04 08 KM

2.4

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in





The physiographic study has identified the mountain ranges and the peaks in the delineated Tansa River Basin. The highest peak of the Mahuli Fort mountain lies in the Shahapur Tehsil at the edge of the delineated study area. Kamandurg and Tungar Hill Ranges are the next highest peaks falling in the Vasai Tehsil. The adjacent figure shows the comparative heights of the peaks lying within / adjacent to the study area in the Vasai, Bhiwandi, Shahapur, Wada and Palghar Tehsils.

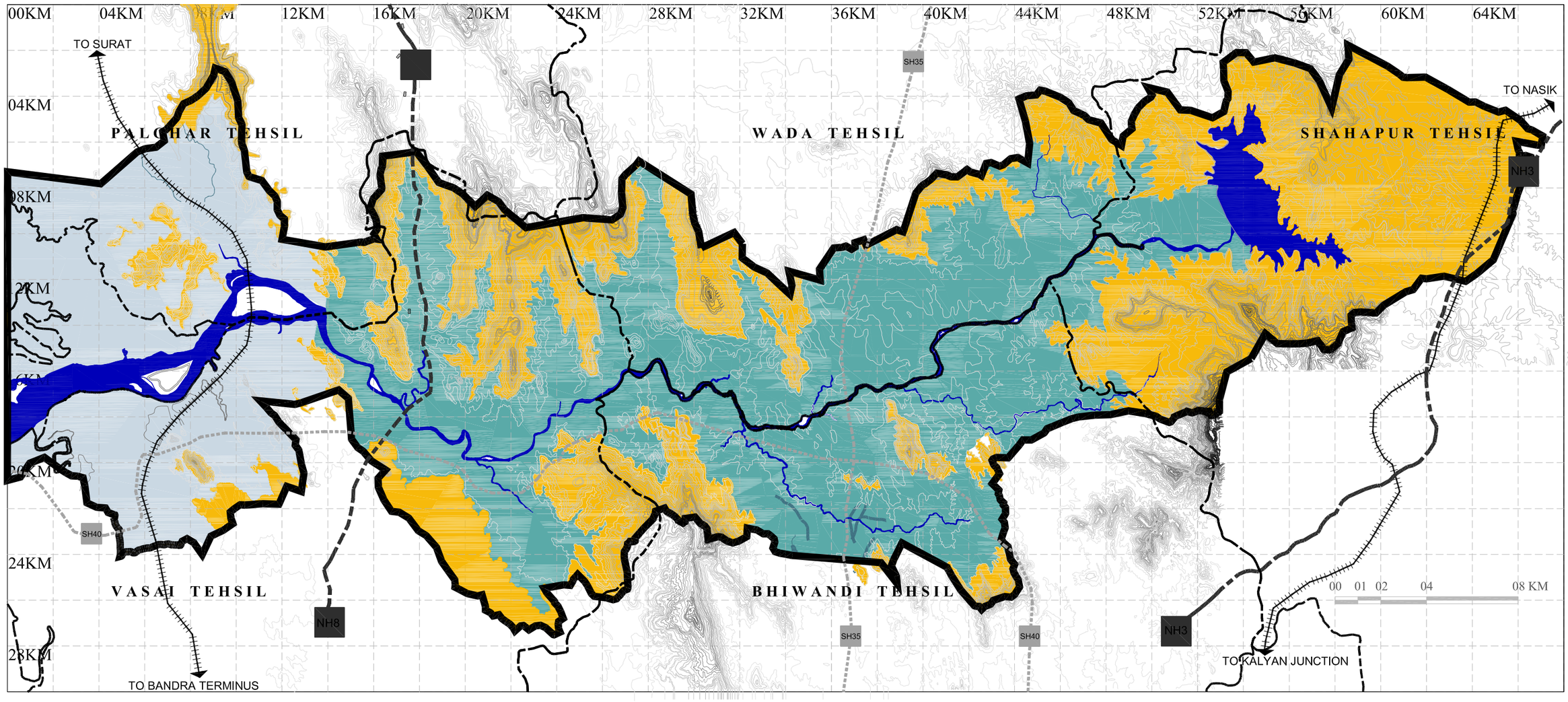
LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY (NH4)
- STATE HIGHWAY (SH35)
- PEAKS
- TANSA RIVER
- VAITARNA RIVER
- STUDY AREA TANSA WATERSHED
- 0 TO 60 M
- 80 TO 140 M
- 160 TO 220 M
- 240 TO 300 M
- 320 TO 380 M
- 400 TO 460 M
- 480 TO 540 M
- 560 TO 620 M
- 640 TO 700 M
- 720 TO 780 M
- 800 TO 860 M
- 880 TO 940 M

ENVIRONMENTAL RESOURCE BASE: PHYSIOGRAPHY

00 01 02 04 08 KM

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in



The study area can be broadly divided into three physiographic zones based on observations of the physiography. The three zones are the coastal lowlands, the floodplains and the hill slopes. The area in the Vasai Tehsil is predominantly made up of the coastal lowlands whereas the Shahapur Tehsil predominantly consists of hill slopes , at the base of which is located the Tansa Lake

LEGEND:

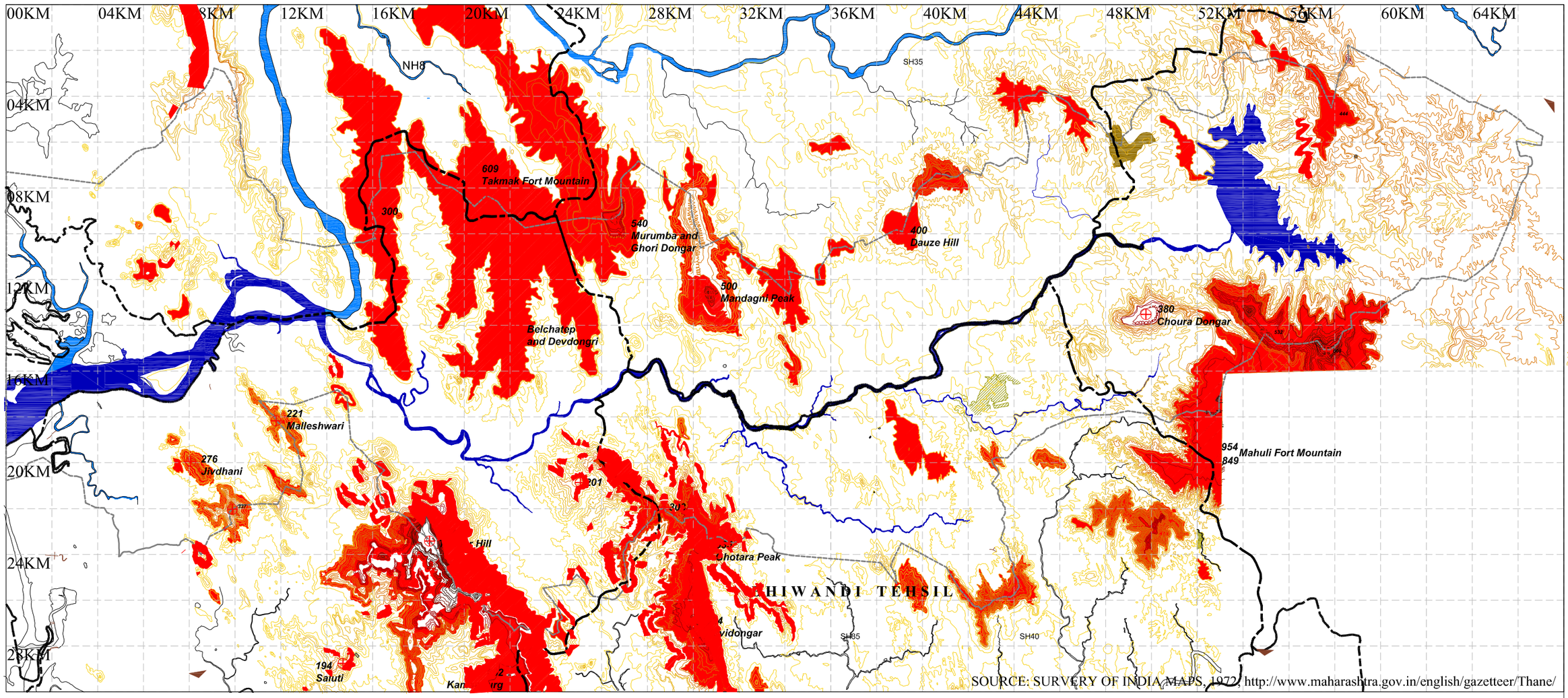
- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY
- STATE HIGHWAY
- TANSA RIVER
- HILL SLOPES
- COASTAL LOWLANDS
- FLOODPLAINS
- 0 TO 60 M
- 80 TO 140 M
- 160 TO 220 M
- 240 TO 300 M
- 320 TO 380 M
- 400 TO 460 M
- 480 TO 540 M
- 560 TO 620 M
- 640 TO 700 M
- 720 TO 780 M
- 800 TO 860 M
- 880 TO 940 M

ENVIRONMENTAL RESOURCE BASE: PHYSIOGRAPHIC ZONES

00 01 02 04 08 KM

2.6

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in



SOURCE: SURVERY OF INDIA MAPS, 1972/ http://www.maharashtra.gov.in/english/gazetteer/Thane/

The map indicates sensitive slopes as slopes greater than 20 percent. These are defined as sensitive as they are susceptible to erosion.

LEGEND:

- TEHSIL BOUNDARY
- PEAKS
- NH4 NATIONAL HIGHWAY
- SH35 STATE HIGHWAY
- SLOPES >20 DEGREES
- TANSA RIVER
- VAITARNA RIVER
- STUDY AREA /RIDGE DIVIDE
- 0 TO 60 M
- 80 TO 140 M
- 160 TO 220 M
- 240 TO 300 M
- 320 TO 380 M
- 400 TO 460 M
- 480 TO 540 M
- 560 TO 620 M
- 640 TO 700 M
- 720 TO 780 M
- 800 TO 860 M
- 880 TO 940 M

ENVIRONMENTAL RESOURCE BASE: SENSITIVE SLOPES

00 01 02 04 08 KM

2.6A

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in

2.2.5 Soils

The soil map (Refer Map 2.7) indicates how varied soils are found within the region, depending upon the interactions of physiography, hydrology and vegetation, leading to a variations in the soils found within the study area.

These also create variations in the productivity of the soils through the river basin creating a variety of landscapes both manmade and natural.

The Deccan traps that cover most of the area, on weathering give rise to a greyish to dirty green, friable murrum which on decomposition and decay yield a rich and fertile reddish brown to coffee brown and black soil. The laterite on disintegration gives a dusty, reddish or reddish brown soil.

The upper hilly regions of Shahpur have shallow well drained loamy soil on moderately steeply sloping dissected hills/ intervening valleys with severe erosion and moderate stoniness.

The soils found here are generally the **Reddish Brown Soils/Traps or Red soil (Latisol)** On these soils mainly Nagli and vari crops are cultivated.

As the plateaus descend on the lower hills towards the coast, shallow well drained loamy soil on moderately sloping dissected hills/ narrow valleys with moderate erosion are found. . These are coarse shallow soils within the middle hilly areas.

The middle region of the study area, comprising of the floodplains of the Tansa River, has very shallow, moderately well drained clayey soils on gently sloping narrow valleys with moderate erosion. These are the **Medium Black Soils** that occur within the river valley in Wada & Bhivandi. This type of soil is mostly observed in the patches of valleys lying between the coastal plain and the hilly slopes of Bhivandi, Kalyan and Shahapur tahsils, which is suitable for paddy and watermelon cultivation.

Soils of these broad groups are found in a several grades, depending on their location and admixture of different rocks. Locally, these are known as rice soils, varkas soils, garden soils and khar and kharvat soils. (Saline soils)

The coastal alluvial plains have slightly deep, poorly drained, fine soils on gently sloping land with residual hills, slight erosion and strong salinilty

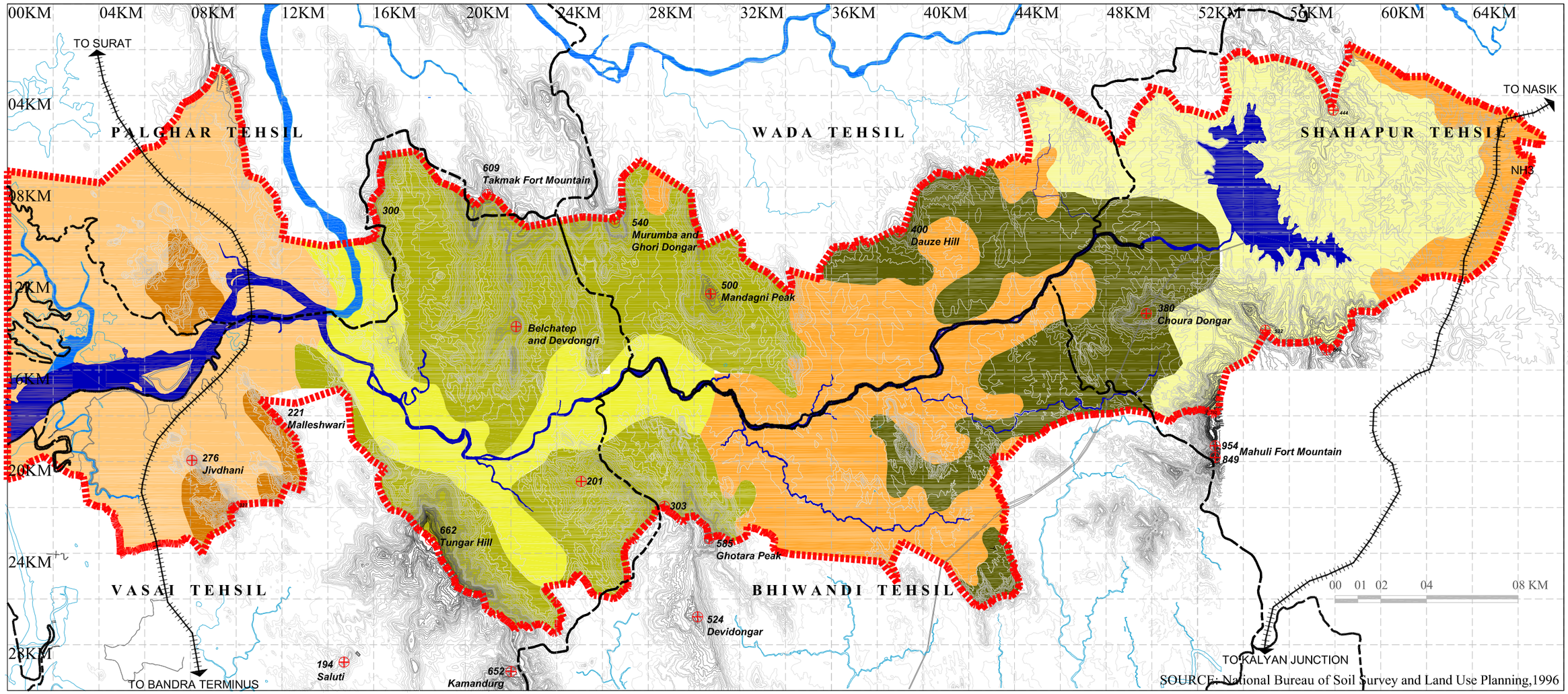
The coastal alluvial soils are also **Medium black soils,** which occur within Palghar,and Vasai tehsils as the river enters the sea, spreads out along the gentle slopes, slows down and deposits fine silt forming the alluvial plains.

This black soil containing sand **(Vertisol) of** soil is fertile and suitable for paddy, vegetables, flowers and fruit cultivation

The coastal wetlands have slightly deep, poorly drained, fine soils on gently sloping land with residual hills, slight erosion, and strong salinilty. Within these regions, the coastal saline soils occur – Kharland *Khajan,* which supports paddy and vegetable gardens.

Significance of Soil Types

- Fertile agricultural soils with organic matter are an important resource as it takes a long time to form and therefore is not easily renewable. Good soils lost to agriculture for building can finally only be replaced by bringing inferior soils into production which requires investment.
- Soils constitute the physical basis of an agricultural enterprise and play a very vital role in the agricultural economy of the region. The soils of Thane district are conveniently divided into three categories [1]
- The Black soil containing sand (Vertisol) Palghar, and Vasai tahsils, are fertile and suitable for paddy, vegetables, flowers and fruit cultivation, and plantations occur within these areas.
- The Red soil (Latisol) found in eastern region, mostly on the slopes of Shahpur, supports mainly Nagli and vari crops.
- The Brownish black soils in the patches of valleys lying between the coastal plain and the hilly slopes of Bhivandi, Kalyan and Shahapur tahsils, supports or paddy and watermelon cultivation.
- Towards the coast where salinity increases these soils support paddy and vegetable gardens.
- Deposits of reddish laterite clay are also found near Gokhivare in Vasai tehsil. This is used for making bricks, tiles and cheap red glazed utensils.



SOURCE: National Bureau of Soil Survey and Land Use Planning,1996

	SOIL TYPE	GEOGRAPHICAL LOCATION	EROSION	AREA in sq. km
	Poorly drained fine soil	Konkan; gently sloping land with residual hills	SLIGHT	177.00
	Well drained loamy soil	Konkan; moderately steep slopes	SEVERE	158.00
	Moderately well drained clayey soil	Konkan; gently sloping elongated ridges	MODERATE	16.00
	Well drained loamy soil	Konkan; moderately steep sloping dissected hills / intervening valleys	SEVERE	149.00
	Moderately well drained clayey soil	Western Ghat; gently sloping narrow valleys	MODERATE	77.00
	Excessively well drained loamy soil	Western Ghat; moderately steep sloping dissected hills / intervening valleys	SEVERE	195.00
	Well drained loamy soil	Western Ghat; moderately sloping dissected hills / narrow valleys	MODERATE	103.00

The study of the geological basins shows seven soil types in the study area. It further identifies their area covered by each type, its geographical location and the erosion levels of each type of soil. These have been highlighted in the adjoining table.

LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- RIDGE DIVIDE
- TANSA RIVER

- 0 TO 60 M
- 80 TO 140 M
- 160 TO 220 M
- 240 TO 300 M
- 320 TO 380 M
- 400 TO 460 M
- 480 TO 540 M
- 560 TO 620 M
- 640 TO 700 M
- 720 TO 780 M
- 800 TO 860 M
- 880 TO 940 M

- SLIGHTLY DEEP, POORLY DRAINED, FINE SOILS ON GENTLY SLOPING LAND WITH RESIDUAL HILLS, SLIGHT EROSION, STRONG SALINILTY
- 21 SHALLOW WELL DRAINED LOAMY SOIL ON MODERATELY STEEP SLOPES WITH SEVERE EROSION
- MODERATELY DEEP, MODERATELY WELL DRAINED, CLAYEY SOILS ON GENTLY SLOPING ELONGATED RIDGES/ HILLS WITH MODERATE EROSION
- SHALLOW WELL DRAINED LOAMY SOIL ON MODERATELY STEEPLY SLOPING DISSECTED HILLS/ INTERVENING VALLEYS WITH SEVERE EROSION
- VERY SHALLOW, MODERATELY WELL DRAINED CLAYEY SOILS ON GENTLY SLOPING NARROW VALLEYS WITH MODERATE EROSION
- SHALLOW EXCESSIVELY DRAINED LOAMY SOIL ON MODERATELY STEEP SLOPING DISSECTED HILLS/ NARROW VALLEYS WITH SEVERE EROSION AND MODERATE STONINESS
- SHALLOW WELL DRAINED LOAMY SOIL ON MODERATELY SLOPING DISSECTED HILLS/ NARROW VALLEYS WITH MODERATE EROSION

ENVIRONMENTAL RESOURCE BASE: GEOLOGICAL BASINS

00 01 02 04 08 KM

2.7

2.2.6 Hydrology

The Konkan coast has numerous streams that originate in the ridges of the Western Ghats and meet the Arabian Sea. The Tansa river basin is a hydrological unit located in the coastal belt which is 30-60 km in width and is traversed by a number of short swift rivulets which rise in the Western Ghats and flow into the Arabian sea. The river basin collects water from several watersheds. The river basin consists of the source region, the floodplains and the delta.

The area of the water shed of the Tansa as shown in the map 2.8 is approximately 902 sq km. The Tansa River originates near Khardi situated in the Shahapur plateau and flows north of Mahuli, Bhiwandi, passes the villages of Vajreshwari and Ganeshpuri and runs for nearly 14 kms through Bassein. It meets the Vaitarana at Chimana at about 12 kms from the sea.

The common drainage pattern of the watershed of the Tansa River as observed through the Hydrology Map 2.8 ,appears to be primarily dendritic in nature. The Santanu River joins Tansa near Akloli apart from a number of rivulets and streams that emerge from the different hills and join it at various places on its way to the sea.

The Tansa river basin is characterized by the plateaus which have lakes. The upper reaches of the river has been dammed to develop a water reservoir, Tansa Lake, to supply drinking water to Mumbai. The natural river course has been transformed. Towards its mouth the river forms an estuary. The river is tidal till the Western Express Highway in Navsai.

2.2.6.1 Hydrology of rivers and streams

The stream or the river is characterized by flow and flood. These give life to the river and create and maintain habitats. They oxygenate the water, recycle nutrients and recharge groundwater and therefore are responsible for creating maintaining and sustaining a number of habitats all along the stream.

On its way down the slope and through the undulating landscape, the stream may flow through natural barriers such as dykes , boulder beds, rapids and moss and algal vegetation which act as filters for sediments and debris and also give rise to a variety of habitats such as riffles, pools, bays and backwaters. They have their own velocities and temperature regimes and hence their own characteristic lifeforms. The meanders, the oxbow lakes and pools , the flood plains and even the hyporic zone that extends below the flow of the river and stretches under both sides of the basin, have their own physical qualities and their characteristic life forms.[8]

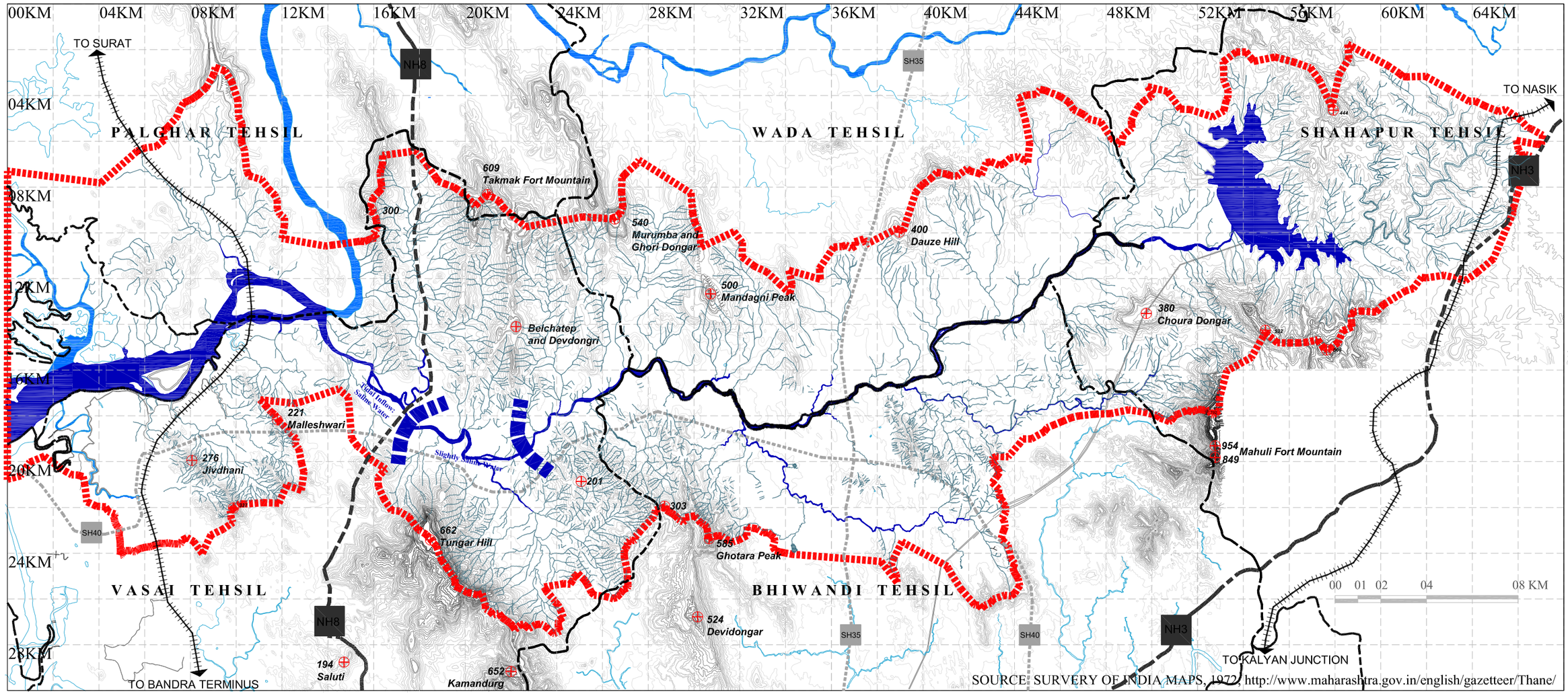
The velocity and erosive powers can be great in the source regions. The mixing of nutrients from the surrounding landscape, the turbulence leading to oxygen mixing enrich the water in the channel. Therefore in its upper reaches, the stream channel is the receiver of water nutrients and sediments from the surroundings. As such the streams productive power/capacity is vested in the stream channel. This region therefore has high fish and wildlife value. On the other hand, a large stream or river formed after coming together of a number of streams and flowing through a level plain becomes a donor of water, nutrients and sediments as it builds up its own flood plain. Here the channel is a fraction of the inundated area, the flow is often turbid due to sediment load and light penetration is low. As sediments are deposited, nutrients are stored in the floodplain where most of the productivity is concentrated. As the streams / rivers flow towards the plains it increasingly meets manmade obstacles and. The streams velocity decreases and sediment deposition rates increase creating fertile plains that support agricultural settlements.The hyporheic zone which extends below the surface channel and on both sides at the sub-surface level, acts both as a storage as well as a channel feeding underground flows and reservoirs and enriching the water table.[9]

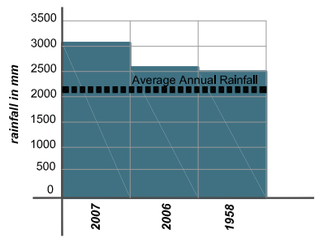
Areas of Significance for Hydrology

- Streams and rivers are two important perennial sources of water. Currently however many of the streams dry up soon after the rainy season due to two reasons- their ecological needs are neglected and they are subjected to over-exploitation and misuse.
- As explained above, the rivers and streams including the upper reaches, floodplains and deltas, all form important habitats.
- Catchment areas are the source regions and the areas of origin of first order streams. It is therefore important that they be maintained with natural vegetation cover.
- The hyporheic zone of rivers and streams stores water and recharges the river during the dry season.
- Village ponds and percolation tanks store the floods and release them in the dry months.
- The river and stream system deposit silt and sediment in the floodplain areas, and support agricultural settlements.
- Tansa is a large important river, tidal for many kilometres and navigable for nearly 12 kms. The loading station of Usgaon, Khanivda , Bhatana and Chimana, have enough water for vessels for 12.5 kms weight.
- The streams, rivers, lakes, reservoirs also have a scenic and recreational value.
- The bed of the Tansa river has a number of hot springs around Akloli Ganeshpuri and Vajreshwari.
- The Tansa Reservoir supplies 14% of Mumbai's water supply.
- The rivers and streams also provides irrigation in a few villages in Vasai and water for domestic purposes in most neighbouring villages.

[8] Prakash Gole – nature conservation and sustainable development in india.

[9] Maurizi and Poillon -1992 cited from ,Prakash Gole Watershed development and nature conservation, Nature Conservation and sustainable development in India. Rawat Publications, August 2001.





		AREA in sq. km
1	VASAI TEHSIL	230.00
2	BHIWANDI TEHSIL	143.00
3	SHAHAPUR TEHSIL	207.00
4	WADA TEHSIL	162.00
5	PALGHAR TEHSIL	133.00
	TOTAL	*875.00*

The Tansa River emerges in the surrounding hills that have been mentioned in the physiography study. The ridge divide forms an overall watershed area of approximately 875 square kilometers. The watershed area in the Vasai, Bhiwandi, Shahapur, Wada and Palghar Tehsils is 230, 143, 207, 162, 133 sq. km. respectively. These watersheds recieve an average annual rainfall of 2300 mm, as can be identified through the adjoining figure. The variation in rainfall from the coast on the west to the ghats / mountains on the east is 1730mm - 2530mm.

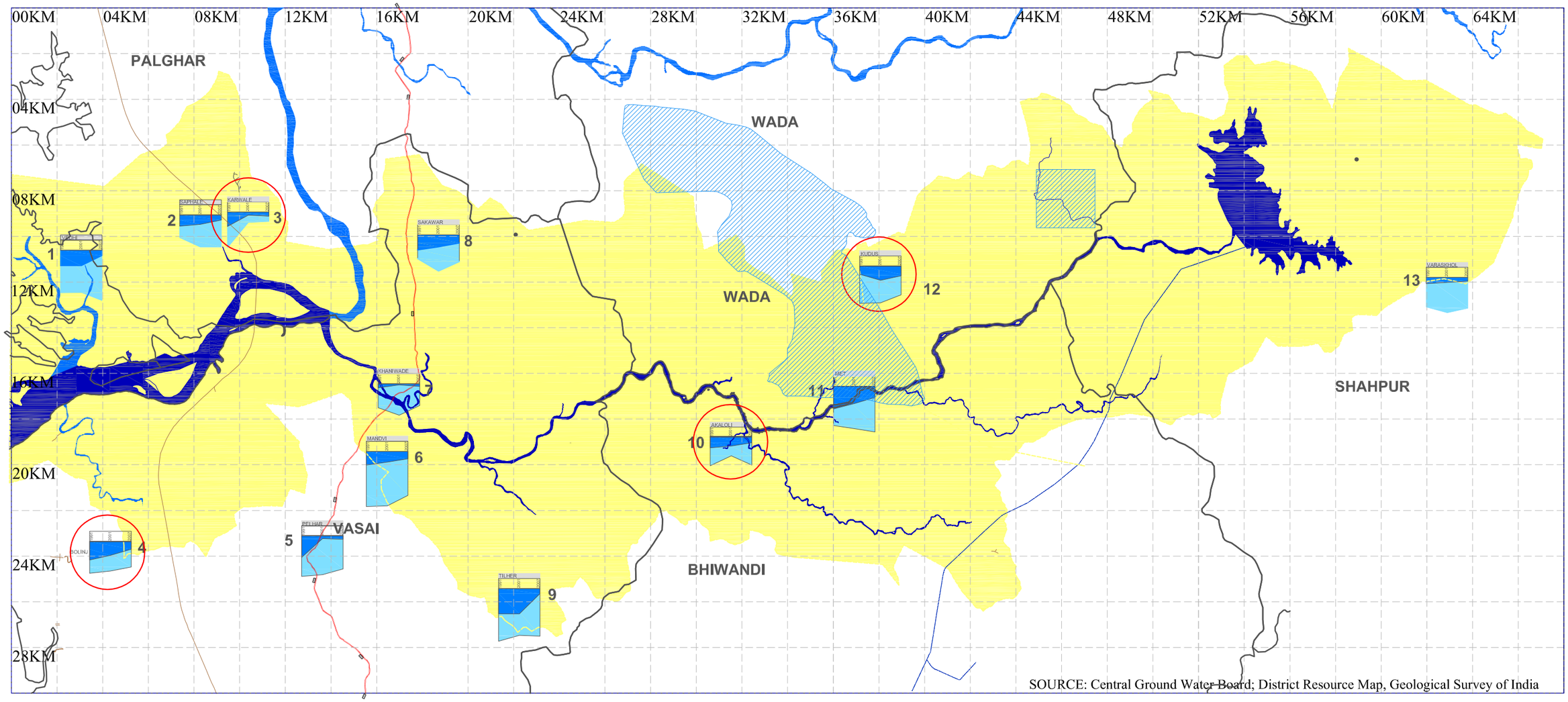
LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY (NH4)
- STATE HIGHWAY (SH35)
- PEAKS
- TANSA RIVER
- WATERSHED
- RIDGE DIVIDE
- 0 TO 60 M
- 80 TO 140 M
- 160 TO 220 M
- 240 TO 300 M
- 320 TO 380 M
- 400 TO 460 M
- 480 TO 540 M
- 560 TO 620 M
- 640 TO 700 M
- 720 TO 780 M
- 800 TO 860 M
- 880 TO 940 M

ENVIRONMENTAL RESOURCE BASE: HYDROLOGY

00 01 02 04 08 KM

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in



The Map indicates the Ground Water levels in various regions and the chemical composition measured in the years 1991, 2001 and 2007.
The data, sourced from Central Ground Water Board of India, shows that there has been a steady rise in ground water levels in all areas except Vedhi (1), Saphale, Akloli (between 2001 and 2007) and Met within the industrial areas of Wada.
The aquifer zone as identified by the Geological Survey of India as an area for potential ground water recharge, corresponds to the lateritic plateau as indicated in the Geomorphology Map (Mao no. 2.4).

LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- NH4 NATIONAL HIGHWAY
- SH35 STATE HIGHWAY
- TANSA RIVER
- TANSA WATERSHED
- GROUND WATER LEVEL (MAY)
- GROUND WATER LEVEL (OCTOBER)
- AQUIFERS

1	VEDHI	7	KHANIWADE
2	SAPHALE	8	SAKAWAR
3	KARWALE	9	TILHER
4	BOLINJ	10	AKLOLI
5	PELHAR	12	KUDUS
6	MANDVI	13	VARASKHOL

ENVIRONMENTAL RESOURCE BASE: GROUND WATER

00 01 02 04 08 KM

2.9

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in

2.2.6.2 Ground water

Individual lava flows in the district have an average thickness of 15-25 meters; and the individual vesicular traps are often up to five meters in thickness. Vesicular traps occurring below water-table are generally the repositories of groundwater, which are tapped locally by open wells. Such wells penetrating the vesicular unit fully are likely to yield large quantity of water. In immediately coastal areas, the vesicular traps are, however, contaminated with saline water due to tidal influence. The scope for ground water therefore, exists in effectively harnessing the vesicular trap units when they occur below water-table in low-lying areas outside the tidal influence.

Aquifers are generally shallow in the area, represented by weathered and fractured basalt located mainly in depressions, river sides, and flat areas. (Refer Map 2.9) Deeper aquifers may also occur. They are, in most cases, represented by inter-lava flow materials, exceptionally by granular rock types.

The data from the Central Ground Water Board indicates that the floodplains have a shallow water table, with very little variation over the years.

Areas of Significance of Ground Water

- The centrally situated moderate dissected plateaus form recharge zones.
- Most villages in the study area use well water for drinking, washing and domestic purposes.
- Tubewells also provide the primary source of water for irrigation within the area.

2.2.7 ECOLOGY – Vegetation and Habitat types

Due to the range of geomorphic units and physiographic expression a wide range of vegetation types, communities and habitats are observed in the region. The ecological habitats including vegetation and flora- fauna define critical wild life areas and corridors.

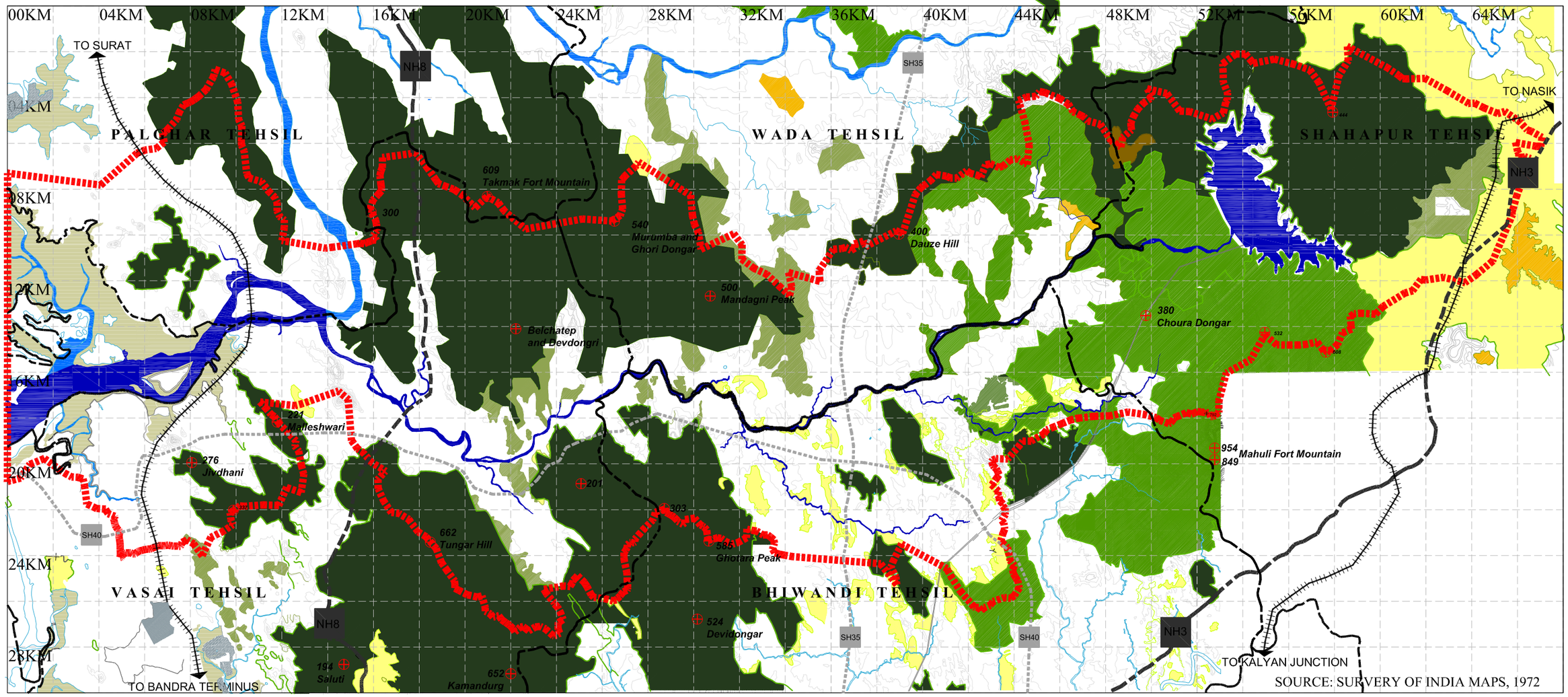
The habitats include the forested slopes of the Western Ghats, hills and plateaus and escarpments, mangrove formations in estuaries, wetlands, riparian and in-stream habitats, grassland habitats agricultural lands and manmade plantations. In the following paragraphs each of these has been described in detail. (Refer Map 2.10)

2.2.7.1 Forest

The forest within the Tansa river basin is complex ecosystem with a high biodiversity and stratification. The forest type varies with the elevation and precipitation. The following different forest and vegetation types are found in the region:

- *Southern moist mixed deciduous forest: This occurs within an elevational range of 500-900 mts.* The soil found here is generally red soil with occasional lateritic patches. The tropical deciduous forests in the area have developed in seasonally dry tropical conditions.
- *Moist teak forest:* Teak is a predominant species in this type attaining a fairly large size at maturity. These types are mostly confined to the lower slopes of hills and occasionally extend up to a height of 400m-450 m depending upon the favorable conditions beyond which they are found either in small patches or are absent. The site quality of the forest varies considerably depending upon the nature and depth of soil. The soil is red soil with varying depth.
- *The western Subtropical hill forest* A part of the Southern subtropical broadleaved hill forest. It is found at higher elevations (slightly lower temperatures and more precipitation) and is confined to certain plateaus and terraces.
- *Southern tropical semi-evergreen forest:*Semi-evergreen forests appear at elevations ranging from 500-1500 mts where the rainfall is between 2000-3500mm. This type forms an intermediate type between the evergreen forests and the moist deciduous forests on hill slopes by the presence of characteristic species of both the zones.
- *Littoral vegetation:* Forest vegetation near the coast includes many ligneus species such as Pongamia pinnata, Thespesia populnea, Pandanus sp etc.

Other types include the coastal mangrove forests and the tropical riparian fringing forests. (Refer Map 2.11)



The study has identified eight categories of vegetation cover based on the 1972 survery of India map. It will be used in the later part of the study to compare the transformations in the vegetation cover during the last 30 years. This map does not identify the vagetation cover encompassed by agriculture and plantation.

In stream habitats within the stream *Mixed plantations along the stream* *Teak plantations* *Mangroves along the coast*

LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY (NH4)
- STATE HIGHWAY (SH35)
- PEAKS
- TANSA RIVER
- VAITARNA RIVER
- RIDGE DIVIDE
- RESERVED FOREST
- FAIRLY DENSE JUNGLE
- DENSE MIXED JUNGLE
- OPEN JUNGLE
- TEAK PLANTATION
- DENSE SCRUB
- OPEN SCRUB
- MANGROVES
- 0 TO 60 M
- 80 TO 140 M
- 160 TO 220 M
- 240 TO 300 M
- 320 TO 380 M
- 400 TO 460 M
- 480 TO 540 M
- 560 TO 620 M
- 640 TO 700 M
- 720 TO 780 M
- 800 TO 860 M
- 880 TO 940 M

ENVIRONMENTAL RESOURCE BASE: FORESTS

00 01 02 04 08 KM

2.11

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069.
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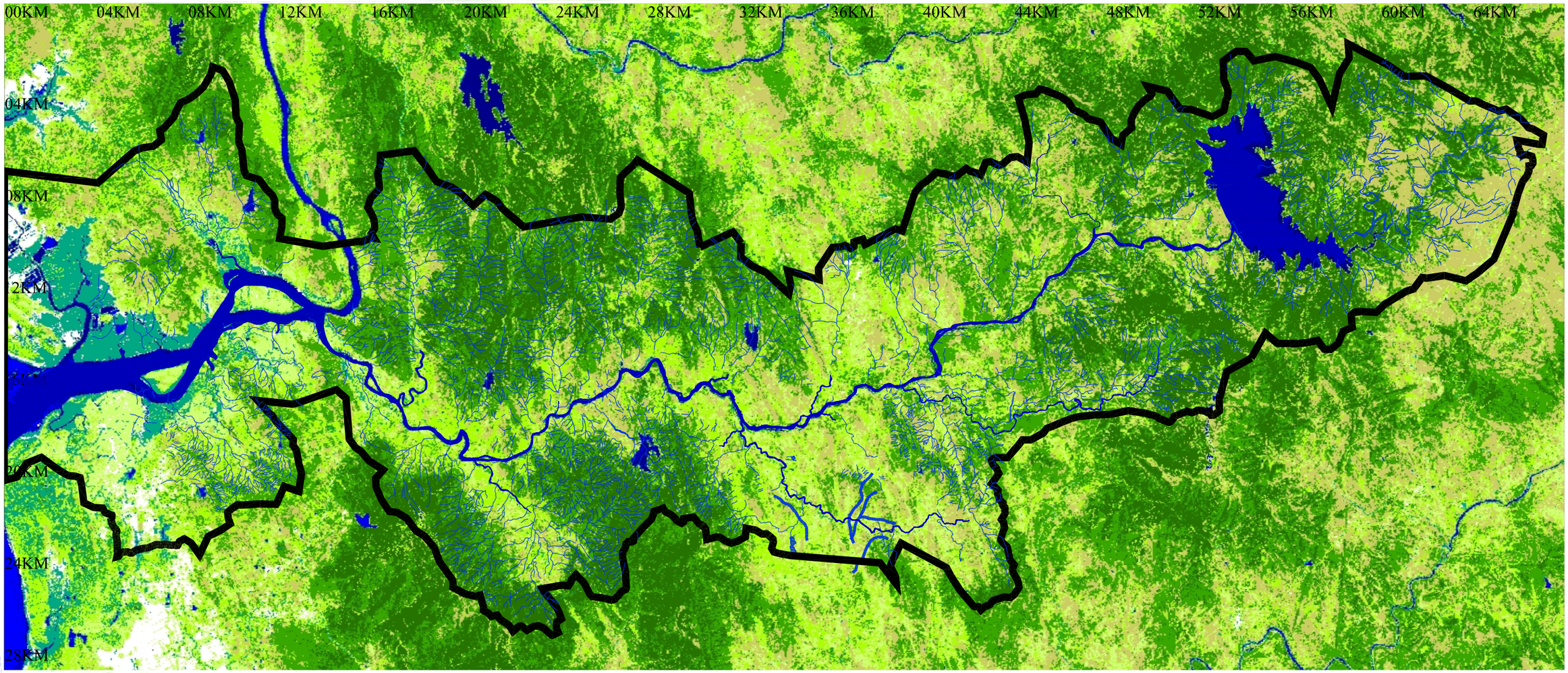


SOURCE: SURVERY OF INDIA MAPS, 1972.
Satellite Image-ETM+ WRS-2, 2000-12-02, EarthSat, Ortho, GeoCover,India

The map indicates the existing habitats within the study area.
The map was generated using remote sensing of satellite images to detect, grasslands and scrublands, agricultural landa and plantations, mangroves and forest.Tthe hydrological pattern from the topographic maps was superimposed to delineate the stream, and riverine habitats.

- TANSA RIVER
- RIDGE DIVIDE
- STREAMS
- GRASSLANDS / SCRUB LANDS/ DE-NUDED SLOPES
- AGRICULTURE/PLANTATIONS
- MANGROVES
- FORESTS
- INSTREAM / RIPARIAN HABITATS / WET LANDS

ENVIRONMENTAL RESOURCE BASE: HABITATS

00 01 02 04 08 KM

2.2.7.2 Forest Diversity (Refer Map 2.12)

***Excerpt from the report* - Human disturbance and forest diversity in the Tansa Valley, India by Radha Veach1 David Lee and Tom Phillipi.**

- **Floristic diversity and forest types in the Tansa Valley**

  The Tansa Valley has been studied floristically in the past. Collections in the region helped in the completion of the floras of the Bombay Presidency by Cooke (1904) as well as the forest flora by Talbot (1894). Two dissertations (Billore 1972; Koshy and Shah 1987) have added to this information. Champion and Seth (1968) described the forests of the Thane District as Moist Deciduous Forest Bearing Teak (Type 3B/C1b). Gaussen et al. (1966) described these forests as 'slightly humid' of the series Tectona-Terminalia-Adina-Anogeissus. At higher elevations (slightly lower temperatures and more precipitation) a different forest type occurs, described by Champion and Seth (1968) as part of the southern subtropical broadleaved hill forest (8A/C2), specifically the western subtropical hill forest. Gaussen et al. (1966) described these forests as dense and semi-deciduous. The forest types delineated by Champion and Seth and the French Institute were not viewed as pristine, but were partly the result of a history of human intervention.

- **Patterns of forest diversity in the region.**

  The diversity of the 14 forest remnants is comparable to that of similar sites in India and other seasonally dry regions in the tropics. The site with the most species was Tungar Hill with 150 species; the least diverse site (besides the mangrove site with 11 species, excluded from additional analysis) was a site near the river source with 62 species. These species totals approach or even surpass those published for wet evergreen forests (Chandrashekara and Ramakrishnan 1994; Ganesh et al. 1996; Pascal and Pelissier 1996; Rai 2000), but these estimates are from quadrats. The woody species diversity is less than that of similar sites in Indo-China (Rundel and Boonpragob 1995) or in Latin America (Gentry 1995). Dry forests in Mexico are more species-rich, with less annual rainfall (Lott et al. 1987). The correspondences with the forest types of Champion and Seth (1968) and Gaussen et al. (1966) are not perfect; some differences would be expected between regions. These forests are floristically more diverse than those described at Sanjay Gandhi National Park in Mumbai (Santapau and Randeria 1970), the uplands on Elephanta Island (Satyanarayan 1959), and consistent with those at moister sites on Deccan trap soils (Legris and Meher-Homji 1979). The 24 predominant species (seen in 13/15 of the sites and 8/11 of the 100 3 500 m quadrats in the disturbance transects; see Appendix) are all persistent, resistant of fire and cutting, and are indicators of a history of disturbance. The higher frequency of teak is suggestive of this history of disturbance (as well as past silvicultural treatment).

  Many species vary in presence from site to site, many are associated with more moist forest associations, and reveal much about the distribution of diversity in the forests, as well as effects of disturbance. Truly remarkable in its high diversity is the semi-evergreen forest of Tungar Hill, 1062 with 150 woody species. Twenty-four of the species at all sites (out of 181 species) are unique to this one location. Other mesic species characteristic of hill forest were also found in neighboring peaks, like Mahuli, Takmak and Ghotara. *Macaranga peltata* and *Pavetta indica* occurred in areas below Ghotara and above Usgaon reservoir, as well as on Takmak, Dyari and Mahuli. Diospyros Montana also occurred on Mahuli, Ghotara and Usgaon, Takmak and Mandagni. Glochidion hohenackeri occurred on Tungar, Dyari, Takmak and Mahuli. Legris and Meher-Homji (1977) described the predominant species of the hills of the Peninsula, including those of the northern portion of the Western Ghats, in moister and evergreen forests. Their moist forest species at these 14 sites include (with the number of sites in parentheses): *Dillenia pentagyna* (10), *Diospyros montana* (5), *Firmiana colorata* (9), *Lagerstroemia lanceolata* (13), *Macaranga peltata* (5), *Oroxylum indicum* (7), *Sterculia villosa* (9), *Toona ciliata* (1), and *Ensete superbum* (11). However, in our experience D. *montana*, S. *villosa* and E. *superbum* are actually very drought-tolerant. We would add *Mimusops elengi*, *Carallia brachiata, Mammea suriga, Ixora brachiata, Albizzia procera and Bauhinia malabarica* as indicators of moist forest. Four species described as diagnostic of wet evergreen forests were also found on these sites: *Garcinia indica* (2), *Spondias pinnata* (11), *Aporosa lindleyana and Sageraea laurifolia* (both Tungareshwar only). Despite Tungar's moderate elevation (Table 1), species that normally grow at much higher elevations have established there. Koshy and Shah (1987) had documented some of this diversity and shown its relationship to the flora at Khandala (Santapau 1954), having in common such *taxa* as *Diospyros montana, Garcinia indica* and *Mimusops elengi.* They noted 38 woody taxa from Tungar, also seen in our collections. We have found additional rare and unusual taxa from this location, 22 of these species not listed by Koshy and Shah: *Aglaia talbotii, Antidesma ghaesembilla, Caryota urens, Cleidion spiciflorum, Chukrasia tabularis var. velutina, Flacourtia montana, Gymnosporia konkanensis, Litsea glutinosa, Margaritaria indica, Persea macrantha, Spermadictyon suaveolens*, and others (see Appendix). Some of these species are very rare from this region, collected from the Konkan for the first time (V. Almeida, personal communication); G. *konkanensis* is endemic to this site. A similar list of species was also observed in the summit area of Kamandurg Fort, some 3 km to the south (unpublished observations). This entire region may well represent the largest remaining expanse of western subtropical hill forest (Champion and Seth 1968) in the Konkan, similar in diversity to Khandala to the south (Santapau 1954), but larger in area and perhaps less disturbed.

  Tungar Hill is remarkable among all of the sites for its semi-evergreen character, high species richness, and presence of numerous rare and mesic species (but partially shared with pockets of forest remnants on nearby hills: DY, Takmak and Ghotara, They represent a forest flora that once was more widely distributed in the Tansa Valley.

- **Factors influencing species diversity:**

  All of the forest remnants were subject to intense pressures of exploitation on their edges. However, neither total size nor buffer distance explained the degree of disturbance within these sites. Some were more protected by steepness of slope and total elevation, distance from graded roads, and smaller human populations in nearby villages. We expected that rarer species might be confined to the moistest and most remote sites at the highest elevations. The proximity of the isolated mountains to the coast increases their humidity and rainfall, which may lower the distribution limits of many of the trees of this forest (Whitmore 1984; Leuschner 1996), on Tungar Hill and, to a lesser extent, on other mountains in the valley. Actually, the highest elevations were dry and exposed, and most rare species occurred in small and protected valleys beneath the summits. Most of the rare species, including those growing exclusively on Tungareshwar, actually grow over most of the elevation range, many near the base of the hill. Thus, elevation may not be a very important factor. The 14 sites in the Tansa Valley were strongly nested, both in total diversity and in similarity. Only 20 species out of the 170 in the Tansa Valley (removing the mangrove site) were not observed in the most species-rich site, Tungareshwar. Thus the other locations principally had subsets of species present in this one site.

Areas of Significance Vegetation and Habitat Types

- Old growth forests and native vegetation are of critical importance supporting biodiversity and habitats. According to a bio-diversity study Human disturbance and forest diversity in the Tansa Valley, India by Radha Veach, David Lee and Tom Phillipi it becomes clear that the bio-diversity in the semi green forest of Tungar Hill is the highest in the region with 150 species while the least diverse sites are the mangrove with 11 species. In the whole of Tansa Valley the total number of species that this study recorded was around 181. The Tungar hill itself had 24 species which are unique to this location. As the study observes " Other mesic species characteristics of hill forests were also found in neighboring peaks like Mahuli, Takmak, and Ghotara. ". Some of the species like the G. kokanensis are native to the region. The study goes on to state that the "this region may well represents the largest remaining expanse of western subtropical hill frorest in the Konkan"1.
- The forests within the region is an important resource, for biomass, fuel, water, major and minor forest produce especially for the tribal communities that subsist on these resources.
- These forests are a highly specialised ecosystem having low resilience. Prime forest once destroyed will be impossible to regenerate.
- The hill vegetation plays a critical role in the hydrological cycle. The forest and natural vegetation cover allow percolation, decreases run-off and acts as a water bank. The forests actually acts like a dam, collecting water and recharging underground flows, and also form catchments for rainwater harvesting. The forests are also areas of origin of the first order streams that feed into the Tansa.
- The forest ecosystem plays a major role in microclimate conditions. Where present it improves the microclimate. Local climate change may cause regional environmental problems and affect natural ecological cycles. The forests within the region absorb atmospheric pollution and act as Carbon sinks.
- Forests regulate the hydrological cycle- control and diminish erosion, sedimentation drought and flooding in other low lying areas during the monsoons can be prevented by maintaining sufficient forest cover on the plateaus and in hilly areas.
- It is of vital importance that the steep slopes, plateaus and hilly areas remain adequately covered with forest. This will prevent erosion and situation in the streams and river.
- They form unique landscapes of Scenic value and recreational potential.
- They provide wildlife habitats.

2.2.7.3 Riparian Habitats

The channel has high biological value here in the upper reaches as it is the receiver of water sediments and nutrients and more so if the source region is covered with forests. This zone is a region of high wildlife value.

When the stream enters the plain and begins to form its own flood plain, it is a giver of water sediments and nutrients. Its channel becomes a fraction of the total inundated area and is characterized by sediment loading and low penetration of light. The stream productivity is concentrated not in its channel but in the flood plain where nutrients are stored and food chains and food webs are built up.

The following riparian/river associated habitats were found within the Tansa River Basin

- *Tropical riparian fringing forests* -
  This type of vegetation is confined to river and stream banks. The species met with in this type are limited and found to occur along the water courses only. The soil is alluvial in most places. Trees species found here include *Ficus glomerata, Syzygium cumini, Pongamia pinnata, Mangifera indica.*
- *In stream habitats*
  Crevices and niches in the streambed rocks and boulders support in- stream habitats. As the streams flow down the slope towards the plains, it gives rise to a number of habitats including rapids, pools, crevices in rocks, boulder strewn basins and the cover of typical bank vegetation. They are home to numerous life forms from tiny invertebrates to reptiles and mammals.
- *Areas of origin of waterfalls*
  These form specialized habitats harboring rare and endemic species.

Area of Significance

- Natural aquatic ecosystems through their most important characteristics of flood and flow maintain a stream flow, attenuate floods, replenish and recycle nutrients, recharge ground water.
- In stream habitats are breeding areas for various species. It is therefore necessary that habitats and bank vegetation be scrupulously protected.
- Riparian zones shade and regulate the temperature of the stream and act as biological filters.
- Riparian habitats are specialised habitats.
- River fish(Hilsa) provide an important source of protein to the tribals who live in that region.

2.2.7.4 Wetlands

Wetlands are transitional areas between aquatic and terrestrial ecosystems, where the water table is at or near the surface of the land and is covered by shallow water. They include marshes floodplains, bogs, shallow ponds, littoral zones of the large waterbodies, tidal marshes etc. They are defined as submerged or saturated land, both natural and manmade, permanent or temporary with water that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed six meters.

- Freshwater- wetlands – They consist of aquatic plants which grow in water and marsh plants which flourish on moist swampy ground remaining saturated with water during a major portion of the year. Fresh water marshes include marshy land along the banks of ponds, rivers, streams and natural swamps and even paddy fields.

  While shallow water bodies attract birds and numerous other life forms including a variety of plants ,the deep reservoirs and deeper portions of lakes are not rich in biodiversity. This is because with increasing water depth light penetration decreases rapidly and so does mixing of oxygen. Light penetration and the supply of oxygen are both adequate in shallow lakes for the development of complex food chains. These react constantly with abiotic elements leading to changes in water chemistry and edaphic factors. Their water inputs and outputs and water level fluctuations and their water residence time makes these water bodies biologically very active.

- *Tidal swamp forest/ Mangrove scrub forest:* The delta / estuary where the river meets the sea forms a zone where maximum deposition of sediment takes place. An estuary has a mixture of salt water and fresh water.

  The silt and nutrients that the streams bring in have given rise to mudflats and mangroves which are responsible for protecting the land from sea erosion and wave action.

Area of Significance

- Wetlands are High biodiversity areas and important ecological habitats. A profusion of species belonging to diverse families are observed in this zone.
  Wetland ecosystems are considered as highly productive help in nutrient dynamics and act as nursery for several kinds of fish and other animals.
- Wetlands and bank vegetation perform several important functions such as filtering the storm water flows into the lake and act as natural biological filters.
- Wetlands are cooling structures that regulate the microclimate.
- They regulate the water regime, and act as a cushion against floods.
- Wetlands can be integrated in the management of rivers and streams and need to be considered not in isolation but as systems interlinked with streams and water systems.

Mangroves are salt tolerant forest ecosystems. These are found along creeks in the intertidal zone. It consists of swamps, forest land within and its water spread areas. Some of the common species found in this zone are *Ceriops tagal, Salvadora persica, Avicennia officinalis, Sonneratia apetala, Rhizophora mucronata.*

Significance of Mangroves

- They stabilize the shoreline and act as a bulwark against encroachment by the sea and the consequent inevitable erosion of the soil in the embankments. It provides a buffer to absorb the pounding of waves, storms and erosions by the sea. The processes of erosion and shore building are therefore held in a delicate balance.
- They absorb excess water and aid in flood control.
- Coastal vegetation provides an important link with terrestrial ecosystems acting as a filter and moderator of terrestrial impacts on the marine biome.
- Mangroves act as Carbon sinks.
- Marine and related ecosystems are the richest in the world in terms of productivity. The mixing of sea water with the inflows, of silt and sediment brought by the rivers with their freshwater generate very highlevels of biological productivity. biodiversity. and provide habitats for a variety of life forms. It is a specialized habitat and an important breeding ground for both aquatic and terrestrial animals. Located there are spawning, feeding and nursery areas for a number of species: they provide staging locations and corridors for migrants including many waterfowl and sea birds and are a refuge for many threatened and endangered species.
- Mangroves are important for the coastal economy. These estuaries with their wetlands, lagoons, mangroves and sea-grass beds are rich in natural resources provide fuel timber and fodder and also support activities such as fisheries and provide livelihood and sustenance to a number of traditional rural communities.

2.2.7.5 Plantations/ Agricultural Land

Plantations

Apart from the natural forests found in this region, there are manmade plantations . The various types include teak, bamboo, casuarina, mixed plantations, orchards- coconut, mango mixed Plantations near gaothans and settlements. In some places the forest department has planted species such as Australian acacia, Eucalyptus, and Subabul.

Agriculture and grasslands

The main crops are rice, mustard, pulses like vaal tur and chana. Trees and hedge plants in farmlands include Ain-terminalia tomentosa, Kinjal, Terminalia paniculata, Carrisa Carandas- Karvand ,cactus sp etc.

Areas of Significance

- These man made habitats provide food and economic sustenance to the communities within the region. Plantations are used for timber production.
- They also form habitats for several species of birds, mammals, reptiles.


Forest

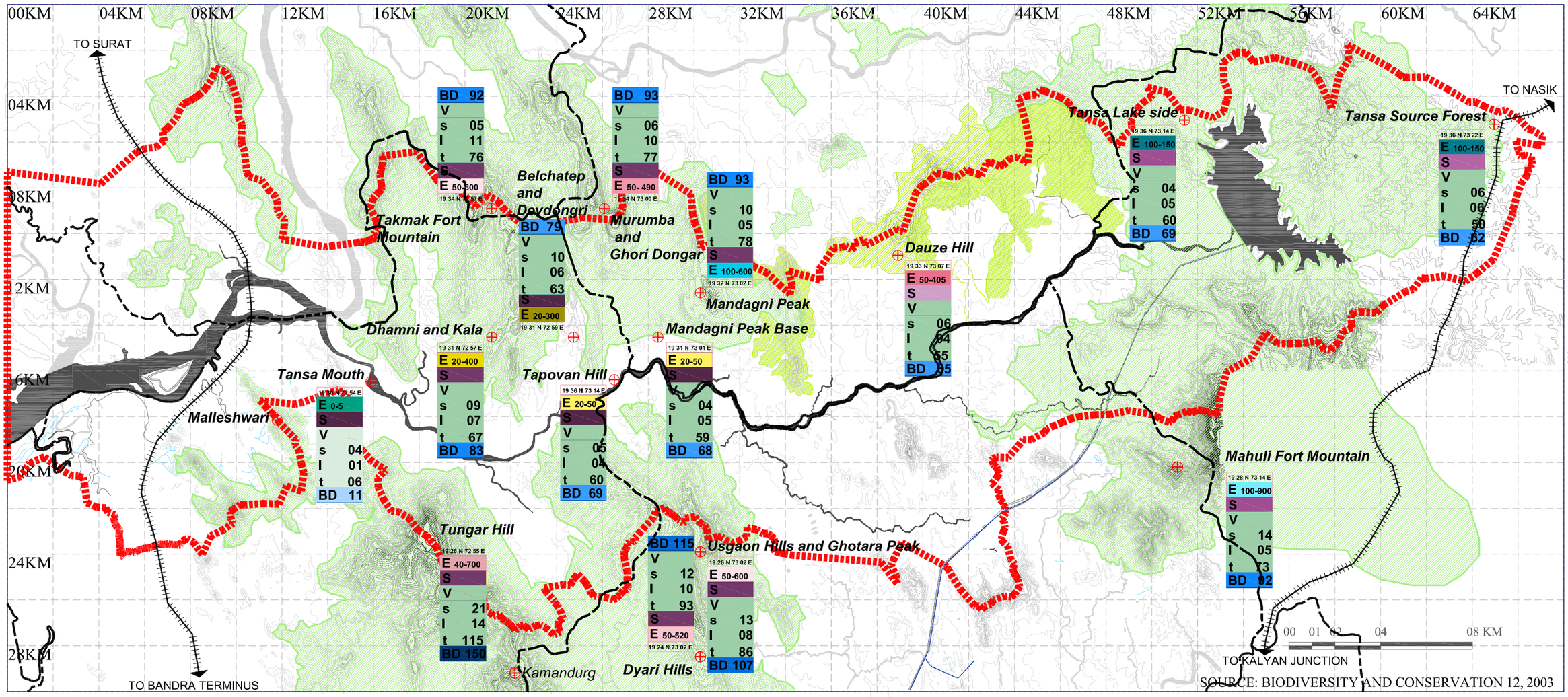

Agricultures and plantations


Tropical riparian fringing forests


Mangroves


In stream habitats


Denuded slopes and scrub lands



This drawing represents the emerging patterns of bio diversity sourced from the study titled *Human Disturbance and Forest Diversity in theTansa* Valley. Of the 15 forested sites in the *Tansa* Valley the least species were seen at a degraded mangrove site near the mouth of the river in Vasai Tehsil, and the greatest number of species were seen in the rich **semi ever-green forest** on *Tungar* Hill. For all sites there were 141 tree, 25 shrub and 15 liana species a total of 181 species. The high species of diversity on Tungar Hill is most likely a relict of the earlier character of forests throughout much of the valley. This area is ranked as the eight most important bio diversity spot in India and merits the highest priority for conservation.

LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- RIDGE DIVIDE
- TANSA RIVER
- FOREST COVER
- SCRUB
- BIODIVERSITY STUDY POINTS

BIODIVERSITY

- 1 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

ELEVATION AND VEGETATION

- 0 - 5
- 20 - 50
- 20 - 300
- 20 - 400
- 40 - 700
- 50 - 405
- 50 - 490
- 50 - 520
- 50 - 600
- 100 - 150
- 100 - 600
- 100 - 900
- V VEGETATION
- s SHRUBS
- l LIANAS
- t TREES

SOIL

- SLIGHTLY DEEP, POORLY DRAINED, FINE SOILS ON GENTLY SLOPING LAND WITH RESIDUAL HILLS, SLIGHT EROSION, STRONG SALINILTY
- SHALLOW WELL DRAINED LOAMY SOIL ON MODERATELY STEEP SLOPES WITH SEVERE EROSION
- MODERATELY DEEP, MODERATELY WELL DRAINED, CLAYEY SOILS ON GENTLY SLOPING ELONGATED RIDGES/ HILLS WITH MODERATE EROSION
- SHALLOW WELL DRAINED LOAMY SOIL ON MODERATELY STEEPLY SLOPING DISSECTED HILLS/ INTERVENING VALLEYS WITH SEVERE EROSION
- VERY SHALLOW, MODERATELY WELL DRAINED CLAYEY SOILS ON GENTLY SLOPING NARROW VALLEYS WITH MODERATE EROSION
- SHALLOW EXCESSIVELY DRAINED LOAMY SOIL ON MODERATELY STEEP SLOPING DISSECTED HILLS/ NARROW VALLEYS WITH SEVERE EROSION AND MODERATE STONINESS
- SHALLOW WELL DRAINED LOAMY SOIL ON MODERATELY SLOPING DISSECTED HILLS/ NARROW VALLEYS WITH MODERATE EROSION

ENVIRONMENTAL RESOURCE BASE: BIO DIVERSITY

00 01 02 04 08 KM

2.12

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL-KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in

2.2.8 ECOLOGY – Fauna[10]

The account of wild life found within the Tansa River basin as at present is given below :

Among big game, Tiger (Vagh, *Panthera tigris*) is found to inhabit the dense semi-ever-green forests in Banganga, Jawhar and Mokhada. These areas are quite in the interior, and usually human intervention is very little. Panther (Biblya Vagh, *Panthera pardus*) is found to inhabit the dense as also scrubby forests in the plains and hills of Jawhar, Mokhada, Wade, Bassein and Murbad talukas. They usually resort to cattle, goat and dog lifting, and move about villages occasionally.

The other carnivora found in the forest are hyaena (taras), wild cat, wild dog and wolf. These animals are found in Murbad, Bassein, Jawhar, Mokhada and Wada talukas. The hyaena lives chiefly on dead cattle, and occasionally kills dogs, goats or young cattle.

The herbivore is also dwindling in number during the past few decades. They are more or less confined to interior forests where population is very scanty. Among the herbivora, sambhar (*Cerus unicolor*) is found in Jawhar, Mokhada and Banganga forests (Mandavi Range) as also in dense forest in Murbad, Tokawada and Dahisar areas. The chital or spotted deer (*Axis axis*) is occasionally seen in and around the forest of Banganga, Jawhar, Udhava, Murbad etc. The barking deer (bhekar) and the mouse deer are found occasionally in dense forest areas of Jawhar, Wada, Dahanu and Murbad.

Monkey or commonly called vanar or makad is also found in some areas. The other small game consists of hares (Sasa, Khargosh, *Lepus nigricollis ruficartetatus*), flying squirrels (petrotnys fimbriatus), mongoose and wild pigs. These animals are found both in open as well as in forest areas all over the district. The peafowl (Mor, *Pavo cristatus*) is found quite occasionally. Grey jungle fowl (Junglee murgee, *Gallus sonnerali*) is found rarely in dense shrub forests. But grey and painted partridges (Titar, *Francolinus*) are common near cultivated areas and are occasionally seen even on the road¬side after the harvest is over. The quails (Lavari, Baler, *Coturnix coturnix*) are quite common, and are found along with the painted and grey partridges.

Among the birds, a large variety occurs in this district, especially near tanks Cord rivers. They inhabit all type of forests. Among them the commonly seen are the red vented bulbul (*Moipastes cafer cafer*), red whiskered bulbul (old compsa *Joacosus fuscicandata*), spotted babbler (*Pellorneum ruficeps ruficeps*),yellow eyed babbler (Chrysomma, *sinensis sinensis*),the Indian tree pie (*Dendrocitta vagabunda vagabunda*), the Indian Shama (Kittacincla malabarica malabarica) , the red-breasted Flycatcher (siphia parva subsp), black Drongo (*dicrurus macrocercus*), the Racket tailed (Discemurus paradisous malabaricus), the tailor bird (orthotomus, sutorius guzerata), the Indian oriole (oriolus oriolus, kundoo),the common myna (*Acridotheres Tristis tristis*)

Many other winter visitors (migratory birds) which come in the district in December and January in the coastal areas, are: the brown-headed king fishers, white-breasted king fishers (Halcyon, *Smyrnensis smyrnensis*) and filed king fisher. These are very common along the coast and are frequently seen catching fish as also lifting the left-over fish of fishermen. Also found are vultures (near Mumbra town) (*Gyps fulvus*) along with eagles.

Several genera of both Lamellibranchs (e.g. *Ostrea, cardium,Venus, cardita, Pectan,* etc.) and gastropods (e.g. *Turitella, trochus, Cerethium, cyperea Patella*, etc.) are found on beach rocks which are all marine forms found in the littoral zone. The presence of ammonia, beccari, *Quingneloculina semmmulum* and *Milliiamina fusca* indicate a shallow and tribulent zone.

The common poisonous snakes found in the area are: Cobra (*Naja naja*), Russels Viper (*Vipera russeli*), common Krait (Bungarus caeruleus), Raat Sea Snake (*Hydrophis caerulescons*), and Haranag. Coral snake (*Callophis nigrescens*, Saw Scaled Viper (*Echis carinatus*), Pil Viper (*Trimeresurus gramineus*).

The common non-poisonous snakes found in the area are Blind snake (*Typhlops hraminius*), Sand Boa (*Eryx conicus*) Indian Python (*Python molurus*), Trinket snake (*Elaphe Helena*), Rat snake (*Ptyas mucosus*), Racers (*Coluber fasciolatus*),Wolf snake (*Oligodon venustus*), Flying snake or Godlen Tree Snake (*Chryso-pelea ornate*), Common wolf snake (*Lycondon qulicus*), Keel back (*Natrix piscator*), Buff striped keelback (*Natrix stolata*), Cat-snake (*Biaga trigonate*), Common green whip snake (*Dryphis nasutus*) Dog-faced water snake (*Cereherus rhynchops*).

Areas of Significance

- The forests, coastal wetlands, rivers, littoral zones as well as man made habitats such as cultivated lands harbour diverse species as listed above.
- The occurrence of Tiger is very rare and within the interiors of the forests and without adequate protection, the species may completely vanish if measures are not taken for preservation.

[10] The sources for the accounts of fauna found within the region were *Heritage of Tansa Valley*, A.K. Sharma, Bharatiya Kala Prakashan, 2004. and the District Gazetteer , Thane District.

2.3 Socio-Economic and cultural resources

2.3.1 Historical Background

The history of the Tansa River Valley[11] can be divided into early Hindu period partly mythic and partly historic, extending to about AD 1300; the Muslim period lasting from 1300 to 1660; the Maratha period from from 1660 to 1800; and the British period from 1800 to 1947. The detailed histories of all these periods are well documented in the Thana District Gazeteer and may not all be pertinent to the study. The chief interest in the history of Thane Coast is that, with comparatively few and short breaks, some of its ports. Sopara, Kalyan, Thane or Sanjan, have from pre-historic times, acted as important ports in the foreign commerce of Western India. The Sopara port had water communication channels through the Vaitarna and the Tansa River and also two mainland routes, one of them which ran along Vajreshwari and Ganeshpuri along the southern bank of the Tansa to the Tal Pass and Nashik. Thus all along the Tansa River Basin there are artifacts found from different periods in history which are of significant cultural importance.

2.3.2 Sites of Historic and Cultural Significance

Map number shows the sites explored in the Tansa River Basin and also indicates prehistoric sites, Shiva temples, probable stupas and mosques.

Apart from these there are 4 hill forts the Mahuli, Ghotara, Takmak and Kamandurg which were located in and around the river basin. These hills forts in history were held by various local chiefs. The most significant of them is the Mahuli fort held by the Raja of Jawhar and other Koli chiefs. Some of the other forts were built up by the Portuguese to safeguard the Sopara and Vasai region from attacks from the local cheiftains.

The temple of Vajreshwari is of comparatively recent origin and has a history dating back to the campaign of Chimaji Appa against the Portuguese in Bassein in 1738. The temple was built on the Gumtara Range and has overtime attained great significance. During Navratri there are thousand of visitors every day visiting this temple. The Maheshvar Mahadeo Temple at Akloli along the south banks of the Tansa River with its hot-springs was also constructed during the Peshwa period. Similarly, the Bhimeshwar Mahadev temple at Ganeshpuri has also been constructed during the time of the Peshwas. Ganeshpuri has also been the residence of Swami Nityanand Maharaj and Gurudev Siddhapeeth and presently the Siddhapeeth trust is located near the temple. On the Mahasivaratri day, every year, a fair is held at the temple attended by thousands of devotees. (Refer Map 2.13)

2.3.2.1 Cultural associations with the environment.

Apart from the sites of cultural significance along the Tansa river basin, this river basin has been rich in tropical forests which have a history of being exploited for at least 2500 years. The tribal communities of the Kolis, Warlis, Thakurs and Katkaris groups have lived in the valley throughout history. The relics of tribal shrines and relics testify to their historical relationship with the forests and river valley.

[11] The *Heritage of the Tansa Valley* by A.K. Sharma, Bharatiya Kala Prakashan, 2004 and the *Thane District Gazetteer* are the secondary sources for compiling the historical background.

Sites of historical significance: The following is a list of the sites reported by *The Heritage of Tansa,* by A.K. Sharma

1. Reconstructed Siva temple at Parol with sculptures dating back to 10th-11th century AD.

Archaeological findings of Early and Middle Stone Age, tools such as cleavers, scrapers, recovered from the bed of a nala were found at Parol.

2. Buddhist Stupa -The study reports possible Buddhist Stupa site at Tilher with a mound measuring 22x35x8 cm discovered within the heavily vegetated peaks of the Tungar, ancient remains of a brick temple with an image Vishnu-Narayan image, a sculptural relief depicting purna kumbha, a figure of a cow feeding her calf.

3. Middle Stone Age tools recovered from the bed of a nala. **Tungareshwar temple** with an image of Parvati dating from the 11th12th century AD, along with tribal shrines and sculptures.

4. Ancient tanks- Ancient tanks with perennial supply 300x100m, with images of Siva were found at Saivan which was a resting place and habitation for traders.

5.Gaja-Lakshmi – Gadhaiya Lakshmi sculpture depicting coitus with animal carved on 70 m high and .86 m wide basaltic slab is lying in a field near the right bank of a nala, east of village Medha.

6. A memorial pillar- A memorial pillar of basalt at Kalambhon measuring 3.10m by 0.51m by 0.43 m. it is located on the east bank of a filled up ancient tank, on a mound. On one side of the pillar four panels carved in high relief depict various scenes. Designs and motifs typical to the Silahara period (10th-11th century A.D) were found.

7.Buddhist Stupa- At Nimbavli, the mound is now reduced to almost ground level but the burnt brick forming a short of circular structure are still visible. The sizes of the bricks 22 by 35 by 7.5 cm indicate that they belong to first century A.D.

8. Bhimeswar Mahadeo Temple -Ganeshpuri is famous for its hot water springs, Bhimeswar Mahadeo temple (made of granite and basaltic rock). The architectural style of the temple indicates that it was constructed during the time of Peshwas. An annual fare is held at Bhimeshwar temple on Mahashivratri day. A Samadhi of Sadguru Swami Nityanand Maharaj lies inside the Peth near the temple.

9. Vajreshwari temple- A temple in the name of goddess Vajreshwari built during the Peshwa period is situated at vajreshwari. According to legends and archeological evidences, the original temple was located at Gunj, which was destroyed by Portuguese around 1700 A.D. A large annual fair is held during navratri in the temple.

10. Maheswar Mahadeo temple, dating back to peshwa period, and also hot water springs are seen in Akloli.

11.A ruined temple - A ruined temple of Silahara period is found at Pahare

12. Ghotgaon- Ruins of a Siva temple, Jain images from approximately 8th to 9th century AD on the banks of the Shantanu River

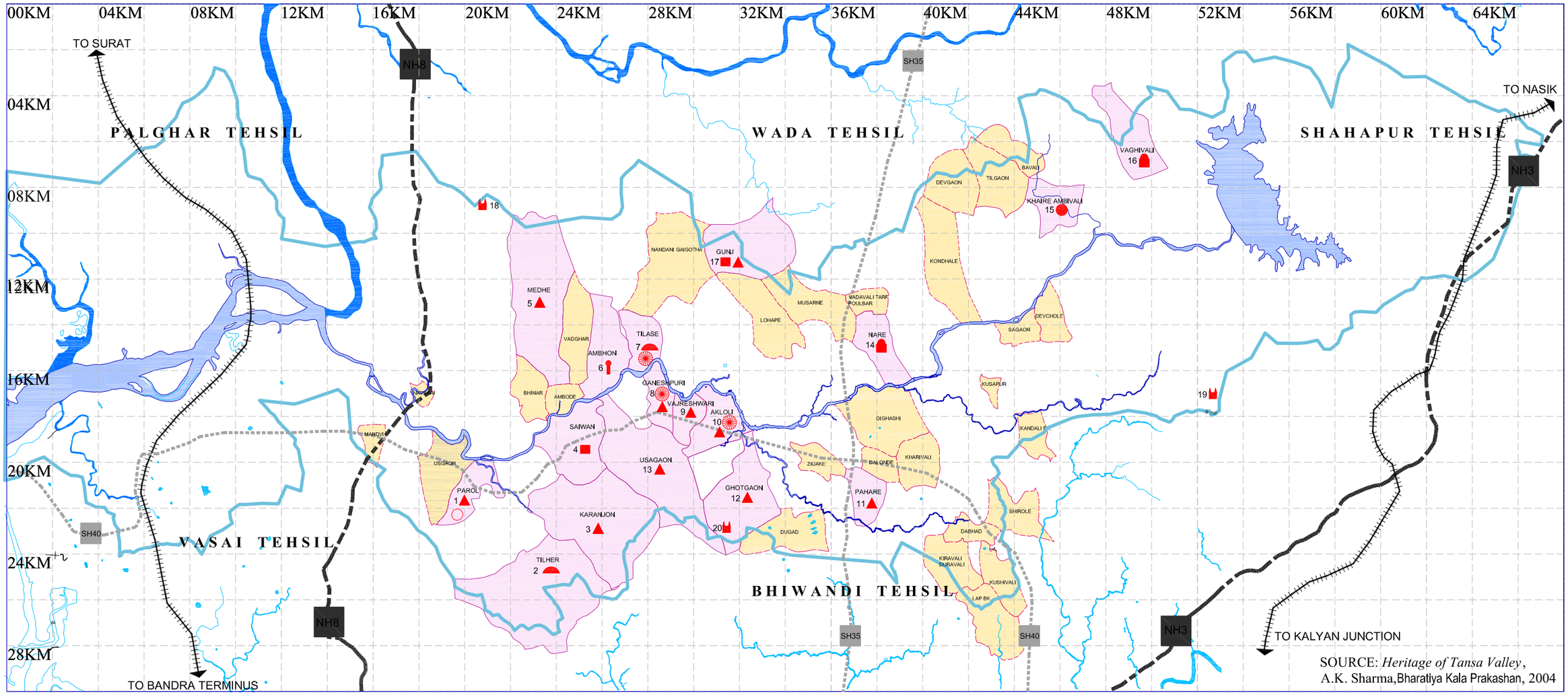
13. Cave remains- Cave remains at Ambivali dated between BC 100 and 600.

14. Bhargavram temple –A temple dedicated to Bhargavram (the sixth incarnation of lord Vishnu) is sitruated at Gunj. The temple is built out of plain recessed basaltic blocks and overlooks a tank. Every year a fair is held around may in honor of the deity, Siva temple, Gaondevi temple.

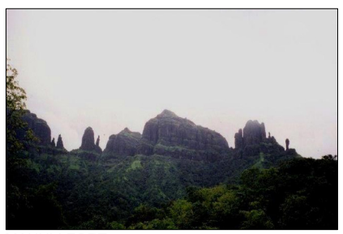
15. Takmak fort- Constructed in the 14–15th centuries and were active until the 18th century

16. Mahuli- The mahuli fort peak is the highest peak within the study area at an elevation of 954 metres with the remains of the old Maratha fort.

17. Ghotara fort-Old Maratha fort at an elevation of 584 metres.



SOURCE: *Heritage of Tansa Valley*, A.K. Sharma, Bharatiya Kala Prakashan, 2004


MAHULI FORT


CAVES


VAJRESHWARI TEMPLE


GANESHPURI HOT WATER SPRINGS


MAHADEO TEMPLE


MAHULI FORT ENTRANCE

The map above sites explored in the Tansa River Basin and also indicates prehistoric sites, Shiva temples, probable stupas and mosques, ancient tribal shrines and relics, 4 hill forts the Mahuli, Ghotara, Takmak and Kamandurg which were located in and around the river basin. Besides these there were also findings of prehistoric tools, and other evidences in the river beds of nalas at Tungareshwar, the river Shantanu and at Parol.

LEGEND:

- TANSA RIVER
- RAILWAY LINE
- NATIONAL HIGHWAY
- STATE HIGHWAY
- EXPLORED AREAS WITH HERITAGE SITES
- STUDY AREA
- EXPLORED SITES
- FORTS
- MOSQUE
- TEMPLE
- STUPA
- WATER TANKS
- KUNDS
- CAVES
- MEMORIAL PILLARS

ENVIRONMENTAL RESOURCE BASE: AREAS AND ZONES OF HISTORIC SIGNIFICANCE

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2.13

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069. website:www.krvia.ac.in

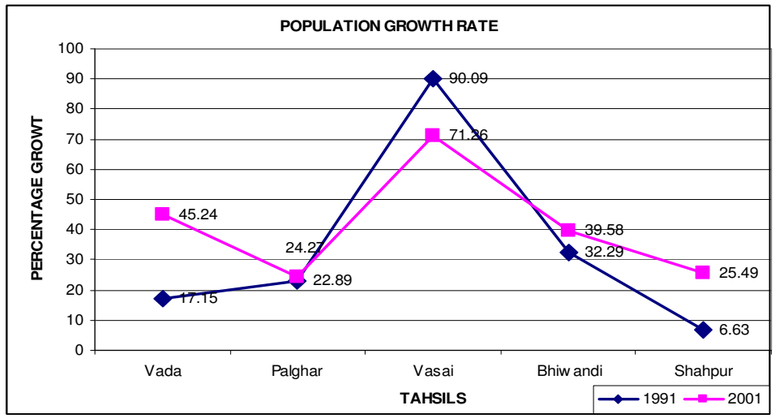


Chart 1: *Tahsilwise Population Growth Rate* Source: Census of India 2001

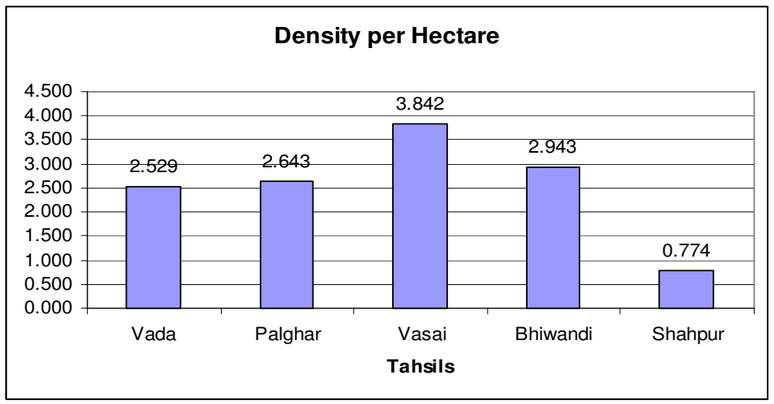


Chart 2: *Tahsil-wise Density of persons per Hectare* Source: Census of India 2001

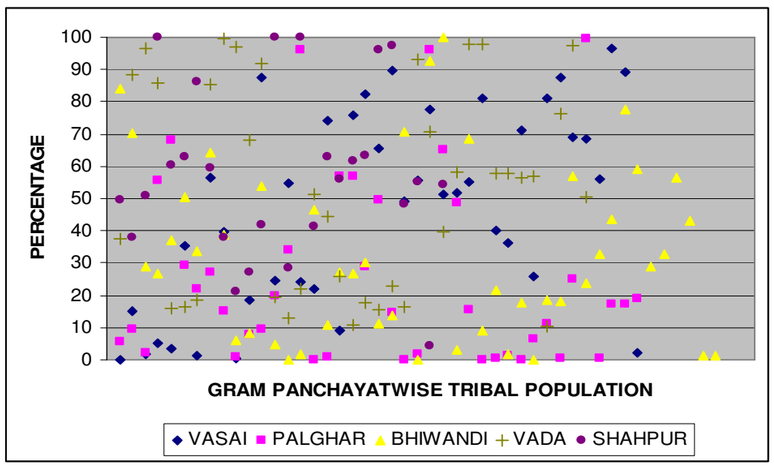


Chart 3: *Gram Panchayat-wise Tribal Population* Source: Census of India 2001

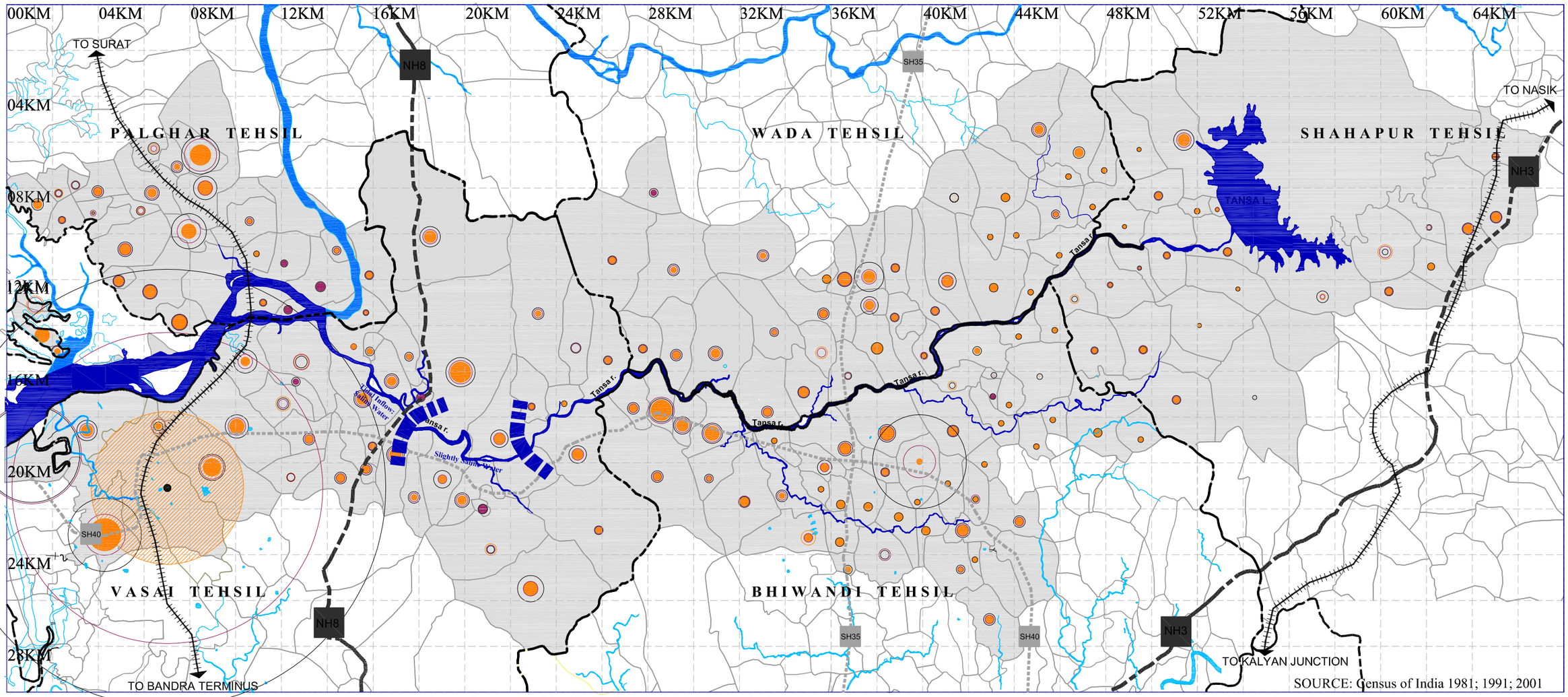
2.3.3 Demographic Profile

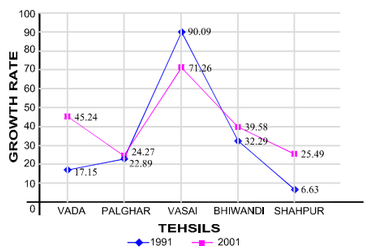
The demographic profile of Tansa Valley brings to the fore very interesting facts. Over the years people from different regions have migrated and settled in this area, for example, the Arab & Persian traders coming with invading forces (640-1350 A.D.), Sindhi refugees from Pakistan during partition in 1947, etc. During the British rule, people from various parts of the country came to the region in search of jobs as Bombay and nearby towns were fast developing into industrial and commercial centres and offered vast employment opportunities. Also, around 1965 A.D. the Koyna Dam outsees were settled in various areas of Tansa Valley by clearing forests. The migration was in the form of entire villages being rehabilitated within the study area.

The Region (or the Study Area) has boomed in Demographic terms in the last 2 decades. In 1991, the entire region saw a decadal population growth of 48% which shot up to 52% for 2001. (Refer Map 2.14) Individually the growth trend seen in the Tahsils under the delineated area, shows that Vasai region had booming growth of 90% in the 1981-91 decade compared to the other Talukas with an average growth rate of about 25%. Though this growth trend slowed down a little in the next decade and fell to 71%, Vasai is experiencing a high population growth. This may be attributed to the industrial growth in the region. The employment opportunities here have been high and hence migration is high too. Also, the close connectivity via rail to Mumbai and cheap accommodations attract migrant population to settle here.

2.3.3.1 Population growth

All Tahsils, Vasai, Palghar, Bhiwandi, Vada and Shahpur are experiencing a sharp increase in population in the last decade compared to the 1991, with an exception to Vasai Region, where the population growth is on a decline from 90% growth rate in 1991 to 71% in 2001. Bhiwandi has been stable around 32% and 39% growth in 1991 and 2001 respectively. Another Tahsil experiencing a fast growth is Vada, with a 45% growth in 2001 compared to a nominal growth of 17% in 1991.





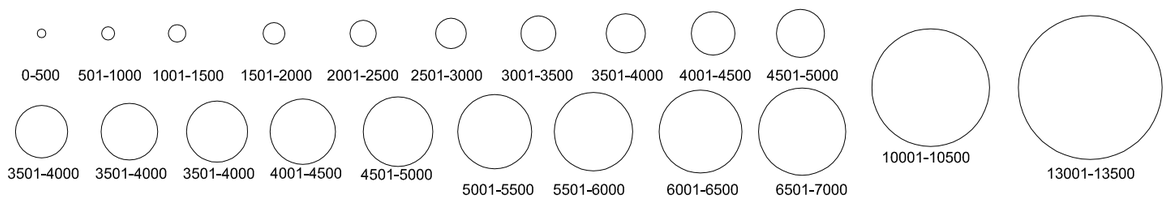
This map developed from Census of India 1981, CoI 1991and CoI 2001, represents Gram Panchayat-wise population growth in the last 3 decades. the populaion at Virar Municipal Council is reported to be 118928 in 2001 Census. Close to it is Arnala with a population of 13170, a decline from 14354 in 1991. Karivali (CT), Bhiwandi too shows a phenominal increase in the last 2 decades, i.e. from 505 in CoI 1981 to 4621 in CoI 1991, to 12932 in 2001. This in effect would meana growth arate of 81.5 per annum in 1981-91 to a more stabilsed 17.9 per annum in 1991-2001. this could mean a huge in-migration to the town in the 80's. Most other panchayats have a more stable growth rate.

The Population Density in the Tansa Region is not very high ranging from 0.774 persons per Ha in Shhapur to 3.842 persons per Ha in Vasai Tahsil. The Population has seen a steep growth during the present decade in most Tehsils except Vasai. The Vasai Region saw a steep rise of approximately 90% in population last decade. Though as per the 2001 Census the growth rate has shown a decline it is still on the higher side of 70%. Bhiwandi and Palghar Tahsil have amore stable growth rate compared to Vada and Shahpur Tahsil.

LEGEND:

NOTE:
Population of Virar M Cl 1981:23,303 1991: 54400 2001: 1158928

- TEHSIL BOUNDARY
- RAILWAY LINE
- NH4 NATIONAL HIGHWAY
- SH35 STATE HIGHWAY
- TANSA RIVER
- 1981 POPULATION
- 1991 POPULATION
- 2001 POPULATION
- STUDY AREA
- NEW VILLAGE; COI 1991
- 1991 POP ≈ 1981 POP
- NEGLIGIBLE GROWTH



DEMOGRAPHIC PATTERNS : DECADAL POPULATION GROWTH

00 01 02 04 08 KM

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069. website:www.krvia.ac.in

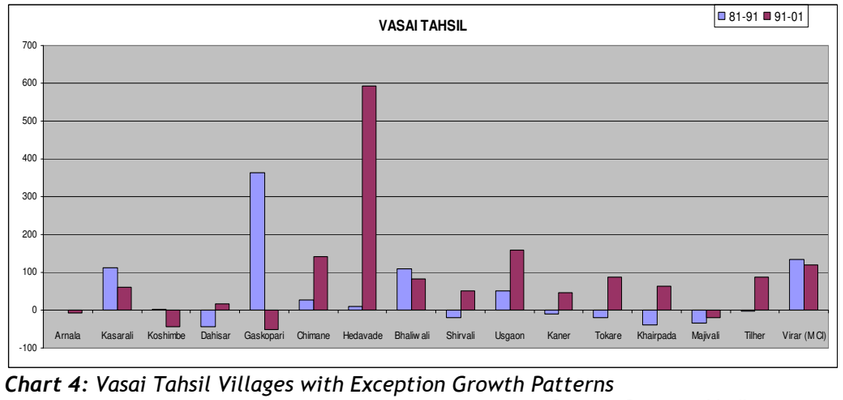


Chart 4: *Vasai Tahsil Villages with Exception Growth Patterns*

Source: Census of India 2001

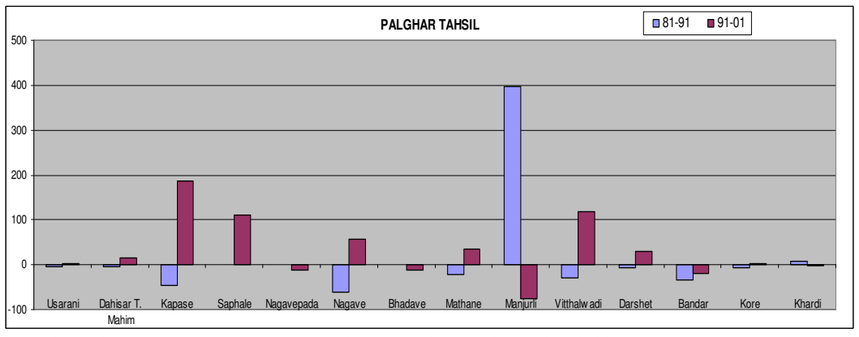


Chart 5: *Palghra Tahsil Villages with Exceptional Growth Patterns*

Source: Census of India 2001

2.3.3.2 Population density

The Density per hectare (Refer map no 2.14) for the five Tahsils indicates Vasai to be most dense with 3.8 persons per HA compared to other Tahsils. This is followed by Bhiwandi, Palghar and Vada. Shahpur is least dense with its dense forest areas at only 0.77 persons per HA of land.

Vasai Tahsil (excluding Gram Panchayats outside Tansa Watershed Region)

The Vasai Municipal Council experienced a population boom of 133% in 1991. but it was not the only contributor to the region. Gaskopari on the fringes of Vasai, recorded 364% growth rate, Kasarali 111% and Bhaliwali 110%. Other surrounding Gram Panchayats, like Dahisar had shown a decline of close to 43%. Khairpada amd Majivali too recorded a decline of 39.4% and 33.2% respectively. (Refer Map 2.14)

During the 1991 and 2001, Vasai region experienced a fast industrial growth in all sectors, agriculture and manufacturing units. During this decade, the Gram Panchayats which had recorded a decline in population, started showing a growth of 88% (Tikare). But some interesting patterns are also noticed here. Gaskopari records a population decline of 51% compared to its 364% growth in the last decade. This pattern maybe a pointer to a Nomadic movement in the area. Hedavade had a population surge of over 593% decadal growth. Vasai Municipal Council stabilizes at 118%.

The fishing villages in Vasai have a high tribal population with many villages like Dahisar, Bhatane, Bhaliwali, Medhe, Vadghar, Kalambhon, Adne, Usgaon, Shirvali, Saiwan, Khairpada, Karanjon, Tilher, etc. having over 50% tribal population. Karanjon and Tilher have the highest tribal population of 96% and 89% respectively. (Refer Map 2.15)

Palghar Tahsil (excluding Gram Panchayats outside Tansa Watershed Region)

The demographic profile of Palghar Tahsil is more or less stable at 22.89% in 1991 to 24.27% in 2001. But some similar patterns like in Vasai Tahsil are seen here as well though at a smaller scale. Villages like Kapase and Vitthalwadi recording a decadal decline of 47% and 30% in 1991 experienced a growth of 186% and 118% in the next decade. (Refer Map 2.14)

On the other hand, Majivali which recorded a 397% growth in 1991, recorded a decline of 75.87% in 2001. Gram Panchayats like Kapase, Saphale, etc showed a growth of over 100% in 2001, in comparison to a steady declining population at Bandar in both 1991 and 2001 (-33% and -18% respectively).

Umperpada T. Manor, Darshet and Shilte are tribal villages with 99.6%, 96.2% and 96.16% tribal population respectively. Most villages in this region have an average 15% tribal population. (Refer Map 2.15)

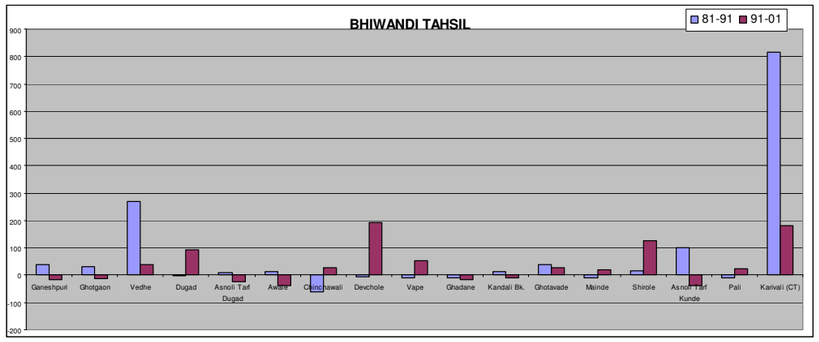


Chart 6: *Bhiwandi Tahsil Villages with Exceptional Growth Pattern*

Source: Census of India 2001

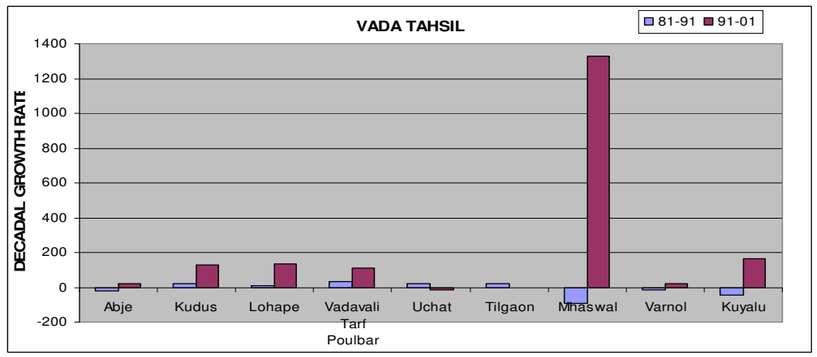


Chart 7: *Vada Tahsil Villages with Exceptional Growth Patterns*

Source: Census of India 2001

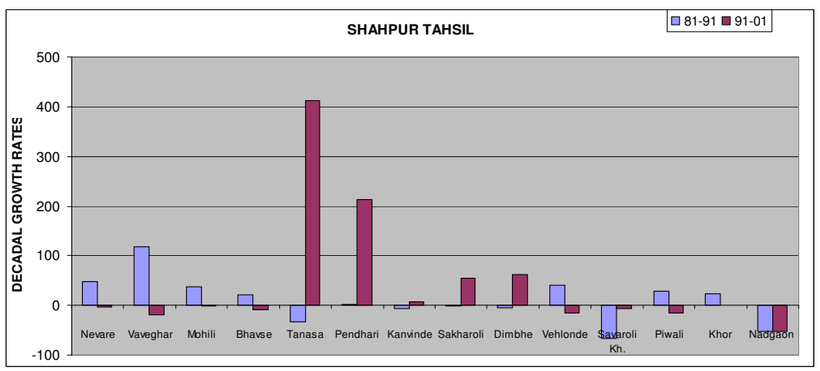


Chart 8: *Shahpur Tahsil Villages with Exceptional Growth Patterns*

Source: Census of India 2001

Bhiwandi Tahsil (excluding Gram Panchayats outside Tansa Watershed Region)

The demographic profile of Bhiwandi illustrates decadal growth of 32% and 39% respectively. This more realistic figure hides even more intriguing facts within it. Though most Gram Panchayats within this region have seen a steady growth, some GPs saw a marginal population decline in the 1991, Chinchawali being the highest at 58% decline. Others like Devchole, Vape, Ghadane, Mainde, etc were around 10% decline. Devchole and Vedhe recorded a growth of 192% and 270% respectively in the next decade. The Census Town, Karivali which had recorded 815% decadal growth in 1991, recorded 179% in 2001. (Refer Map 2.14)

Ganeshpuri, with its hot springs is a tourism spot and should be attracting more migrant settlers. But in contrast in the 2001 it has recorded a decadal decline of 17% compared to a growth of 39% in the previous decade. A steady growth is seen in the other two Gram Panchayats of Vajreshwari (21% in 1991 and 42% in 2001) and Akloli (15% in 1991 and 30% in 2001)

The tribal population share in Bhiwandi is 21.8% to 76.3% of General and 1.89% of SC population. Usgaon, Bhiwali, Ghotgaon, Vape, Shirole, Karmale, Mainde, Kelhe, Kiravali Duravali and Pali have a Tribal Population of over 50% with Usgaon being highest at 84%. Akloli, Ganeshpuri & Vajreshwari have 37.18%, 29.05% and 26.51% of Tribal population. (Refer Map 2.15)

Vada Tahsil (excluding Gram Panchayats outside Tansa Watershed Region)

Vada is an Industrial zone of the region with many manufacturing units based here. Major cement, paints, chemical factories are based here. The major Industrial growth happened in the last decade and thus resulted in the population graph touching 45% in 2001 compared to 17% in 1991. (Refer Map 2.14) Mhaswal Gram Panchayat is a case in focus here. Based at the banks of the Tansa, this village is the most lucrative location for industrial growth. This Village saw a 90% population decline in 1991 Census. But in the next decade the growth rates shot upto 1328.33% which means a 132.8% growth per annum. This a direct marker for high in-migration in this village town. The Surrounding villages of Devgaon and Tilgaon are also undergoing similar growth pattern. Other Gram Panchayats have also recorded a 3-figure growth in 2001 like Kuyalu (162%), Lohape (133%), Kudus (130%), etc.

Vada is also the region where National Reserve Tungareswar Forests are located. The highly dense areas of the forests are the natural habitat for various tribes residing in the region. The villages like Nandani Gaigotha, Gorad, Kelthan, Lohape and Zadkhaire are Tribal Villages over 95% of their population being Tribal. Except Kelthan and Lohape the other 3 villages have no SC population. The total ST, SC and General break-up stands at 45.78%, 3.02 and 51.2% respectively. (Refer Map 2.15)

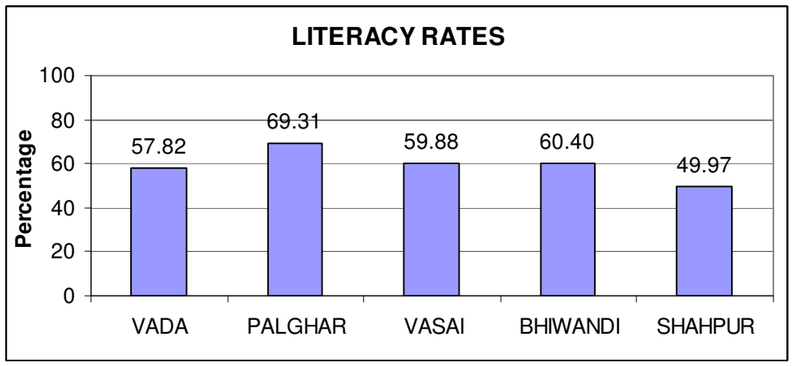


Chart 9: *Literacy Rates in Tahsils* Source: Census of India 2001

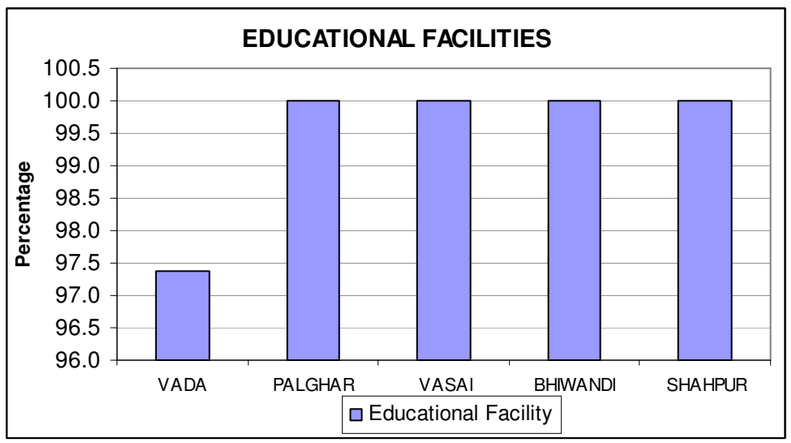


Chart 10: *Present Educational Infrastructure* Source: Census of India 2001

	VADA	PALGHAR	VASAI	BHIWANDI	SHAHPUR
Number of Villages	38	40	41	42	25
No. of Primary Schools	50	50	55	47	24
No. of Middle Schools	14	10	12	14	5
No. of Secondary Schools	6	5	6	7	3
No. of Senior Secondary Schools	1	0	0	2	0
No. of Colleges	0	0	0	1	0
No. of Industrial Schools	0	0	0	0	0
No. of Training Schools	0	1	0	1	0
Adult Literacy Schools	0	23	0	7	18
Other Schools if any	41	40	45	42	25

Chart 11*: Educational Institutions in the Tahsils* Source: Census of India 2001

Shahpur Tahsil (excluding Gram Panchayats outside Tansa Watershed Region)

Shahpur Tahsil is where the source of ***Tansa*** River, Tansa Lake is situated. The highly forested areas of Shahpur are populated by a huge Tribal population of 54.1% compared to 1.37% of Schedule Caste and 44.5% of General population. Dimbhe, Vaveghar and Khoste are 100% tribal areas. Nadgaon is the only village with 4.23% tribals compared to the rest of the region. This village is followed by Kanvinde and Lahe with 27% and 21.6% tribals. (Refer Map 2.15)

The population growth rates indicate that Vaveghar experienced a 118% decadal growth in 1981-91. Whereas even more interesting fact is that Nadgaon and Savaroli Kh. recorded a decline of 53% and 67% in the same decade. Nadgaon has recorded another decline of 52% in 1991-2001 censuses as well. Coupled with the tribal data this could be an indicator of out-migration of the tribal population in the village. (Refer Map 2.14)

In contrast to this Tanasa and Pendhari villages at the edge of the Lake have recorded a population boom off 411% and 212.5% in 2001. Tanasa has 86% tribal population and Pendhari 60%. Also noticeable is that Tanasa had shown a population decline of 33.5% in the earlier decade. This population increase could also be due to the Tansa Dam being located near these villages.

2.3.3.3 Literacy

The education based in frastructure within the entire region is adequate in Primary education and middle level schools. Literacy Rates are found to be high for the region, highest being in Palghar and Bhiwandi with 69% and 60% respectively. This maybe corroborated with the presence of high number Adult Literacy Institutions in both the Tahsils. The number of Primary schools is very 100% for all except for Vada Tahsil. But the villages without a primary school have a school within the range of 5-10 km.

Though the number of senior and senior secondary schools is low, there are no colleges in the entire area except one at Vajreshwari, Bhiwandi. Training schools are located in Ganeshpuri, Bhiwandi Tahsil and Umbarwada T. Manor, Palghar. There are no Industrial Training based schools on the entire region. Also, as per census 2001, the adult literacy programme has been taken up in the region on a mass scale with 23 schools in Palghar, 7 in Bhiwandi and 18 in Shahpur.

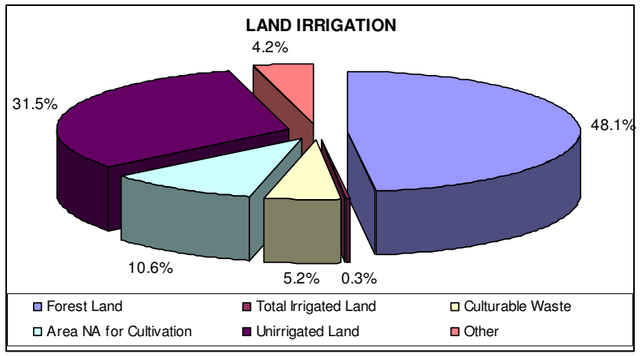


Chart 12: Percentage of Irrigated Land to Un-irrigated Land
Source: Census of India 2001

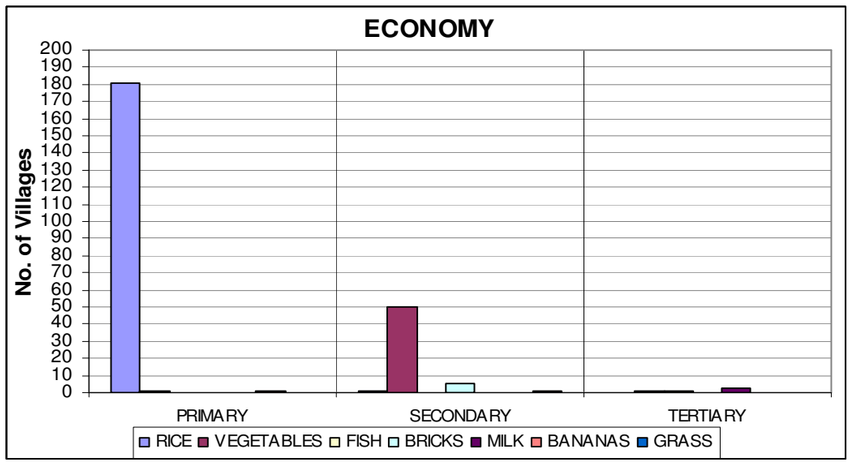


Chart 13: *Economic Profile of the Villages* Source: Census of India 2001

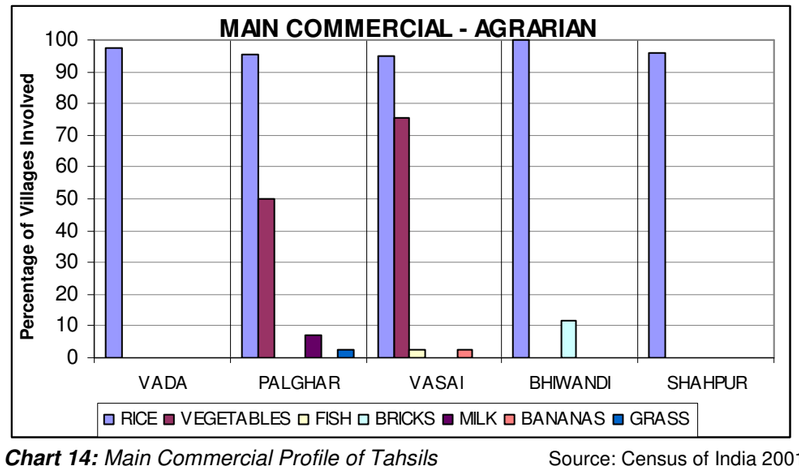


Chart 14: *Main Commercial Profile of Tahsils* Source: Census of India 2001

2.3.4 Economic Profile

The economy in the region may be divided into three catgories – Agrarian, industrial and tourism. The 2001 Census, states that 33% of the population is involved in the Agriculture Sector. The rest others are involved in Household industries or other sectors. Though the economy is agriculture based very small percentage of land falls in the category of irrigated land. Of the total area under the Tansa River Basin Watershed, 48% of the land is forest land. 10.6% of the land is not available for cultivation and another 5.2% of the land is categorized as cultivable waste i.e. gauchars and groves. Large chunks of land, i.e. 31.5% are is un-irrigated and the remaining land is either under settlement or is private farmlands.

Table1: Land utilization pattern in Thane District

S. No	Land use category	Area in '00 ha.	% to total geographical area
1.	Total geographical area	9558	100.00
2.	Area under forests	3303	36.91
3.	Land put to non-agricultural uses	581	6.18
4.	Barren land & land not suitable for cultivation	545	5.80
5.	Permanent grazing and other pastures	401	4.27
6.	Land under miscellaneous trees, crops & grooves	229	2.43
7.	Cultural waste	145	1.54
8.	Current fallow	145	1.54
9.	Other fallow	156	1.66
10	Saline soils	208	2.17
11	Net area sown	3714	39.95
12.	Area sown more than once	68	1.78
13	Gross cropped area	3819	101.78

Figures are percentage to net area sown
Source: Socio-economic Review and District Statistical Abstract of Thane district (2005)

- **Irrigation:** The details about Tahsil-wise irrigation facilities are given in Table 3

Table 3: Tahsil-wise Irrigation Facilities (Area in ha)

		Irrigated area				
		Surface	Well			
1.	Vasai	470	2444	2914	17931	16.25
2.	Palghar	2096	1906	4002	41552	9.63
3.	Wada	1198	69	1267	33462	3.79
4.	Bhiwandi	85	464	549	27152	0.98
5.	Shahapur	1625	13	1635	68886	2.37

Source: Socio-economic Review and District Statistical Abstract of Thane district (2003-2004).

The gross cropped area of Thane district is 3, 81, 809 ha in which the proportion of area irrigated by wells and other sources are 2.88 and 2.57 per cent, respectively. The maximum proportion of gross irrigated area is under fruit crops and vegetable crops, which is 59.67 per cent.

- **Fisheries**

Thane is one of the marine districts of the state. The marine fishing is practiced all over the coastline of 112 km. in the district. Total fish production in 2000-2001 was 76,132 metric tones. The fishing trade flourished in the district, as there is always demand for fish at Mumbai market. Fishing trade is increasing gradually and still has a vast potential.

- **Cropping pattern:** The cropping pattern followed in Thane district is presented in Table 2

Table2: Cropping pattern of Thane district

S.No	Crops	Area ('00 ha.)	% to gross cropped area
1.	**Cereals**		
	a) Paddy *Oriza sativa*	154000	36.37
	b) Other cereals	35700	8.43
	Total cereals	189700	44.80
2.	**Pulses**		
	a) Red gram *Cajanus cajan*	3400	0.80
	b) Bengal Gram *Cicer arentinum*	3900	0.92
	c) Field bean *Dolichos lablab*	2600	0.61
	d) Urd *Phaseolus mungo*	5100	1.20
	e) Other pulses	1660	0.39
	Total pulses	16660	3.93
3.	Total food grains	206360	48.74
4.	Condiments and Spices	700	0.16
5.	Fruits and Vegetables	33616	7.93
6.	Total food crops	240676	56.84
7.	Total fibre crops	200	0.04
8.	Total oil seeds	4900	1.15
9.	Total medicinal and drug plant	300	0.07
10.	Grasses	177300	41.87
11.	Other non-food crops	300	0.07
12.	Total non-food crops	180049	42.52
13.	Total net cropped area	375000	88.57
14.	Area sown more than once	6726	1.58
15.	Gross cropped area	423376	100.00

Source: *Socio-economic Review and District Statistical Abstract of Thane district (2003-2004)*

From Table 2, it can be seen that the percentage of area under cereals to gross cropped area was 47.84 per cent, while the area under pulses was only 2.46 per cent. Thus, the total area under food grains (cereals and pulses) was 50.30 per cent. The total food crops occupy an area of 52.81 per cent, while the remaining 47.15 per cent area was under non-food crops. Among cereals, paddy occupied largest area (39.49%) of the gross cropped area. Thus, it can be concluded that the cereals dominate cropping pattern of the district.

2.3.4.1 Present Cropping Pattern of Thane District

In Thane district rice is main crop and it is cultivated on 154000 ha, throughout the district. In minor millets Vari (Fox tail millet) & Ragi(Eleusine caracana) (Finger millet) is being cultivated in hilly slopes of Jawhar, Mokhada, and Shahapur & Murbad and an area of 17900 ha, 16900 ha respectively. In pulses bengal gram (Cicer arentinum), red gram (Cajanus cajan), black gram (Phaseolus mungo) & field bean (Dolichos lablab) are the mainly grown during Kharif & Rabi season.

Fruits crops are mainly grown in coastal tahsils of Thane district viz. Dahanu, Palghar & Vasai. After implementation of Employment Guaranty Scheme (EGS) by Maharashtra Govt. area under fruit crops is increased. Since 1991 to 2005 total 61152 ha of land is brought under horticultural crops .So far mango (Mangifera indica) is planted (403107 ha.), cashew Anacardium occidentale (9142 ha)., coconut (Cocos nucifera)(2038 ha.) and Sapota (9244 ha). Before EGS scheme in Dahanu, Palghar & Talasari tahasil Sapota was widely grown on area of about 2700 ha.

In hilly tribal area cultivators migrate for wages to the cities as there is no work in the villages after harvest of kharif crops.

TALUKA: VADA

Farming Situation: AES-4 Medium Black Soil Rainfed

Irrigation water source: Ground water & partially Canal irrigation

Crop	Jun	July	August	Sept	Oct.	Nov.	Dec.	Jan	Feb	March	April	May
Rice (Rainfed)												
Rice (Irrigated)												
Grass Land												
Finger millet												
Bengal Gram												
Rabi Vegetables												
Mango												
Cashew												

Source: *Techno-Economic Feasibility Study Report on Integrated Programme for Development of Horticulture in Tribal /Hilly Areas of Thane District of Maharashtra State*

TALUKA: PALGHAR

Farming Situation: AES1 Black Soil/ Red trap partially Canal irrigated

Irrigation water source: Graund water & Canal irrigation

Crop	Jun	July	August	Sept	Oct.	Nov.	Dec	Jan	Feb	March	April	May
Rice (Rainfed)												
Rice (Irrigated)												
Grass Land												
Bengal Gram												

Finger millet								
Rabi Vegetables								
Mango								
Sapota								
Coconut								

Source*: Techno-Economic Feasibility Study Report On Integrated Programme for Development of Horticulture in Tribal /Hilly Areas of Thane District of Maharashtra State*

TALUKA: VASAI

Farming Situation: AES1 Medium Black Soil partially irrigated

Irrigation water source: Ground water & Canal irrigation

Crop	June	July	August	Sept.	Oct	Nov.	Dec.	Jan	Feb	March	April	May
Rice (Rain fed)												
Rice (Irrigated)												
Grass Land												
Bengal Gram												
Rabi Vegetables												
Mango												

Source*: Techno-Economic Feasibility Study Report on Integrated Programme for Development of Horticulture in Tribal /Hilly Areas of Thane District of Maharashtra State*

TALUKA: BHIWANDI

Farming Situation: AES-4 Medium Black Soil rainfed:

Irrigation water source: Ground water

Crop	June	July	August	Sept	Oct.	Nov	Dec.	Jan	Feb	March	April	May
Rice (Rain fed)												
Rice (Irrigated)												
Finger Millet												
Rabi Vegetables												
Mango												
Sapota												
Cashew												

Source*: Techno-Economic Feasibility Study Report on Integrated Programme for Development of Horticulture in Tribal /Hilly Areas of Thane District of Maharashtra State*

TALUKA: SHAHAPUR

Farming Situation: AES1 Medium Black Soil/ Red trap partial irrigated

Irrigation water source: Ground water & Canal irrigation

Crop	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April	May
Rice (Rain fed)												
Rice (Irrigated)												
Fox Tail Millet												
Grass Land												
Finger Millet												
Bengal Gram												
URD												
Field bean												
Mango												
Cashew												
Sapota												

Source*: Techno-Economic Feasibility Study Report On Integrated Programme for Development of Horticulture in Tribal /Hilly Areas of Thane District of Maharashtra State*

2.3.4.2 Institutions Involved

- **Co-operative societies**

A co-operative sector covers various aspects of agricultural needs such as extension of agricultural credit and provision of agricultural inputs through co-operative societies. At the end of 31 March 2001, there were in all 16,288 co-operative societies. Out of these, 116 (0.79%) were milk co-operatives, credit co-operatives were 1537 (9.44%) in the district. Of the credit co-operatives, 404 (26.28%) were agriculture credit co-operatives.

- **Regulated markets**

In Thane district, there are 6 Agricultural Produce Marketing Committees (APMC's) alongwith 15 subyards as given in Table 6. Rice is the major commodity.

Table 4: Regulated markets in Thane District

S.No	Name of APMC	Tahsil	Sub yards
1.	Shahapur	Shahapur	1
2.	Bhiwandi	Bhiwandi	3
3.	Palghar	Palghar	5
5.	Vasai	Vasai	3

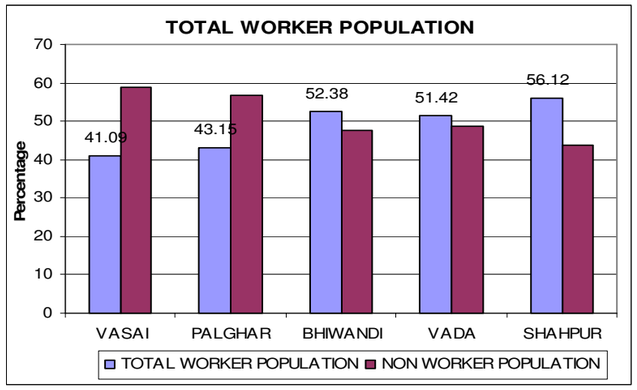


Chart 15: *Percentage of Worker & Non-workers*

Source: Census of India 2001

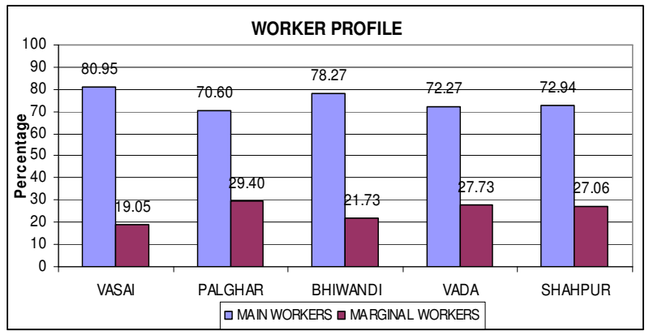


Chart 16: *Percentage of Main & Marginal Workers*

Source: Census of India 2001

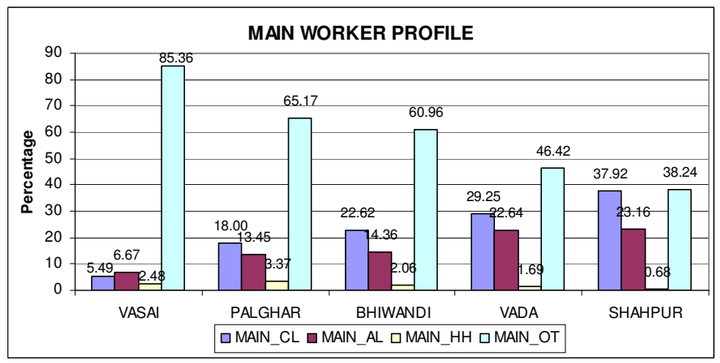


Chart 17: *Profile of Main Workers in Tahsils* Source: Census of India 2001

2.3.4.3 Occupational Patterns

The Agrarian Sector is majorly categorized as Agriculture and Fisheries. The Coastal Areas of the region has a large worker population relying on fishing for their living. In the Agriculture sector Rice is major farm produce apart from many vegetables, bananas and Horticulture farming. The Census lists almost 97% villages to be involved in Rice Farming followed by vegetable farming at 75%. Apart from this the inner coastal areas of Vasai and Palghar rely on activities like sand dredging and brick kilns as another source of income. Some areas of Bhiwandi and Vada also have Brick Kilns as their second main commercial activity. This in terms of census implies second manufactured product next to first which in most cases is rice production. Vada is majorly an Industrial Hub in the region with many chemical and paint industries based here.

Owing to high ground water table and rainfall, the economy in Shahpur tahsil is totally Rice farming based. In Vasai, and Palghar region vegetable produce is secondary to rice farming. Arnala Killa in Vasai is dependent on Fishing Industry for it economic sustenance. Palghar has Milk produce as another economic activity followed by rice and vegetable production consecutively. The census data shows the emergence of brick kilns in Bhiwandi Tehsil and it is listed as secondary main commercial activity for villages Vedhe, Khativali, Manivali, Dugad and Waret.

The Total Worker Population profile of the Region shows that the percentage of workers to non-workers is higher in the Shahpur, Vada and Bhiwandi. The 47% of the Population is Worker Population. (Refer Map 2.16). In most regions, the percentage of the Workers categorized as Main Worker Population is also very high at over 70%. (Refer Map 2.17). The Main Workers are defined as workers working for over 6 months in a year and those working for less than 6 months are categorized as Marginal Workers. The ratio of Main Worker to Marginal Worker is 4.5. (Refer Map 2.18).

The Main worker population may be categorized in the four sectors as Agriculture, Cultivators, Household Industries and Others. Approximately, 16% of the worker population is Cultivators, i.e. Land owners or cultivators of Government held land and 17% are Agriculture Labourers. Household Industry is almost Non-existant at 3%. A major chunk of population is involved in the Other Industrial Sector. (Refer Map 2.19)

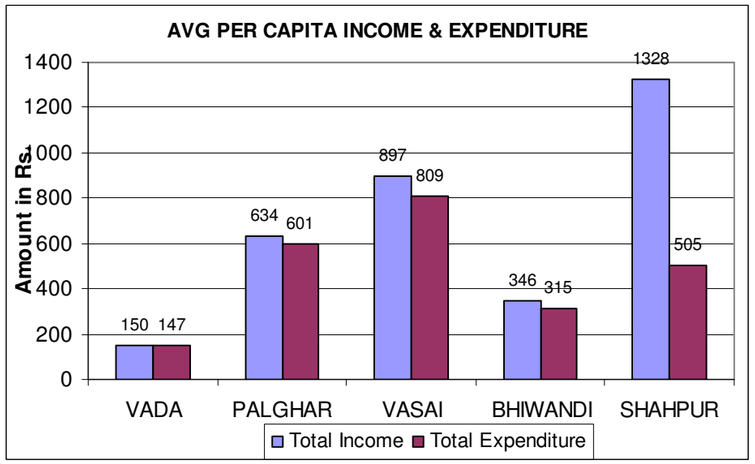


Chart 18: *Average Income-Expenditure Patterns in Tahsils*
Source: Census of India 2001

The other Industries Sector is prominent in Vasai, Palghar and Bhiwandi region. In Vasai, Cultivators and Agricuturers are merely 5% each and household industries are even lesser. Here, it is noted that the Agricuturers are more than cultivators. Thus, indicating that land-ownership is lower in the Agriculture sector. In Palghar, the Agrarian sector forms 18% and 19.5% respectively, but with more land-owners are involved here. The situation is similar in Bhiwandi and Vada.

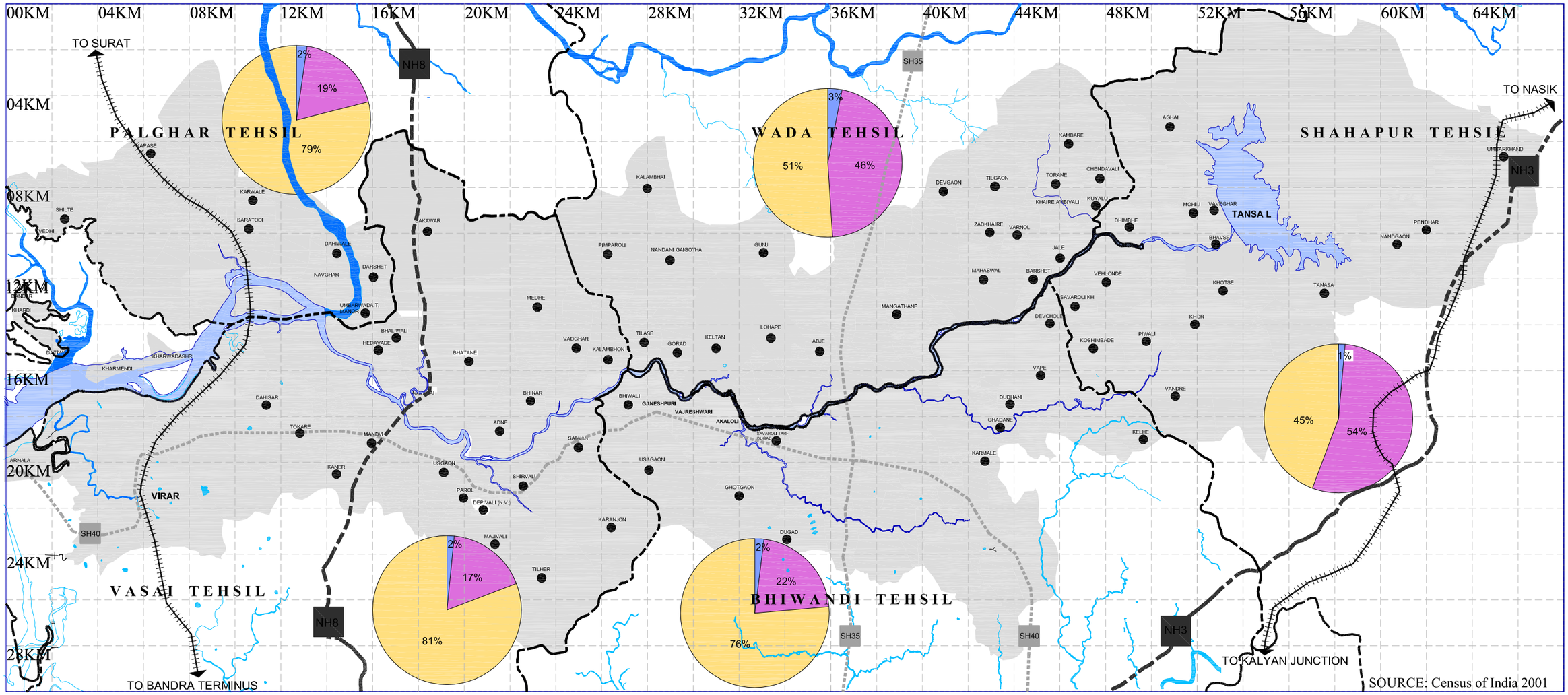
Shahpur is in contrast to the other Tahsils. The Agrarian sector forms the major economy in this region. 38% workers are involved in both the agriculture as well as other industries each. The high percentage of Cultivators also indicates more land-ownership. This could be a resultant of a good per capita income here.

As one studies the Income-Expenditure pattern in the region, economic profile shows a large population residing in these areas to be Below Poverty Line (BPL). (Refer Map 2.20) The Average monthly Income for the Tahsils stands at Rs. 671/ month. The monthly expenditure figure is Rs. 475/month. This means that 71% of the income goes into monthly expenditure of food and daily supplies. Shahpur shows a strong income based economy compared to other regions. The average per capita income for Shahpur is around Rs. 1328 compared to a low of Rs 150 for Vada. Vasai and Palghar too indicate a lower per capita income cpompared to Shahpur.

The Expenditure in the Vasai, Palghar and Bhiwandi areas is over 90% of the total income. Vada has almost 100% expenditure whereas the savings in Shahpur are higher. This is a direct indicator to the high living costs for Vasai and Palghar region.

Areas of Socio-economic Significance

- Tribal population in the region is high, especially in the villages surrounding Vajreshwari, Ganeshpuri and Akloli which are earmarked as the RTD Zone. The rapid urbanization of the region could break the sensitive relationship the tribal share with the eco-systems.
- The demographics of the region bring forth interesting population growth patterns. In areas closer to urban agglomerations, municipal towns and Industrial areas have experienced population growth to the point of 80% per annum. But areas dependent on agriculture based economy have shown a population decline. This seems a clear pointer to out-migration from the agriculture dependent areas to richer areas. This may also be a resultant of a high literacy rate but a weak economy providing very few opportunities to the inhabitants.
- Around 98% of the economy in the region is Rice production based. Rice is a produce completely dependent on high water table and rainfed areas. Any imbalance in this set-up can result in loss of such fertile land and a huge economy sector. But still there is a need to strengthen the agriculture based economy in the region which is evident by the low income profile in most areas. The worker population is very high but income patterns are very low.
- Another interesting fact in the local economy is a low profile of the household industry sector.



The Population Distribution across the Region shows a high percentage of Schedule Tribe concentration. Shahpur has the highest concentration of Schedule tribe, i.e 54% of the Population in the Tehsil is constituted by them. This is followed by Wada.The high concentration of the Tribals in the area increases the vulnerabilty of the the region to deforestration and urbanisation.
Villages like Khoste, Dimbhe, Vaveghar (Shahpur Tahsil) and Newade, Dudhani (Bhiwandi Tahsil) have 100% tribal population.

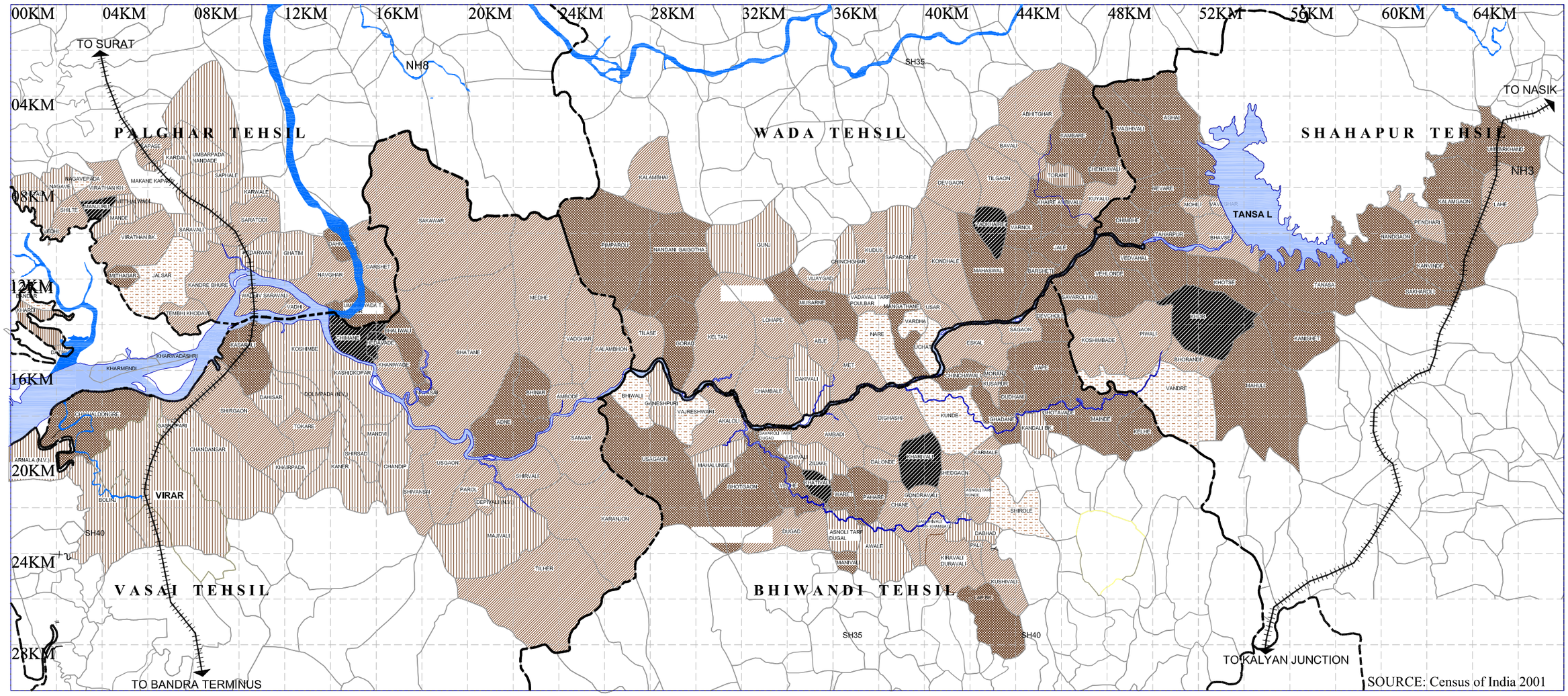
LEGEND:

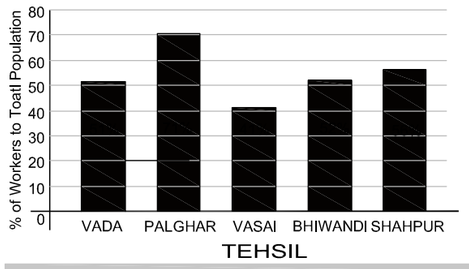
- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY
- STATE HIGHWAY
- TANSA RIVER
- STUDY AREA
- POPULATION DISTRIBUTION CHART
- GENERAL CATEGORY
- SCHEDULE TRIBE
- SCHEDULE CASTE
- VILLAGES WITH OVER 50% TRIBAL POPULATION

DEMOGRAPHIC PATTERNS : TRIBAL POPULATION DISTRIBUTION

00 01 02 04 08 KM

2.15





The Region has over 50% of the Population as Workers. A very high concentration of Worker Population is seen in the Shahpur Tehsil (in range of 55% to 65%). Along the river stretch, it is noticed the worker profile changes towards the interiors of the Region. The panchayats with a worker population below 25% , i.e. Kunde, Bhiwali, Vajreshwari (Bhiwandi), Nare, Uchat (Vada) are on the river banks and Shirole (Bhiwandi), Jalsar (Palghar), Vandre (Shahpur) are landlocked areas.are located both ta the river basin and in the interiors of the zone. In Vasai Tahsil, Chimane and Hedavade, located at the junction where Vaitarna R. Meets the Tansa R., have the highest working population.
The density is highest in Palghar (over 70%) followed by Shahpur (over 55%). Bhiwandi and Wada have over 50% employed population. Along the mouth of the river the population is high though it declines a little between the the mouth of the river and Bhiwandi Tehsil.

LEGEND:

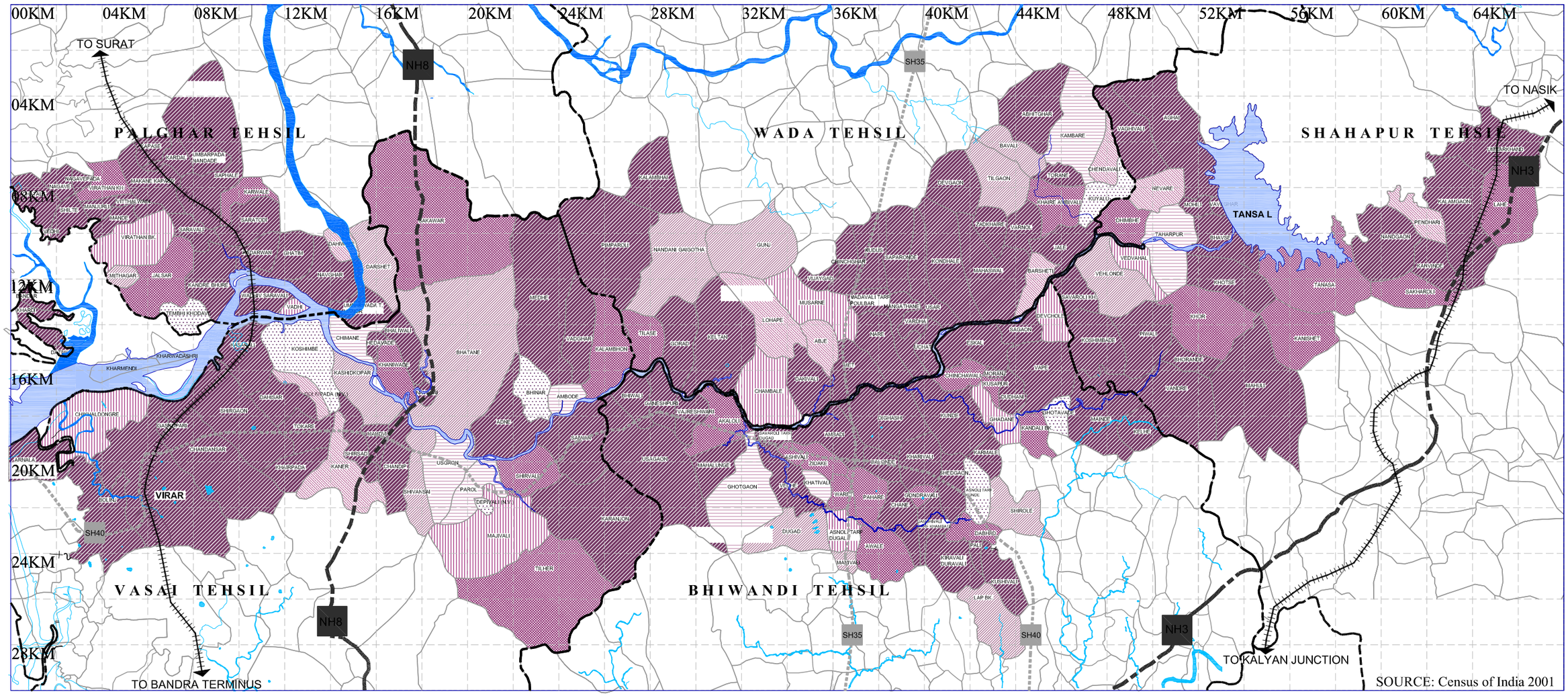
- TEHSIL BOUNDARY
- RAILWAY LINE
- NH4 NATIONAL HIGHWAY
- SH35 STATE HIGHWAY
- TANSA RIVER
- STUDY AREA
- 65.01 AND ABOVE
- 55.01 TO 65.00
- 45.01 TO 55.00
- 35.01 TO 45.00
- 25.01 TO 35.00
- 15.01 TO 25.00
- 15.00 AND BELOW

DEMOGRAPHIC PATTERNS : WORKER POPULATION

00 01 02 04 08 KM

2.16

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069. website:www.krvia.ac.in



The percentage of Main worker population to the Total population in each village is found to be very high across the Study Region. The villages with very low worker population have either seen a decline in total population or insignificant growth in the last two decades. The average worker population stands above 65%.

L E G E N D :

- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY
- STATE HIGHWAY
- TANSA RIVER

PERCENTAGE OF TOTAL WORKERS TO MAIN WORKERS

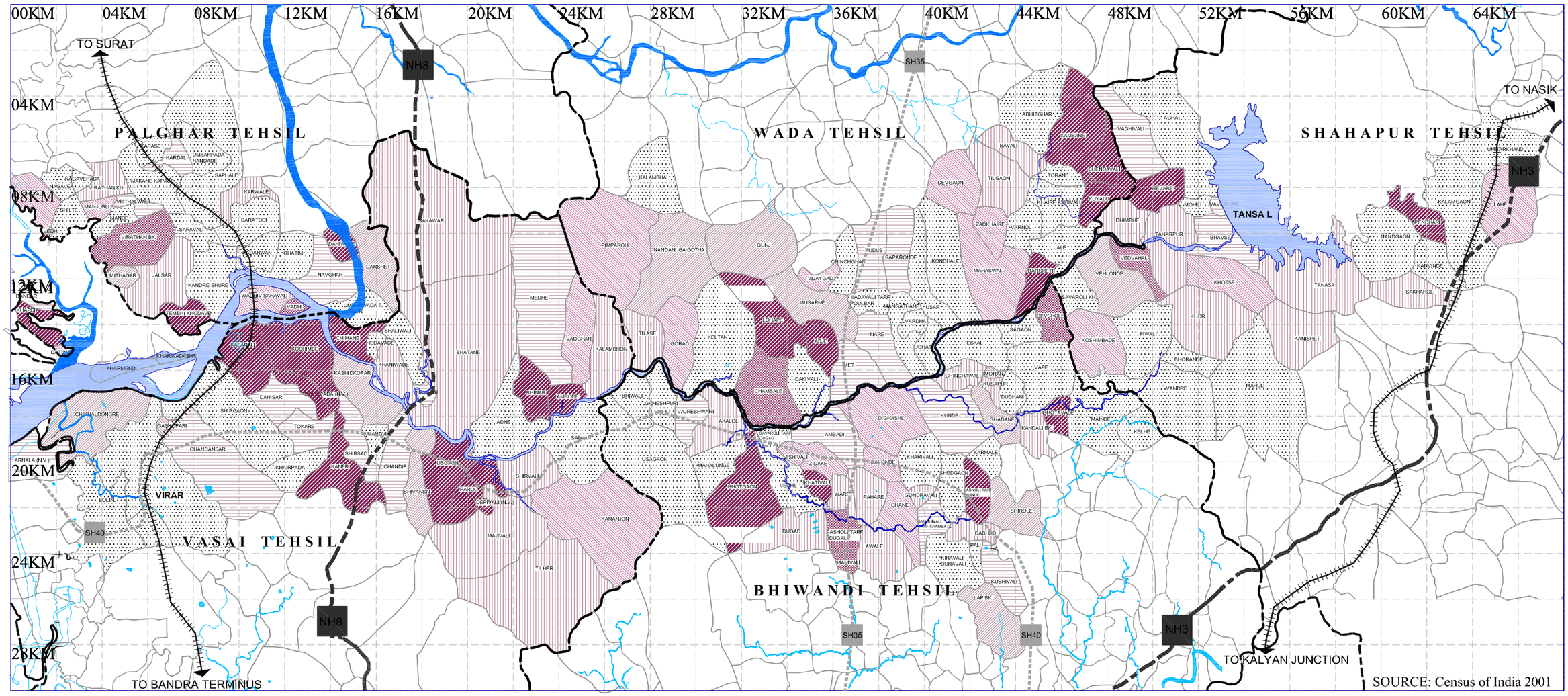
- 65.01 AND ABOVE
- 55.01 TO 65.00
- 45.01 TO 55.00
- 35.01 TO 45.00
- 25.01 TO 35.00
- 15.01 TO 25.00
- 15.00 AND BELOW

DEMOGRAPHIC PATTERNS : MAIN WORKER POPULATION

00 01 02 04 08 KM

2.17

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069. website:www.krvia.ac.in



The Percentage of Marginal Workers to the Total Worker Population is very low. This indicates that significant chunk of population works either throughout the year or atleast for more than 6 months in an year to earn a living. This further indicates that the population in the region is economically backward corroborated with the Map illustrating the Income Patterns in the region Also, when compared with the SC-ST population data, it was analysed that regions with high ST population have a high marginal worker population except in Shahpur Tahsil where the Tribal villages seem to be employed in the agriculture sector totally. Also, Kasarali, Koshimbe, Chimane in Vasai TAhsil have a high marginal worker population. these were aslo the regions where activities like sand-dredging were seen both in the google images and recon site surveys.

LEGEND:

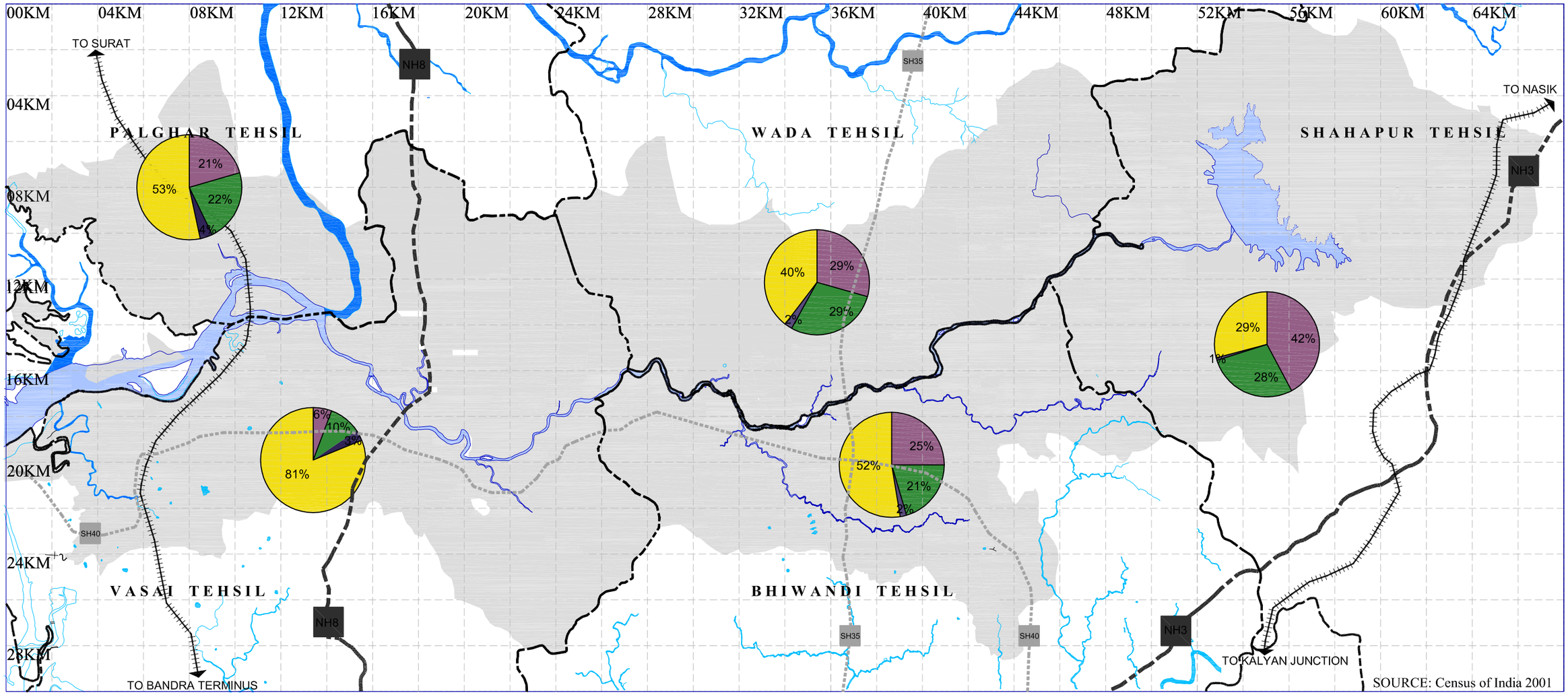
- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY
- STATE HIGHWAY
- TANSA RIVER
- 65.01 AND ABOVE
- 55.01 TO 65.00
- 45.01 TO 55.00
- 35.01 TO 45.00
- 25.01 TO 35.00
- 15.01 TO 25.00
- 15.00 AND BELOW

DEMOGRAPHIC PATTERNS : MARGINAL WORKER POPULATION

00 01 02 04 08 KM

2.18

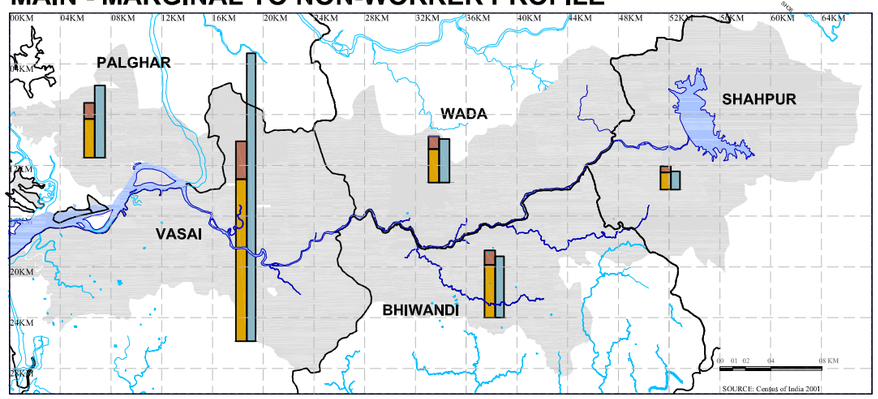
ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069.
website:www.krvia.ac.in



The Worker Profile shows major employment in the agriculture sector in Vada, Shahpur and Bhiwandi Tehsils. Palghar and Vasai Region show more inclination towards other industries. Overall in the entire region, the Household Industry Sector is very low profile.

The Main / Marginal to Non Worker Break-up illustrates a high number of non worker population in Vasai Region as compared to other Tehsils. In Shahpur major population is of worker and BHiwandi and Wada tehsils show an approximate 50-50 break-up.

MAIN - MARGINAL TO NON-WORKER PROFILE



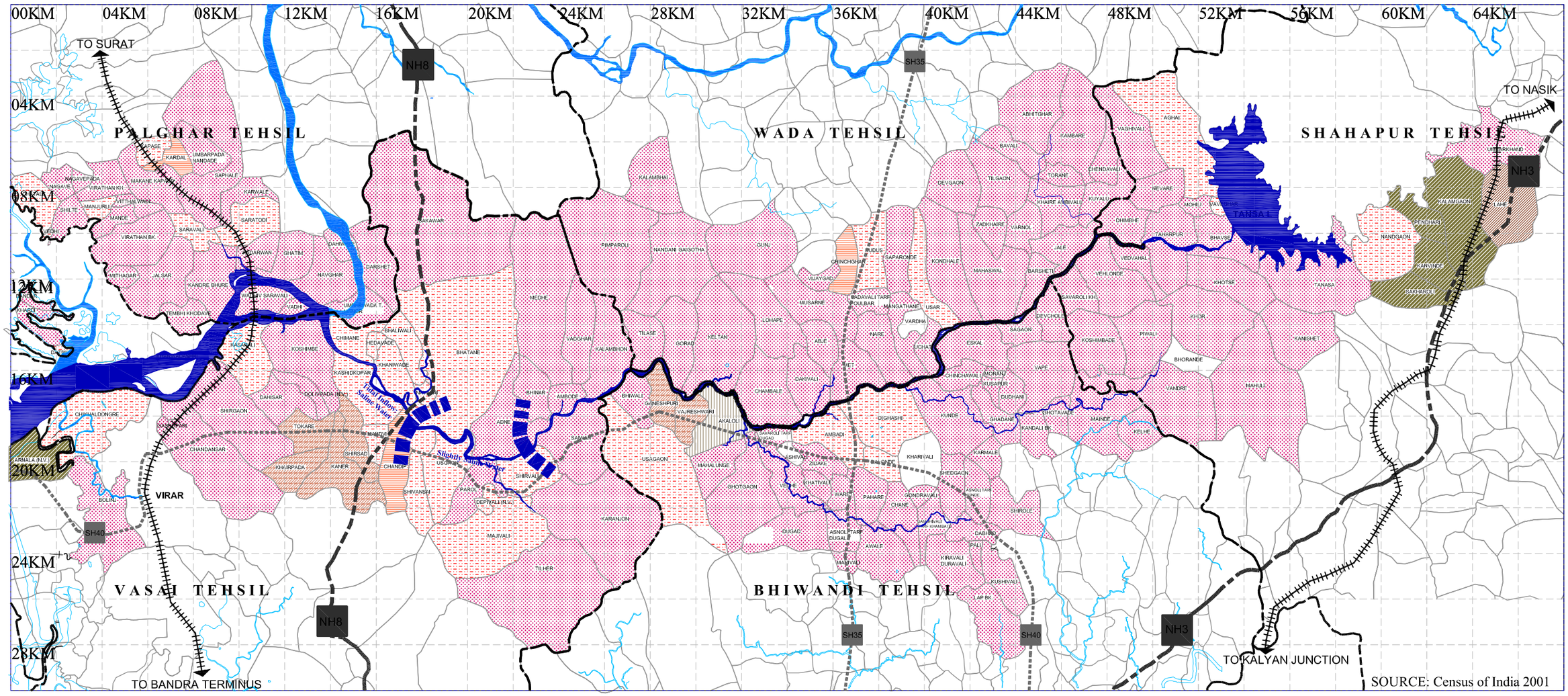
LEGEND:

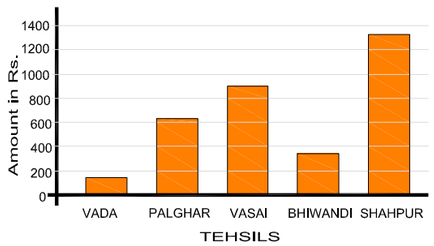
- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY (NH4)
- STATE HIGHWAY (SH35)
- TANSA RIVER
- STUDY AREA
- CULTIVATORS
- AGRICULTURERS
- HOUSEHOLD IND.
- OTHERS
- MAIN WORKERS
- MARGINAL WORKERS
- NON WORKERS

DEMOGRAPHIC PATTERNS : WORKER PROFILES

00 01 02 04 08 KM

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in





The Average Monthly Income Pattern for the Study Area illustrates most villages as Below Poverty Line. It is noticed that Shahpur Tehsil has the highest Average Monthly Income at Rs. 1328/month in respect to other tehsils despite having highest tribal population. Akloli (Rs. 2348), Vajreshpuri (Rs. 1672) and Ganeshpuri (Rs.1858) register a higher Income Pattern in respect to neighbouring villages. This could be due to incoming Pilgrim population to these villages as a result of the Hot Springs in the area. The regions around the National Highway have a higher Income Pattern.

LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY
- STATE HIGHWAY
- TANSA RIVER
- 5001 AND ABOVE
- 4001 TO 5000
- 3001 TO 4000
- 2001 TO 3000
- 1501 T0 2000
- 1001 TO 1500
- 501 TO 1000
- 500 AND BELOW

DEMOGRAPHIC PATTERNS : AVERAGE MONTHLY INCOME PROFILE

00 01 02 04 08 KM

2.20

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in

2.4 Land Uses

Under Indian Forests Act of 1927, forests are divided into two categories, viz., reserved and protected forests. In case of protected forests the rights are clearly recorded and regulated. The protected forests at present are being worked under the working plan for Thane woodland. In the revised plan it is proposed to amalgamate compact blocks of well-wooded areas not honey combed with the cultivation for conversion into reserved forests and will be brought under intensive forest management. Wooded areas honey combed with cultivation will either be developed with farm forestry or handed over to the Revenue department for utilizing the lands for cultivation depending on the conditions of the forests.

There is no Kumri cultivation in this district. But there are in-forest cultivation plots in reserved forests given out for cultivation on annual leases renewable every year. All these in-forest cultivation plots are to be given to the occupants permanently as occupants Class II and they would continue as forest villages under the control of the Forest department. Besides, there are some encroachments also. In case of protected forests there are woodland plots, eksali plots and those granted under Grow More Food Campaign and so on. Some of the forest encroachments have been regularized and the holders are allowed to cultivate thereon as per Government directives from time to time.

These cultivations have caused the honey combing of protected forests. 'eksali plots and in-forest cultivation plots which belong to the category of encroachments are to be given to the occupants permanently as occupants Class II. The eksali plots and encroachments in the forest cultivation plots in the reserved forests and woodland plots and those granted under Grow More Food Campaign will continue under the administrative control of the Forest department even after their permanent grant to the occupants, though such areas are in the midst of the forests and under Revenue department if such areas are bordering the private malki lands. (Refer Map 2.21 and Map 2.22)z

2.4.1 Proposed Land Uses within the Study Area

A study of the proposed land uses within the watershed of the Tansa was conducted in order to understand the impact of these within the study area.

Almost 32 percent of the delineated study area, in the Talukas of Bhiwand and Vasai, fall within the Mumbai Metropolitan Region. The Regional plan indicates the following zones and development guidelines within the study area.

- **Urbanizable Zone (U1 Zone)**

  The U1 zone primarily covers areas where more intensive urban development and economic activity is expected in the future. These areas come under the Development Plan which is expected to regulate development. A part of the urbanisable (U1) zone of Virar in Vasai taluka falls within the study area.

- **Green Zone- G Zone**

  A large part of the study area falls within the Green Zone which includes agricultural lands, plantation areas, hilly areas, forests other than reserved or protected forests, and low-lying areas have been designated as Green Zone. However, the proposed DC regulations intend to permit certain selective developments such as farm houses, week end houses on 200 sq m plots, holiday homes, resorts, large institutions on minimum 2.5 Ha plots, film shooting sites on minimum 5 Ha sites and certain obnoxious or hazardous uses with adequate environmental measures.

  This is in reaction to the transformations of peripheral agricultural lands in response to rising land values. The FSI proposed within these zones is 0.05, with a view to “minimize adverse impact on the character of the countryside”.

- **Forest Zone-(F Zone)**

  Most of the watershed area of the Tansa lies under forests. These are highly restricted areas of Reserved Forests and Protected Forests under the Indian Forest Act, 1927, and forests acquired under the Maharashtra Acquisition of Private Forests Act. It did not include private lands under forests or plantation. As per the Regional plan for the MMR, any activity which is permissible in G Zone is permitted in the F Zone, subject to clearance from the Forest Department.

  The Plan also states that a large part of he forest land being degraded, afforestation of these degraded forest lands will be an important step in improving the region’s environment.

- **Recreation And Tourism Development Zone(RTD Zone)**

  The study area contains two such designated RTD zones, one of which lies all along the western coast of Vasai Taluka , extending till Arnala within the study area, and the other around Vajreshwari, Akloli and Ganeshpuri. The present Regional Plan has proposed identified an area of almost 7.5 sq. kilometers comprising of the entire villages of Vajreshwari, Bhiwali, Akloli and Ganeshpuri as Recreation and Tourism Development Zones.

  The regional plan states that “in the absence of planned effort by any public agency, and because of lack of any incentives for private development of (existing recreational and tourism) areas, no new major recreational areas could be created within the region during the last two decades. Over the years because of the general

increase in income and mobility, the demand for recreational and tourism facility (sic) has increased manifold and the existing facilities are proving o be inadequate.

The revised regional plan has therefore proposed creation of Recreation and Tourism Development Zone of 500 m width around places of recreational and tourism value such as archaeological and historical monuments, religious places, places of architectural, natural and scientific interest, wild life sanctuaries, national parks and areas of natural scenery.

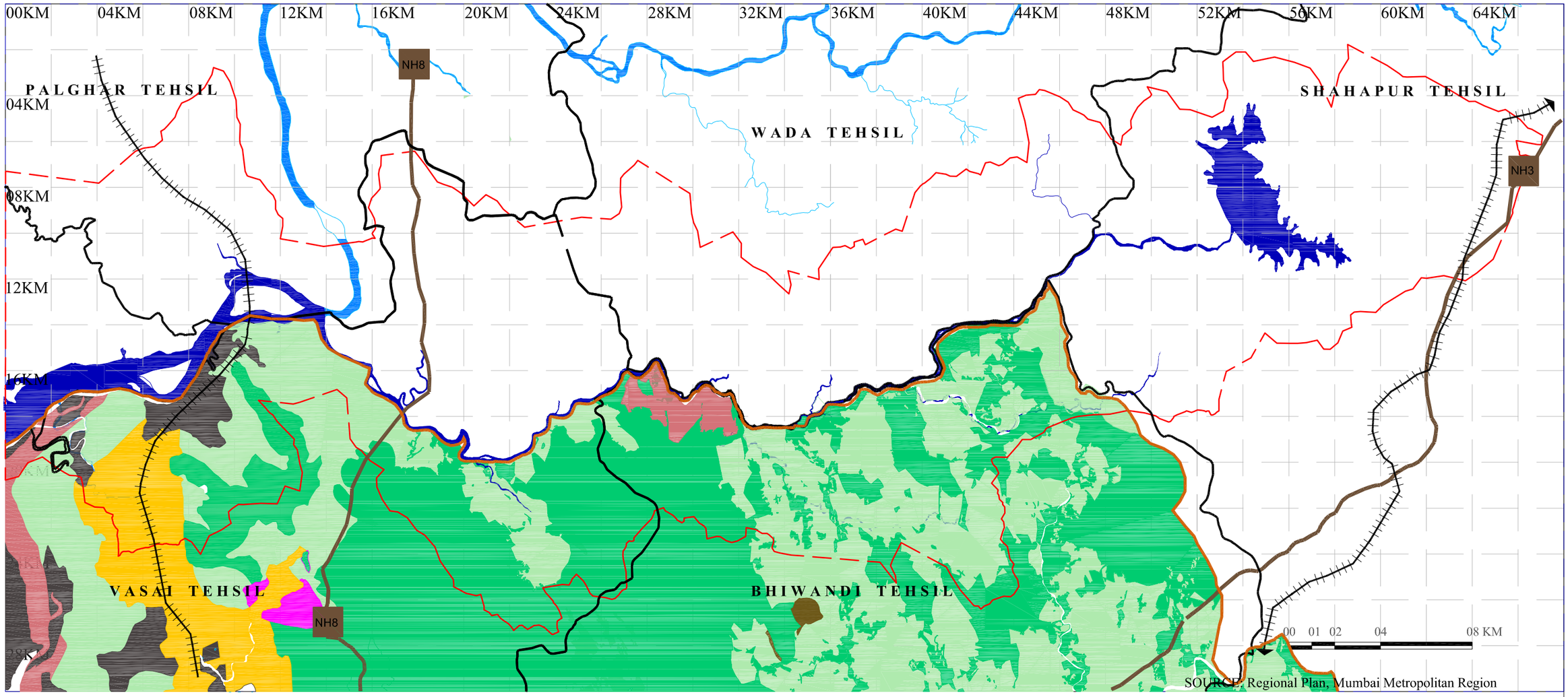
In the RTD Zone very restricted development intended for promoting recreational activity and tourism, will be permitted. This will include hotels, holiday homes, resorts, club houses, restaurants, shops, swimming pool, camping grounds, water sports facility, etc.

As an incentive, requirement of the minimum area for holiday homes, resorts, etc. is dispensed with in the RTD Zone. Similarly an FSI of 0.2 is permitted in the RTD Zone as against 0.05 in G Zone.

- **Coastal Regulatory Zone (CRZ)**

  Under the Environment Protection Axct, 1986, the notification in February 1991, the area of 500 m along the sea coast and upto 100 mteres from rivers and creeks is designated as coastal regulatory zones. The developments within these areas are required to be regulated in accordance with the provisions of the notification and the Coastal Zone Management plan.

A 500 m wide area along the coasts of Arnala and Chikhal Dongri under the CRZ within the study area has been designated as the Recreational and Tourism Development Zone.



The map indicates the landuse withn the study area as proposed within the Mumbai Metropiltan Regional Plan.
The area of the watershed under the MMR is 291 sq. km, approximately 32 percent of the entire study area. A larger proportion of the study area lies outside the MMR, wherewe have been unable to obtain the proposed land use plans.
Most of the study area within the MMR is designated as Forest Zone or Green Zone.
A part of the urbanisable zone of Vasai lies within the study area.
The Proposed Recreation and Tourism Development Zone at Vajreshwari occupies an area of almost 11 sq. km.

LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- NATIONAL HIGHWAY (NH4)
- STATE HIGHWAY (SH35)
- PEAKS
- TANSA RIVER
- WATERSHED
- RIDGE DIVIDE

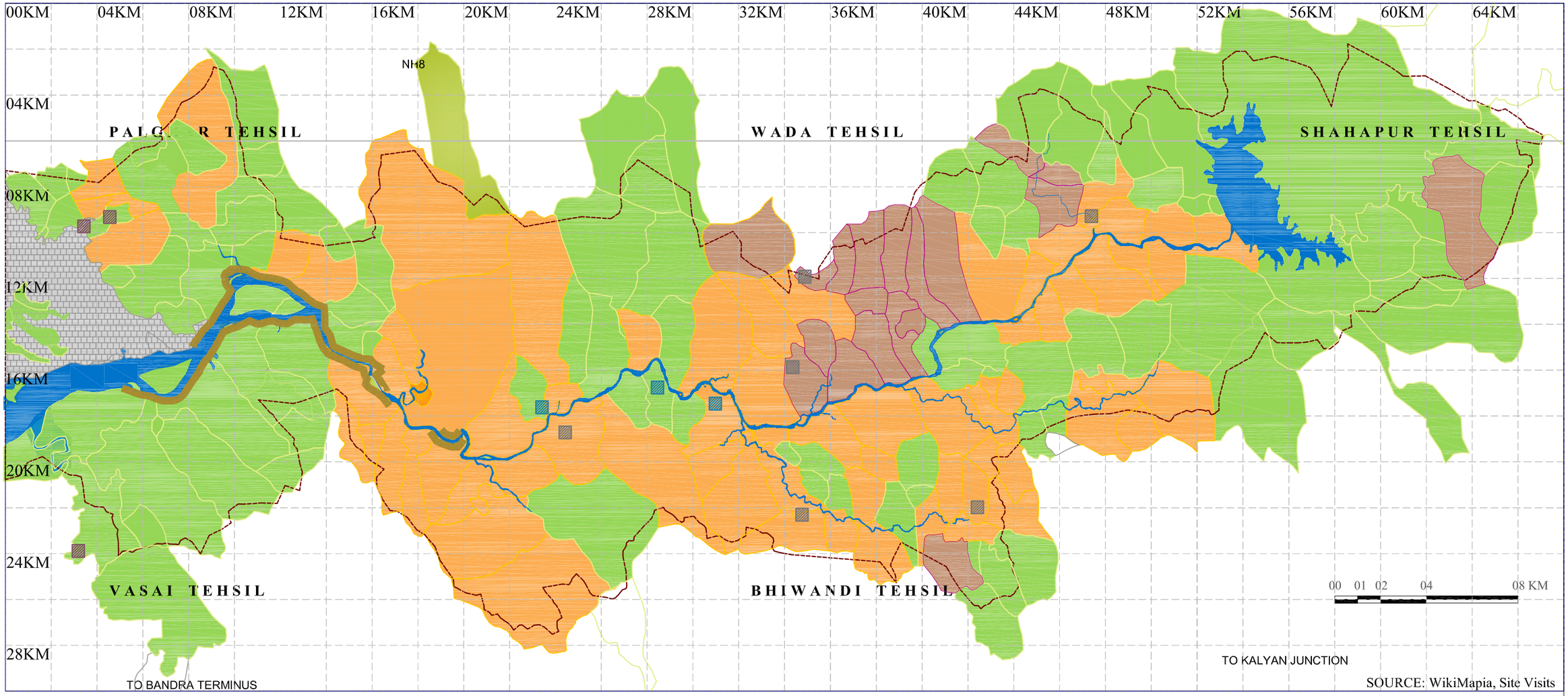
LAND UTILISATION

- MMR BOUNDARY
- TEHSIL BOUNDARY
- RAILWAY
- ROAD
- GREEN ZONE ONE
- FOREST ZONE
- COASTAL WETLANDS
- TANSA RIVER
- URBANISABLE ZONE
- INDUSTRIAL ZONE
- RECREATION AND TOURISM ZONE
- QUARRY

DEMOGRAPHY AND SOCIO ECONOMIC BASE: PROPOSED LANDUSE

00 01 02 04 08 KM

2.21



The map has been prepared through visual surveys on site and confirmation of the location and extent of activities from satellite images overlayed by the administrative boundaries, to generate a broad understanding of existing activities through the region. The colours do not indicate actual intensities or activities, but denote the zones where activities predominate.

LEGEND:

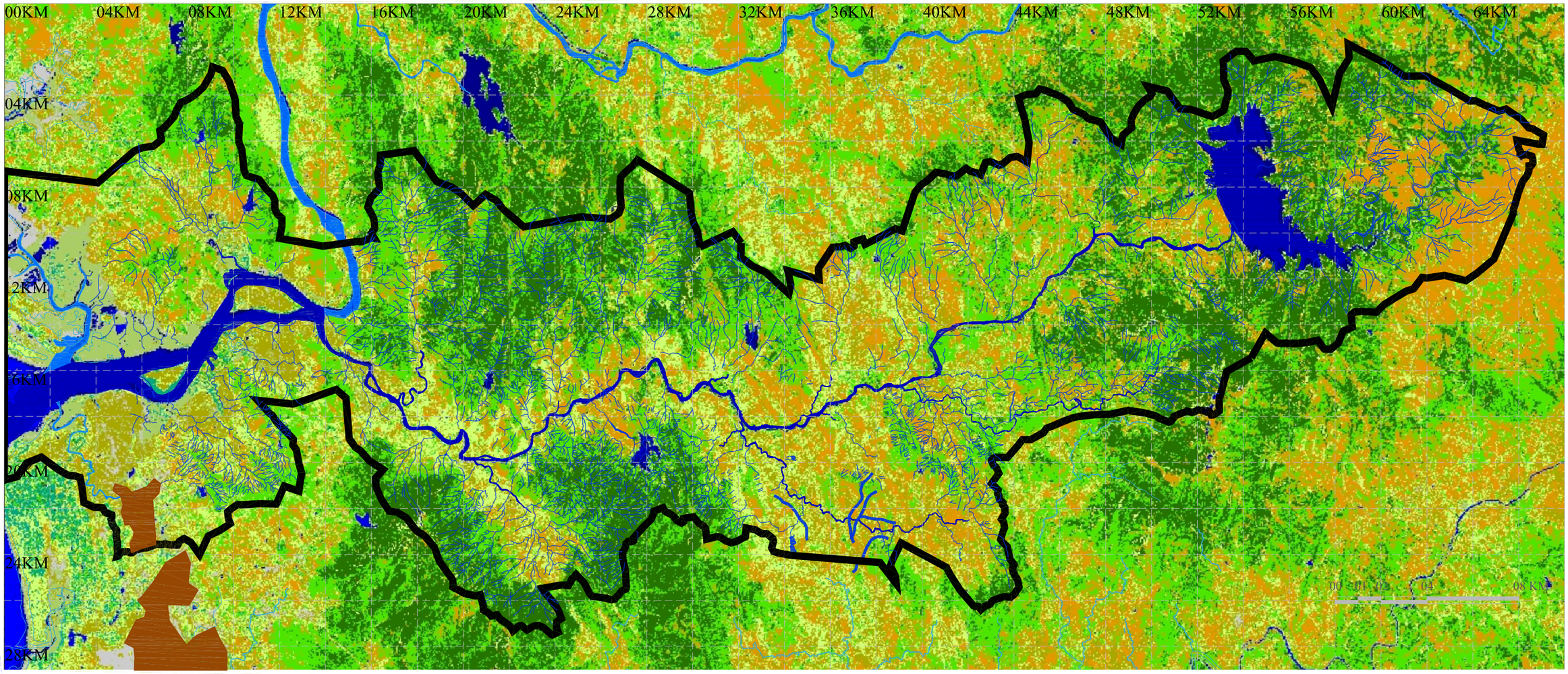
- TANSA RIVER
- RAILWAY LINE
- NH4 NATIONAL HIGHWAY
- STUDY AREA
- SAND DREDGING
- FARMS
- BRICK KILNS AND FARMS
- INDUSTRIES
- SALT PANS
- STONE QUARRING
- TOURISM AND RESORTS
- FISHING

ENVIRONMENTAL RESOURCE BASE: BROAD LOCATION OF ACTIVITIES

00 01 02 04 08 KM

2.21A

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in



SOURCE: SURVERY OF INDIA MAPS, 1972.
LAND SAT Image

The map indicates the existing landcover within the study area, and specific conditions of landcover such as denuded slopes, escarpments or barren land, sparse or dense fiorests, degraded mangrove areas.
It also indicates existing conditions pertaining to the landuse such as fallow lands or fertile agricultural lands and plantations, salt pans, urbanised areas.
The map was generated using remote sensing of satellite images to generate a landcover map., the hydrological pattern from the topographic maps was superimposed to delineate the stream, and riverine habitats.

- TANSA RIVER
- RIDGE DIVIDE
- RIVERS/STREAMS/ESTUARIES
- SURFACE WATER- LAKES/ RESERVOIRS/PONDS
- DENSE FORESTS
- SPARSE FOREST
- FERTILE AGRICULTURAL LANDS/ PLANTATIONS AND SETTLEMENTS
- DENUDED SLOPES/ BARREN LANDS
- FALLOW LANDS
- MANGROVES
- DEGRADED MANGROVES
- SALT PAN LANDS
- URBANISED AREAS

ENVIRONMENTAL RESOURCE BASE: LANDCOVER MAP

00 01 02 04 08 KM

2.4.2 Activity Profile

Activities are divided into primary, secondary, and tertiary
Primary activities are identified on the basis on the activities which rely/depend/thrive on the natural/ecological resources/ecosystem available in the area. In this area the activities observed are farming, brick kilns, fishing, sand dredging, plantations, stone quarrying, grazing, and salt pans.

Agriculture, plantations, Mainly farming is practiced in this area because of favorable fertile soil depositions by Tansa River and water availability of due to Tansa River (streams, rivulets, ground water, and wells). Production of single and double crops is observed.
There are also instances of shifting cultivation within the forest areas, by tribal communities.

Farm lands along river

Brick Kilns
Some agricultural lands have been converted into brick kilns Due to increase in building construction industry in recent times in cities around the area like Bombay. They are accompanied by temporary informal settlements of labour in their vicinity.

Brick kilns with informal settlements

Brick kilns replacing farms

Saw dust factory

Constituents of brick kilns

Sand dredging
Sand dredging is practiced along the edge of the river at the mouth of the river. It is estimated that more than 5000 boats are involved in the activity from local information during site visits. The activity has increase to meet the requirements of the growing building industry in cities like Bombay. The activity is heavily dependent upon migrant labour which has resulted in growth of informal settlements along the sand dredging zones.

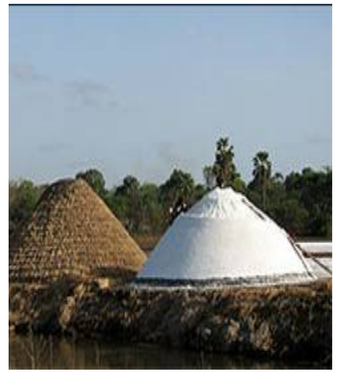
Migrant labour settlements

Transport of sand

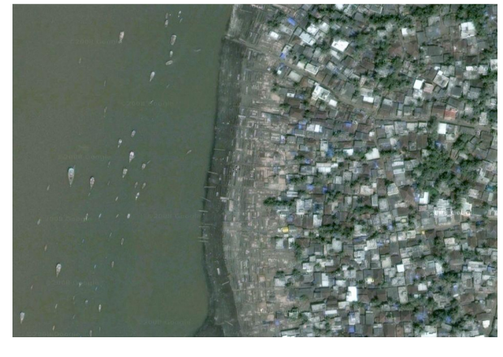
Stone Quarrying
Stone is extracted from the hilly areas within the study area for use in the building construction industry.

Cattle rearing, Grazing.
Livestock is an integral part of agriculture and consists of cattle, buffaloes, sheep, goats, pigs and poultry. Cattle constitute a large proportion of the livestock, and grazing on the hill slopes, and grasslands is a predominant activity around agricultural villages.

Salt pans are found towards the coast. Coastal wetlands are converted into salt pans.



Fishing
The fishing trade flourishes in the district, as there is always demand for fish at Mumbai market. Fishing trade is increasing gradually and still has a vast potential. Within the coastal villages such as Arnala, Khardi, Dativare, Bandar, have coastal fishing settlements of the Kolis.



Secondary activities

There are industrial activities within Wada Tahsil, Bhiwandi Tahsil, Shahapur Tahsil and Vasai Tahsil. Wada shows a high concentration of industries including hazardous waste generating industries chemical, textile, metal, dyes and paints, electronics, wires, asbestos cement, plastics, foams, petroleum. Their industrial waste discharge leads to river water, ground water and air pollution which affects the ecosystem of the river basin. Increase in population associated with industrial growth has been observed.

Industries in Wada

Industries along the Tansa

Tertiary activities

Tourism for religious or pilgrimage purposes is mainly concentrated in Ganeshpuri – Vajreshwari area (which comes under RTD zone) because of presence of hot water springs and temples. The locals around this area earn income by serving tourists provisions like food and accommodation catering to mainly religious tourists. Informal growth of shacks which provide for food and changing and resting spaces around the hot water springs is observed. There is also a formalised growth in terms of hotels and lodges, and shops catering to tourists within the gaothan markets and resorts in the surrounding areas. There is a high concentration of these activities on the days of the Jatra, on Mahashivratri and Gurupurnima.There is also to a smaller proportion, of nature associated tourism, with trekkers and picnickers, who visit the fort sites such as Mahuli, Tungar forests and waterfalls at tungareshwar.

Tourist hotels on the river edges

Tourists and Villagers Bathing at thermal springs

Informal growth around thermal spring, along Tansa river at Akloli

2.4.3 Common property resources:

Tribals and the poor peasants depend on livelihood on public land in multiple ways: cultivating it without any title, grazing sheep or cattle, quarrying stone, tapping palm toddy, catching fish in the water resources/farmlands, mangroves, mudflats. Apart from cultivated lands the common property resources include lands which are described as wastelands- scrublands used for grazing, food or sustenance by tribal populations.

- Forest Resources

Rural dwellers, primarily tribal, collected products from 92 plant species, including eight herbs Since some species yielded more than one product, 127 items were collected. Some species yielded several items, like Madhuca indica. The four most important uses were medicines (45 species), fruit (27), timber (15) and vegetables (13). Fifteen commodities were sold in markets or to middlemen for cash, not including the value of some illicitly cut timber (Ballal 2000).

The major forest produce in the district includes teak, timber, timber of various species, viz., ain, bibia; khair, dhavda, hed, kalamb, sawar, etc., The minor forest products include bamboo, grass, apta leaves, tembhurni, palas, bel, tad, palm, bark of chilhar and ain, kadhi patta, babul branches, mohwa flowers and seeds, hirda fruits, karvi, honey, gum. vavding, etc. **Villagers enjoy the special privileges regarding removal of grass, seeds, dead leaves, bamboos and firewood for their use.** Scheduled tribes in Shahapur division are allowed to collect fruits, edible tubers and palas leaves for their domestic use as well as for sale. Apta and temburni leaves are also allowed to be collected by scheduled tribes of Dahanu. Many of the forest species have medicinal uses. Mowha (*Madhuca indica*), is used in the production of liquor.

2.4.4 Administrative Set Up:

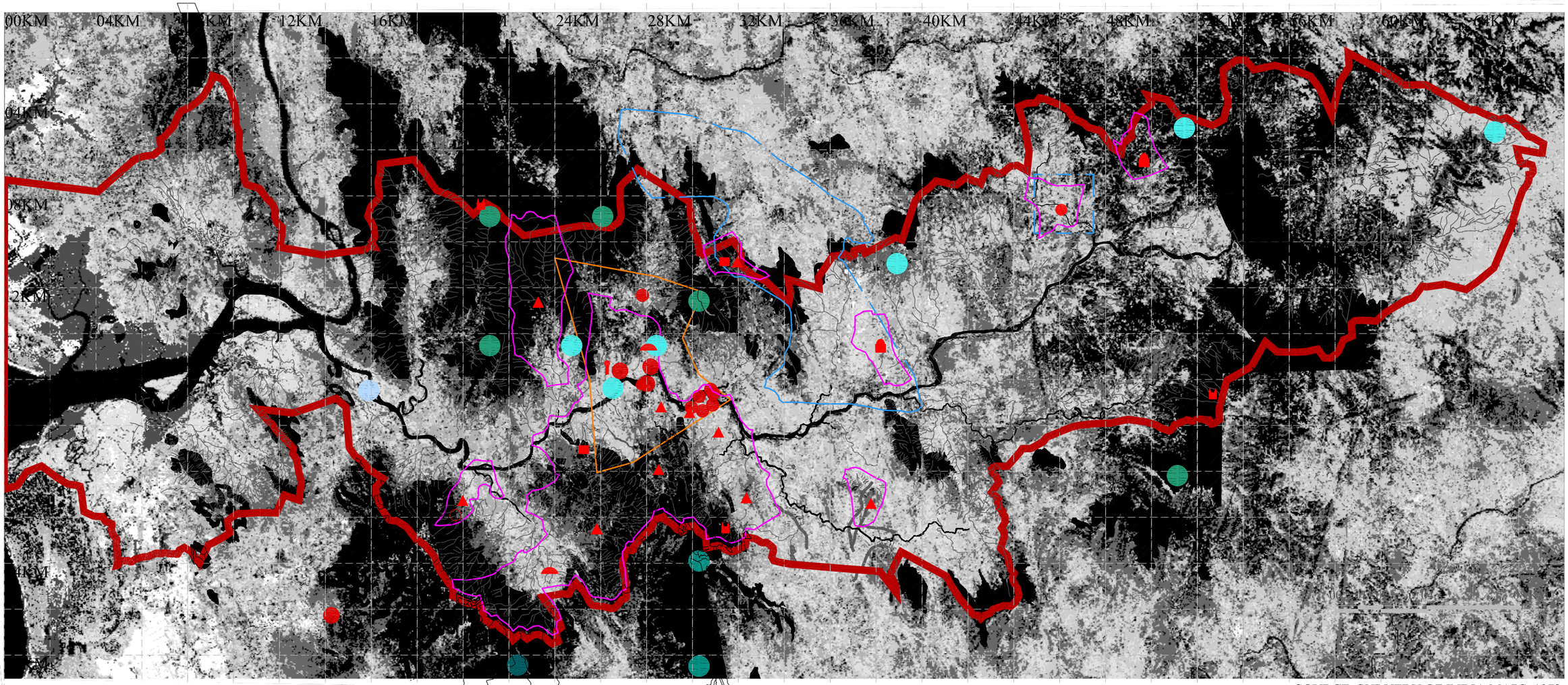
According to Administrative convenient, the State is divided in six regional division. The Thane district is included in Konkan Region Division. The district consists of 13 tehsils which are Thane, Vasai, Palghar, Dahanu, Talasari, Jawhar, Mokhada, Bhiwandi, Wada, Shahapur, Murbad, Kalyan and Ulhasnagar.

At the district level, Collector is the Administrative Chief and the Tehsildar at Tehsil level. For rural development, Chief Executive Officer of Zilla Parishad, at district level and Block Development Officer at Block level, are in charge of the administration. Municipal Councils are responsible for urban development work.

The following table indicates the administrative set up of Thane district alongwith the comparative position of Maharashtra State.

TABLE - 1
ADMINISTRATIVE SET UP (1998-99)

Sl.No	Particulars	Unit	Thane	Maharashtra
1	Tehsils	Nos.	13	326
2	Panchayat Samities	Nos.	12	320
3	Draught Talukas	Nos.	00	N.A.
4	Cities	Nos.	23	336
5	Villages	Nos.	1697	43864
6	Area	Sp. Kms.	9558	307713
7	Mahanagar Palika	Nos.	04	15
8	Nagar Palika	Nos.	10	228
9	Gram Panchayati	Nos.	927	27598
N.A. Not available				



SOURCE: SURVERY OF INDIA MAPS, 1972.

The map above was generated by overlaying the various resource maps, to create a composite significance map for the study area.
The habitats were graded in terms of their sensitivity/significance. Significance is defined as explained in the in Section 2.2.
It is evident from the map that in the areas around Tungareshwar, Ganeshpuri, Akloli, several areas/sites of significance overlap,
1) The geo-thermal zone,
2) A concentration of historic sites
3)The rich and diverse forests of Tungar hill
4) Areas of sensitive slopes, and habitats.

- SENSITIVE SLOPES
- GEO-THERMAL ZONE
- HERITAGE ZONE
- HERITAGE SITES
- AQUIFER ZONE
- HIGH TO LOW BIODIVERSITY INDEX
- RIDGE DIVIDE
- MOST SENSITIVE HABITATS
- MODERATELY SENSITIVE HABITATS
- LESS SENSITIVE HABITATS

ENVIRONMENTAL RESOURCE BASE: SIGNIFICANCE MAP

00 01 02 04 08 KM

2.23

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL-KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069. website:www.krvia.ac.in

CHAPTER 3 STRESS ON THE REGIONAL ENVIRONMENT

3.1 Introduction

The last chapter established the areas of environmental significance and sensitivity that occur within the Tansa watershed.

The physiography, geology, geo thermal activity, hydrology, landcover, soil, ground water, habitats as well as livelihoods and communities sustained by them, form a complex interdependent system. Change and transformation in any one would impact the entire system.

Activities that are sustained by these resources also put stresses on them, and more so in cases where new activities that are introduced from outside, that do not have a direct dependency and relationship with the resource. Certain activities and Development projects and lead to large scale transformation of the landscape leading to deterioration of the environment, air water and biota, Changes in the habitat pattern loss of biotic and human resources and cultural practises.There is a serious threat in these cases of resources being lost through over exploitation or insensitivity.

The following stresses on environmental resources were observed in the Tansa River catchment:

- **Stresses on biodiversity and ecological habitats.**
- **Stresses on physiography and hydrology**
- **Environmental pollution.**
- **Depletion of resources and loss of livelihoods.**

3.2 Stress on Biodiversity and Ecological Habitats

3.2.1 History of exploitation of forests in the region

According to a study done on the Human Disturbance and Forest Diversity in the Tansa Valley, India by Radha Veach, David Lee and Tom Phillipi[1] over 2500 years of disturbance have affected the forests of the valley, particularly near the river, but it is unclear if demand for timber was great enough to extend well into the isolated hills and these 14 sites until the last two centuries. The Tansa Valley was a major transportation corridor between the Deccan and the coast, particularly for the important Buddhist center of Sopara (fifth century BCE; Campbell

1 Human Disturbance and Forest Diversity in the Tansa, Valley, India, Biodiversity and Conservation, Kluwer Academic Publishers, 2003.

1882). Timber exploitation for domestic and ship construction, as well as export, probably continued through the succession of local kingdoms, and then increased with the rise of Portuguese Bassein, in the 16th century when timber was used for the construction of Portuguese ships (Pereira 1935). A British official, Dr Hove, travelled through the district about 1786 and observed forests thick with teak (evidence of earlier disturbance) northeast of Bassein (Campbell 1882). After the defeat of the Portuguese by the Marathas, the British eventually established control by 1818. Nearby Bombay became a major center of ship construction for the British navy, and depletion of these forests was a matter of strategic concern. Hove noted that these same trees were supplying the Bombay dockyards by 1820. Colonel Jervis, the Chief Engineer at Bombay, reported to the Military Board on his forest survey of the North Konkan in 1843. ‘‘The hills stretching westward from Doogaur and Vijuirabhoy (e.g. Dugad and Vajreshwari) to the sea were formerly covered with wood, but in 1843 on their sea face, there was hardly a bush to be seen; all had been cut away for the Bombay market’’ (Stebbing 1922). Such concerns led to the establishment of a state forest department, and recovery of these forests. The new limits on forest use in the Thane District led to an uprising (Tucker 1979). The descriptions of forests in the Gazetteer of 1882 paint a somewhat refurbished picture (Campbell 1882). Their exploitation continued in the 20th century, first by the British before the independence, then by the Maharashtra State Forest Department. More remote locations may have been exempt from felling, however. Three of the forest remnants are sites of old hill forts, Mahuli (MH), Ghotara US) and Takmak (TA), and Kamandurg to the south of the Tungar site. These forts were constructed in the 14–15th centuries and were active until the 18th century (Campbell 1882). At times these sites were densely populated, leading to extensive deforestation as well as introduction of exotic species, some native to other parts of the subcontinent. Some of these forts, like Mahuli, were put under siege, which would have further damaged the vegetation. Scriptures prescribed the planting of auspicious plants in forts (Banerjee 1980), which may explain the presence of naturalized exotics not observed elsewhere in valley forests.

3.2.1.1 Conclusions

Post independence there was a lot of exploitation of these forests by the Maharashtra State Forest Department. These activities have reduced the biomass, the forest density and canopy height, affecting the bio-diversity of the area. After 1988 however a lot of the activity of logging of wood has been stopped as per decree of the Central Government.

All of these sites are within lands managed as Reserve Forest by the Maharashtra Forest Department. Selective cutting continued in these forests, but probably less extensively than by the British (the extraction roads were abandoned), and cutting had been banned by central government decree since 1988. Unfortunately detailed records were not available, but extensive logging had not been observed in these areas for 20 years.

3.2.2 Present state of the forests:

The results of the report suggested that a history of disturbance, accelerated during the last century, has reduced biomass, canopy height and tree density in forests throughout the valley. The forests and soils have thus retained less of the precipitation of the monsoon and increased the effect of the post-monsoon dry season on the vegetation. More mesic species have disappeared as the effects of disturbance have accumulated over time. Descriptions of forests in the Thane District in the 19th century included a number of common species which are no longer present or extremely rare. Although all of the forest remnants preserve some diversity in the face of periodic (and presently increasing) disturbance pressures, most of the species in these remnants are tolerant of drought stress, and coppice well in response to cutting and lopping branches. The results reported here suggest that the valley forest was richer and more mesic in character, and has declined in biodiversity and water retention capacity during the past century. (Refer Map 3.1)

3.2.3 Causes of deforestation and loss of ecological habitats

These forests have been modified by anthropogenic influence in the form of shifting cultivation, cutting for firewood and timber, unchecked grazing by domesticated animals etc. spread of settlement and urbanization, and industry. Other avenues of interference are roads, quarrying, and commercial tourism.

Logging of wood and Collection of firewood , cutting for fuel, lesser timber and the making of charcoal
Tree felling is rampant and minor forest produce is extracted from protected areas and forests. Presently the principal pressure on these sites is by tribal residents of villages near the forest margins. Four groups live in the valley: Koli,Warli, Thakur and Katkari (Anonymous 1982). The Warli traditionally used forest products and had an excellent knowledge of forest biodiversity (Save 1945). Such groups have lived in the area before and throughout this history. At low population densities their original impact on these forests was probably minor.

According to a study done on the Human Disturbance and Forest Diversity in the Tansa Valley, India by Radha Veach, David Lee and Tom Phillipi[2], All of the sites were subject to this pressure on their margins, but some contained areas that were more protected because of isolation. Certain observations (like tree stumps) document disturbance at least two decades ago. This was due to the collection of firewood and illicit tree felling near forest margins. Most visitors in the forests were collecting firewood. These collecting activities drop rapidly beyond 2 km into the forest. Forests adjacent to the villages of Usgaon and Keltan were dramatically different compared to more isolated ones nearby, like the hills above Usgaon and those at the base of Mandagni Peak. Intense exploitation for firewood and timber dramatically reduced the biomass in these areas, and also reduced diversity. Only certain species important for other uses are exempt from such collecting. The only large trees close to the villages were those with a particular value for the villagers, e.g. fruit. Yet, considerable diversity of hacked and stunted plants persisted, even within 500 m of these villages. Presumably the species surviving in the areas near villages are subject to repeated lopping for firewood, fires and browsing by animals. Still, woody plant diversity is surprisingly high near the villages. These species, typically those with the widest distributions in the valley, are extremely resilient. (Refer Appendix)

[2] *Human Disturbance And Forest Diversity In The Tansa, Valley, India, Biodiversity and Conservation*, Kluwer Academic Publishers, 2003.

During 1998-99, total forest revenue of the district was Rs. 51,491 thousands which was increased by 21.62% compared to the year 1997-98. The revenue received from Timber wood and Fire wood is 84.51% of total forest revenue.

- **Deforestation of hills due to shifting cultivation-**
  In the hilly regions the practice of cutting and burning of vegetation for shifting cultivation leads to deforestation and loss of habitats.

- **Deforestation for brick kilns**
  Brick kilns also consume firewood as fuel and saw dust, a constituent which is one of the reasons for deforestation.

- **Forest fires**
  Fire is an additional human impact in these forests, mostly near villages, but burning up-slope for considerable distances.

- **Collection of minor forest produce:**
  Certain forest species important for other uses are exempt from such logging and collecting. These collecting activities drop rapidly beyond 2 km, but other products are gathered throughout the forests. Collection of most minor forest products has little effect on forest structure and biomass, but may sometimes contribute to tree mortality (like gum collecting in Sterculia urens).

- **Grazing**
  The percentage of forest area in the district is higher than the percentage of 33 prescribed by the national forest convention. But the cattle population of 730,655 in the district is such that it puts a heavy strain on the grazing capacity of the forests. The grazing is free and unrestricted and constant trampling of the forest floor during the rainy season prevents not only the germination of seed but also kills the regeneration. This resulted in the sparseness of tree-growth Map no. 3.2 indicates sparseness of forests around forest edges indicating the impact of activities such as grazing and logging for firewood.

3.2.3.1 Impact of deforestation on fauna and wildlife:

The pressure of population and the inroads made by the urban population from Bombay and Thana, as also rural population from the district in the forest areas for cultivation have disturbed a large portion of the forest for growth and breeding of animals. The disturbance of wild life in their natural habitat due to increased human activity for collection of fire-wood, leaves and general forest produce has also contributed to the reduction in number of animals and their breeding. Also large-scale poaching for meat, skins and feathers by villagers and traders has been detrimental to wildlife. The misuse of guns, meant for crop protection, for killing wild animals by various sections of population has also been quite large.

- **Loss of riparian vegetation and in-stream habitats**
  Vegetation and habitats along rivers and streams are destroyed. The sand dredging activity is a threat to riparian and in stream habitats. The importance of in-stream habitats and bank vegetation is not understood and there are no efforts for their conservation and protection. There is Removal of riparian vegetation for agriculture or urbanisation.

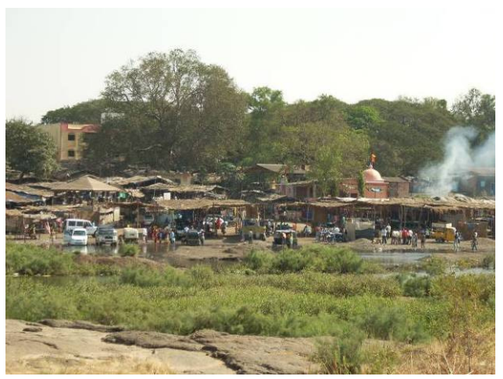
The burning of slopes around villages

The planting of exoticspecies near Akloli hot springs

Grazing on slopes around villages

Brick kilns replacing agricultural lands.

Loss of Riparian vegetation, through sand Dredging



Loss of riparian vegetation due to encroachment.

Developments and encroachments for tourism and religious activity in or on the banks of river beds and at thermal spring locations have affected the hydrology and local ecosystems.

3.2.4 Stresses on Mangroves and Coastal Wetlands

Mangroves are exploited for their fuel and timber resources. As seen from the satellite image analysis a large area of mangroves is either degraded or stunted. There is loss of mangrove habitats, through reclamation and filling of coastal wetlands, sand dredging, deforestation for creation of saltpans.

Kharland development – Protective walls to stop the ingress of seawater and provide more land for agriculture have threatened the survival of the mangroves. Incompatible and even dangerous land uses patterns and urbanization further threatens marine ecosystems.

3.2.5 Stresses on fertile agricultural lands

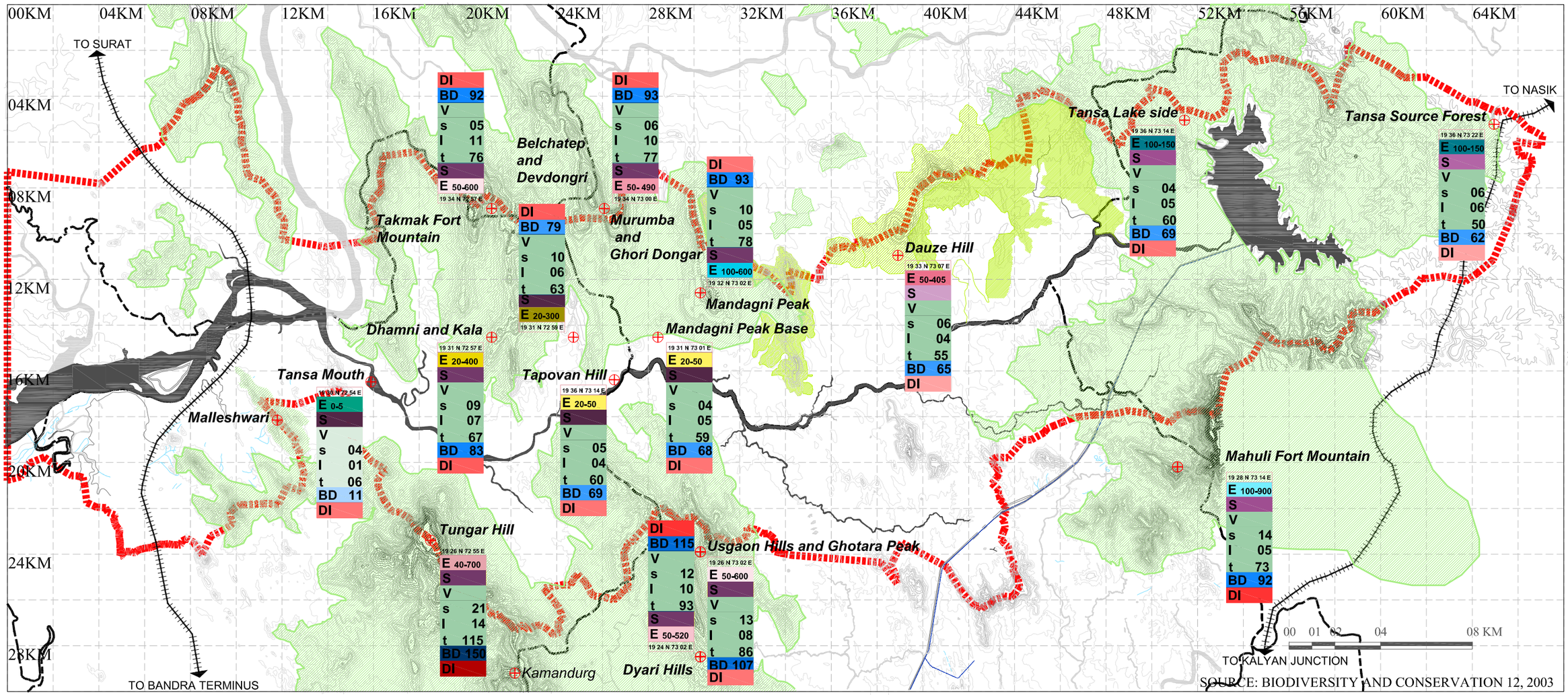
There is a loss of fertile agricultural lands which are being converted to brick kilns. Precious topsoil having high organic content –is a non renewable resource and is being used for manufacturing bricks for construction activity.

3.2.6 Other causes:

Removal of native vegetation and Landscaping and plantation with exotic species in resorts, private farmhouses and tourist areas for beautification. Monoculture plantations by the forest department with Eucalyptus, Australian Acacia and Subabul species.

Stone quarrying on hill slopes, near Ganeshpuri.

Erosion due to sand dredging along the banks of the Tansa.



SOURCE: BIODIVERSITY AND CONSERVATION 12, 2003

As per the report on *Human Disturbance and Forest Diversity in theTansa* Valley. Of the 15 forested sites in the *Tansa* Valley the highest disturbance index was recorded at a site within Tungar Forest which has also the highest diversity index. This area is ranked as the eight most important bio diversity spot in India and merits the highest priority for conservation.The degree of forest disturbance was mapped at each site on a scale of increasing disturbance from 1 to 10, where 1 would be a forest of closed canopy, no evidence of timber cutting or extraction of minor forest products, with a canopy 20-25 m high, 5 would be occasional stumps of cut trees, evidence of frequent exploitation of minor forest products and a partly open canopy, and 10 would be no standing trees and numerous shrubs

LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- RIDGE DIVIDE
- TANSA RIVER
- FOREST COVER
- SCRUB
- BIODIVERSITY STUDY POINTS

BIODIVERSITY

- 1 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

ELEVATION AND VEGETATION

- 0 - 5
- 20 - 50
- 20 - 300
- 20 - 400
- 40 - 700
- 50 - 405
- 50 - 490
- 50 - 520
- 50 - 600
- 100 - 150
- 100 - 600
- 100 - 900
- V VEGETATION
- s SHRUBS
- l LIANAS
- t TREES

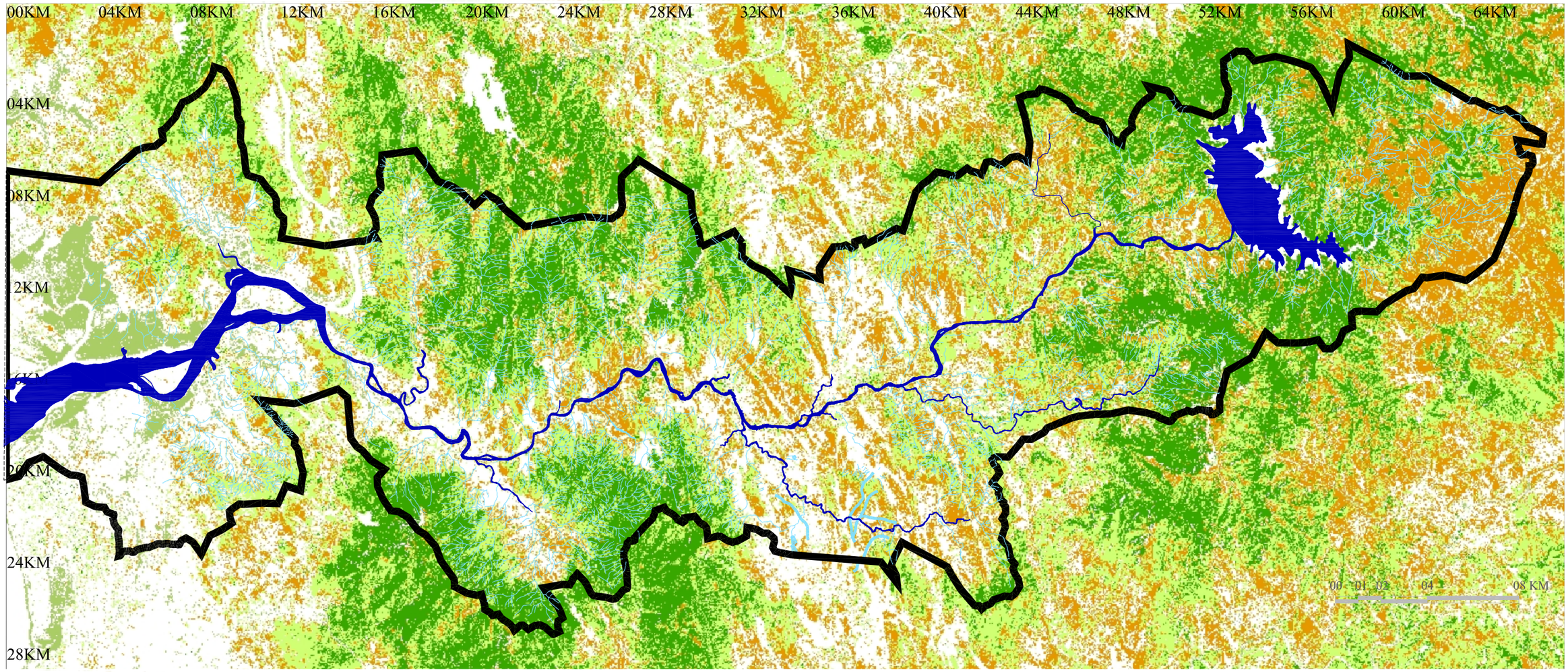
DISTURBANCE INDEX

1 2 3 4 5 6 7 8 9 10

ENVIRONMENTAL STRESSES: DISTURBANCES TO THE BIODIVERSITY

00 01 02 04 08 KM

ENVIROMENT MANAGEMENT PLAN FOR THE GEO-THERMAL ZONE OF THE TANSA RIVER BASIN, 2008, DESIGN CELL- KAMLA RAHEJA VIDYANIDHI INSTITUTE FOR ARCHITECTURE AND ENVIRONMENTAL STUDIES, JUHU SCHEME, VIDYANIDHI MARG, JUHU SCHEME, MUMBAI - 400069, website:www.krvia.ac.in



SOURCE: SURVERY OF INDIA MAPS, 1972.
Satellite Image-ETM+ WRS-2, 2000-12-02, EarthSat, Ortho, GeoCover,India

The map indicates areas where there has been a loss of habitats, through analysis of satellite imagery,to understand areas of sparse forests, denuded slope, degraded mangrove, confirmed by visual surveys on site.

1) **The areas of sparse forests** that occur mainly till a distance of two kilometres around the edges of forests, that show the impact of activities such as logging, collection of firewood
2) **Denuded slopes** that show the impact of grazing, burning of up slopes, etc. on the vegetation.
3) **Degraded mangroves** towards the coast where sand dredging activity, salt pans, etc have destroyed the mangroves.
4) **Loss of in-stream and riparian habitats** due to deforestation, dessication, pollution and construction.

- TANSA RIVER
- RIDGE DIVIDE
- STREAMS
- DENUDED SLOPES
- SPARSE FOREST
- DEGRADED MANGROVES
- DENSE FORESTS

ENVIRONMENTAL RESOURCE BASE: DEFORESTATION AND LOSS OF HABITATS

00 01 02 04 08 KM

3.2

3.3 Stresses on Physiography and Hydrology

3.3.1 Physiography

The main stress on physiography is erosion, and there are several causes for erosion and areas susceptible to erosion as listed below that occur within the study area. (Refer Map 3.3)

- **Deforestation**
  The edges of the forest show sparse vegetation and denuded slopes seen in the satellite image analysis of the region indicate the loss of natural vegetation cover. Removal of natural vegetation cover leads to erosion of soil and siltation in waterbodies.

- **Brick kilns and Loss of topsoil**
  Fertile agricultural lands are being converted to brick kilns. Fertile topsoil is used for manufacturing bricks leaving the lands exposed, fallow/prone to erosion.

- **Areas having Steep slopes**
  Slopes of 20 degrees and more as per the definition by the Ministry of Environment and Forests. These areas are prone to erosion.

- **Shifting cultivation**
  Shifting cultivation in the catchment increases the of rate erosion and siltation in reservoirs. In the hilly regions the practice of cutting and burning of vegetation for shifting cultivation leads to enhanced soil erosion, formation of gullies and drying up of streams and springs resulting in the destruction of their channels and habitats within them

- **Excavation, quarrying and removal of soil:**
  Blasting, digging and excavation results in erosion and loss of topsoil. These borrow areas include bare hill slopes, depressions and quarries.

  Quarrying for stone for construction material is observed in the area.

- **Landslides-**
  Landslides occur due to natural causes when a mass of rocks or earth slides down a slope.

- **Sand dredging**
  Sand dredging and removal of sand from river beds is a major cause for erosion of the river beds. Excavation and deepening of the river bed leads to the deepening of natural water channels and courses. This may result in the instability of river banks which become more susceptible to erosion and are likely to collapse.

3.3.2 Impacts on Hydrology

Modern water management systems that deepen mainly on arresting flows and creating storages fundamentally affect the ecology of streams and rivers. These management systems produce impacts on the ecology of streams by neglecting their source regions and indirectly leading to deforestation and destruction of wildlife habitats, checking their flow, blocking fish migration, drowning or destroying in-stream habitats, riparian zones and vegetation and submerging a sizable portion of the floodplain under reservoirs thereby destroying its productive potential.

Dams arrest the flow, changes flow patterns, sets up different temperature regimes and gradients in the reservoir and gives rise to deoxygenated cold water, leaving too little base flow in the channels which in turn affects the innumerable life forms. When flows are converted to stagnation and floods are not allowed to perform their functions of cleaning and replenishing the river basins, the normal natural regime of an aquatic ecosystem changes, affecting water quality, channel geometry, and riparian zone, floodplains and even deltas. This drastically transforms the riparian and in- stream habitat conditions destroying their life support systems, especially vegetation and creating different temperature gradients. If such changes are drastic the aquatic ecosystem fails to support biodiversity.[3]

Productivity in the upper reaches of the stream is affected by secondary and tertiary changes such as cutting of forests, expansion of settlements, industry etc. Forest cutting shifting cultivation, grazing have impoverished these zones, dried up perennial springs, increased run off and have led to silting of reservoirs.

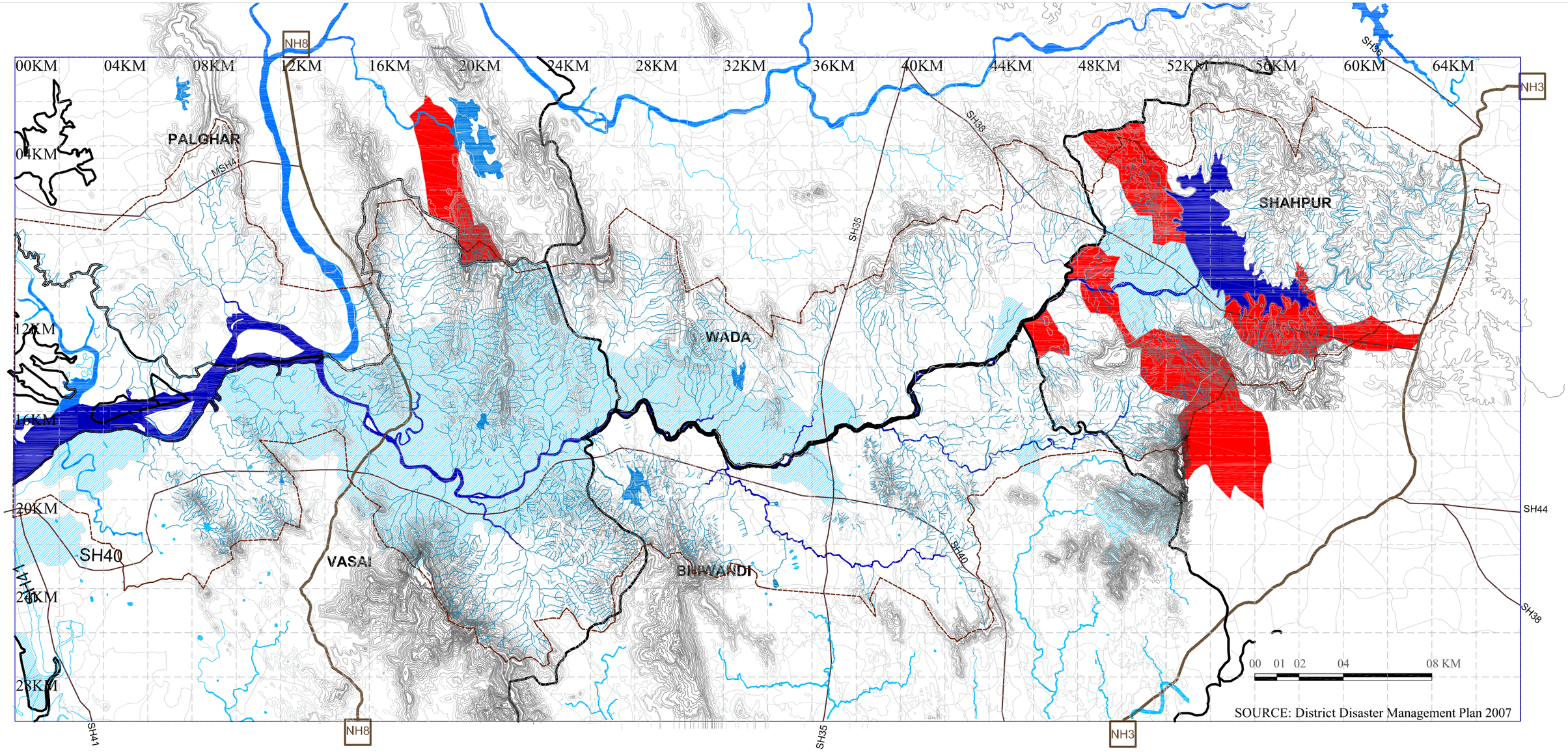
Changes in the landscape have affected the flow regime of streams and rivers, their water quality, the absorptive and moisture retaining qualities of the soil, the levels of the underground water-table and the distribution of flora and fauna.

3.3.2.1 Floods (Refer Map 3.4)

Modification in the terrain and water channels has led to flooding in certain areas. Release of water from the Tansa dam results in regular flooding in the low lying areas surrounding it. Map no. 3.4 indicates the affected villages within the study area. Flood prone villages within the study area Savroli, Kurd, Dimbhe, Vedhval Tansa, Aghai, Bhatsa and Mahuli in the Shahapur taluka.[4]

[3] Prakash Gole , Nature Conservation and sustainable development in India. Rawat Publications, August 2001.

[4] Source: District Disater Management cell, Thane district



The study has identified broad areas in which flooding occurs regularly as well as thosse susceptible to occassional floods. the areas indicated on the map are the administrative boundaries of the village and do not represent actual areas of flooding.
The areas prone to chronic flooding, (maarked in red) indicate that the building of the reservoirs and the release of excess water from the dams is the main cause of flooding in low lying areas around as ithas disturbedthe natural course of the river along the slopes.

L E G E N D: FLOODING PATTERNS
VILLAGES SUSCEPTIBLE TO REGULAR FLOODING
VILLAGES SUSCEPTIBLE TO OCCASSIONAL FLOODING

FLOOD PRONE VILLAGES WITHIN THE STUDY AREA

TALUKA	RIVER	VILLAGES
SHAHPUR	TANSA	1. Savroli, 2. Kurd, 3. Dimbhe, 4. Vedhvai, 5. Shahapur
	VAITARNA	1. Tansa, 2. Aghai, 3. Bhatsa,
		4. Mahuli
PALGHAR		1. Ganje

VILLAGES SUSCEPTIBLE TO OCCASSIONAL FLOODS

TALUKA	RIVER	VILLAGES
BHIWANDI	TANSA	1. Ambadi, 2. Ravati, 3. Chirambpada
SHAHPUR	TANSA	1. Bhavsi, 2. Mahuli, 3. Baleghar, 4. Thahapur, 5. Aghai, 6. Nevda, 7. Timbhe, 8. Velvahar
VASAI	TANSA	1. Naigaon, 2. Malavande, 3. Panju, 4. Kalamb, 5. Arnala, 6. Arnala killa, 7. Chikhaldongri, 8. Shiravli, 9. Parol, 10. Chandip, 11. Khanivde, 12. Hedvade, 13. Chimane, 14. Bhalivli, 15. Kashid Kopar, 16. Kachrali, 17. Kardi Koshimb, 18. Dolib, 19. Shivansai, 20. Mandvi, 21. Adne, 22. Usgaon, 23. Bhatane, 24. Navsai, 25. Vadghar, 26. Shirsai, 27. Saiwan, 28. Dahisar, 29. Kalbon, 30. Ambode,31. Bhinar, 32. Medhe.
WADA	TANSA	1. Nimbavli, 2. Gorai, 3. Chamble, 4. Met, 5. Dakivli, 6. Usar, 7. Borsheti, 8. Kelthan.

Developments and encroachments for tourism and religious activity in or on the banks of river beds and at thermal spring locations have affected the hydrology and ecosystems.

Deforestation on hill slopes and in the catchment areas increases the rate of runoff causes flooding in low lying areas in the floodplains and near the coast. Loss of wetlands and mangroves which absorb excess water and act as a cushion against floods would also lead to flooding in low lying areas near the coasts.

Resorts and hotels are built on the edge of the river, encroaching on its natural floodplains, partially chanellising it. In Ganeshpuri and Vajreshwari several resorts build pools/tanks within the river.

3.3.2.2 Stresses on Ground water

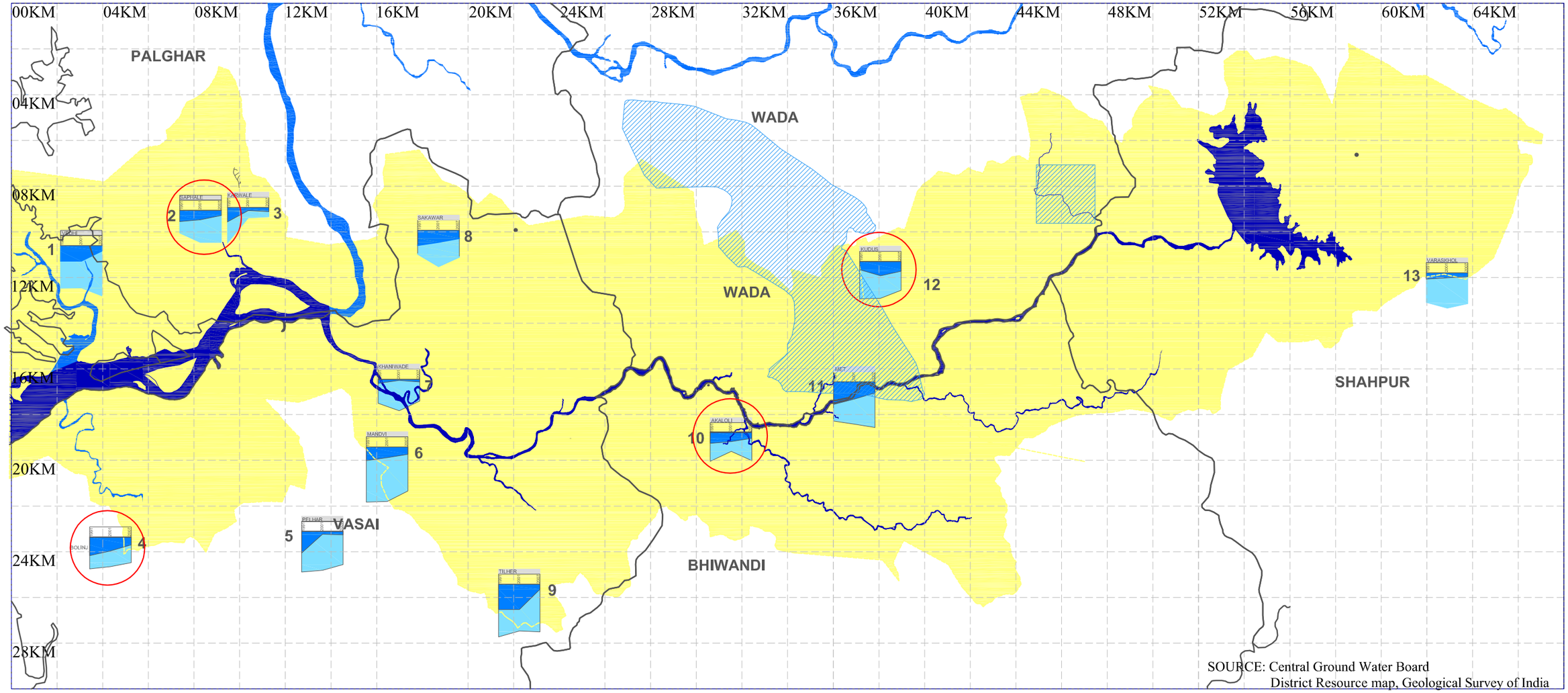
- ***Lowering of the water table***

Increase in the rate of deforestation will have an impact on ground water levels in certain areas.

Construction of bore-wells and increased drawing of ground water for tourism activities, swimming pools etc have an impact on ground water levels. This will have an impact in the areas around the proposed RTD zone. Tourism related activities such as resorts and hotels with swimming pools and landscaping draw large amounts of ground water as revealed in case studies in Goa[5], and can lead to lowering of the water table. Extensive hard-paved areas for landscaping in urbanised areas affect the percolation of water and affects ground water levels.

Due to excessive drawing of ground water near the municipalities of Vasai, salinity of these areas has increased thereby affecting farming and plantations. Map no. 3.5 indicates lowering of groundwater levels in Akloli, Met lying along the Tansa and Saphale and Vedhi along the coast. The Geological Survey of India recommends the area to the north of the Tansa, where the main aquifer lies, in the region of the high Lateritic plateau for ground water development.

[5] *Tourism and the Environment, Case studies of Goa, India and the Maldives* By Kalidas Sawkar, Ligia Noronha, Antonio Mascarenhas, O.S. Chauhan and Sinaad Saeed. Economic Development Institute of the World Bank, 1998.



SOURCE: Central Ground Water Board
District Resource map, Geological Survey of India

The map was generated from data provided by the Ground Water Control Board, as to the levels of ground water in the months of may and october in the years , 1991, 2001, 2007 and pollution levels.
The Hydrology map of the region from trhe District Resource map identifying aquifer areas was overlayed over it .

L E G E N D: GROUND WATER LVL.

- GROUND WATER LEVEL (MAY)
- GROUND WATER LEVEL (OCTOBER)

L E G E N D: CHEMICAL COMPOSITION

- TANSA WATERSHED
- ABOVE PERMISSIBLE LIMIT
- ABOVE ACCEPTABLE LIMIT
- VILLAGES WITH CRITICAL LEVELS OF POLLUTION
- AQUIFER ZONE

L E G E N D: WATER QUALITY	1. VEDHI	2. SAPHALE	3. KARWALE	4. BOLINJ	5. PELHAR	10. AKALOLI	11. MET	12. KUDUS	13. VARASKHOL	
Turbidity	0.1	1.0	1.0	0.3	1.0	0	3.4	0.2	0.2	Turb
pH	7.6	8.2	8.2	8.1	8.8	8.3	6.9	8	7.3	pH
(Cond) Conductivity	308	1110	305	2910	606	157	597	921	249	Cond
(TDS)Total Dissolved solids	197	710	195	1862	140	100	382	589	100	TDS
Th	148	256	180	1052	140	292	280	332	116	Th
(Ca) Calcium	48	53	50	64	43.2	50	5	99	32	Ca
(Mg)Magnesium	6.7	30	13	214	7.68	40	64	20	8.6	Mg
(Na) Sodium	6.7	110	10.6	297	64.8	38	23	5	11	Na
(K) Potassium	0.8	19	6.2	39	1.7	6	0	0	1	K
Fe (Iron)	0.05	6.05	6.1	0.05	0.1	0.1	0.25	0.05	0.05	Fe
(T Alk) Total Alkility	156	352	132	360	112	208	232	92	88	T Alk
CO3	0	0	24	96	16	32	0	0	0	CO3
HCo3	136	352	108	264	96	176	232	92	88	HCo3
Cl	32	104	34	670	114	82	62	146	32	Cl
SO4	84	43	15	76	9.9	49	31	35	19	SO4
(P) Phosphorous	0.1	0.05	0.2	0.1	1.1	0.1	0.2	0.28	0.7	P
NO3	11	11	3	13	12	14	13	31	6	NO3

The data, shows that there has been a steady rise in ground water levels in all areas except Vedhi (1), Met (11), and Akloli (between 2001 and 2007) and Saphale towards the coast.
The industrial area around Wada shows high levels of ground water pollution, as recorded at Kudus. Whereas the GSI has identified this region, being the aquifer zone, for ground water development.
Bolinj seems to have most critical levels of ground water pollution due to its proximity to Virar and sewage and industrial pollution. saphale too with a recession in the ground water level and high ferrous content has a critical gorund water condition.

ENVIRONMENTAL RESOURCE BASE:STRESSES ON GROUND WATER

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Littering and disposal of scrap and waste near sand dredging areas and settlements.

Ipomoea carnia growth indicating discharge of sewage and pollution along the river edge

Industrial activity along the river edge, at Wada.

3.4 Environmental Pollution

- **Surface and Ground Water Pollution**

  According to the MPCB, the Tansa has class A II water from the Tansa dam to the saline zone, which means that it is water suitable for public supply with adequate treatment.

  The use of fertilizers- The use of chemical fertilizers in the region may also have led to pollution of ground and surface water, as shown in map 3.6, and 3.7.

- **Industries**

  Discharge of untested and toxic effluents by industries in the region has resulted in pollution in streams and waterbodies. The primary causes of Ground water pollution are industrial activites.

  The data obtained from the Ground Water Control Board indicates high levels of ground water pollution near urbanized and industrialized areas. The industrial area within Wada, north of the Tansa shows impacts of industrial pollution on ground water as the readings at Kudus indicate high levels of TDS, Thorium and Magnesium.

- **Sewage**

  Sewage is discharged directly into streams. In Urbanized areas/recreational areas storm water drains and nallas are converted into open sewers discharging untreated sewage directly into streams and surface water bodies. There are encroachments along the river and stream banks with inadequate sewage treatment facilities. Discharge of sewage in streams rivers, nallas, lakes and talaos has resulted in eutrophication and the proliferation of weeds like Ipomoea carnea.

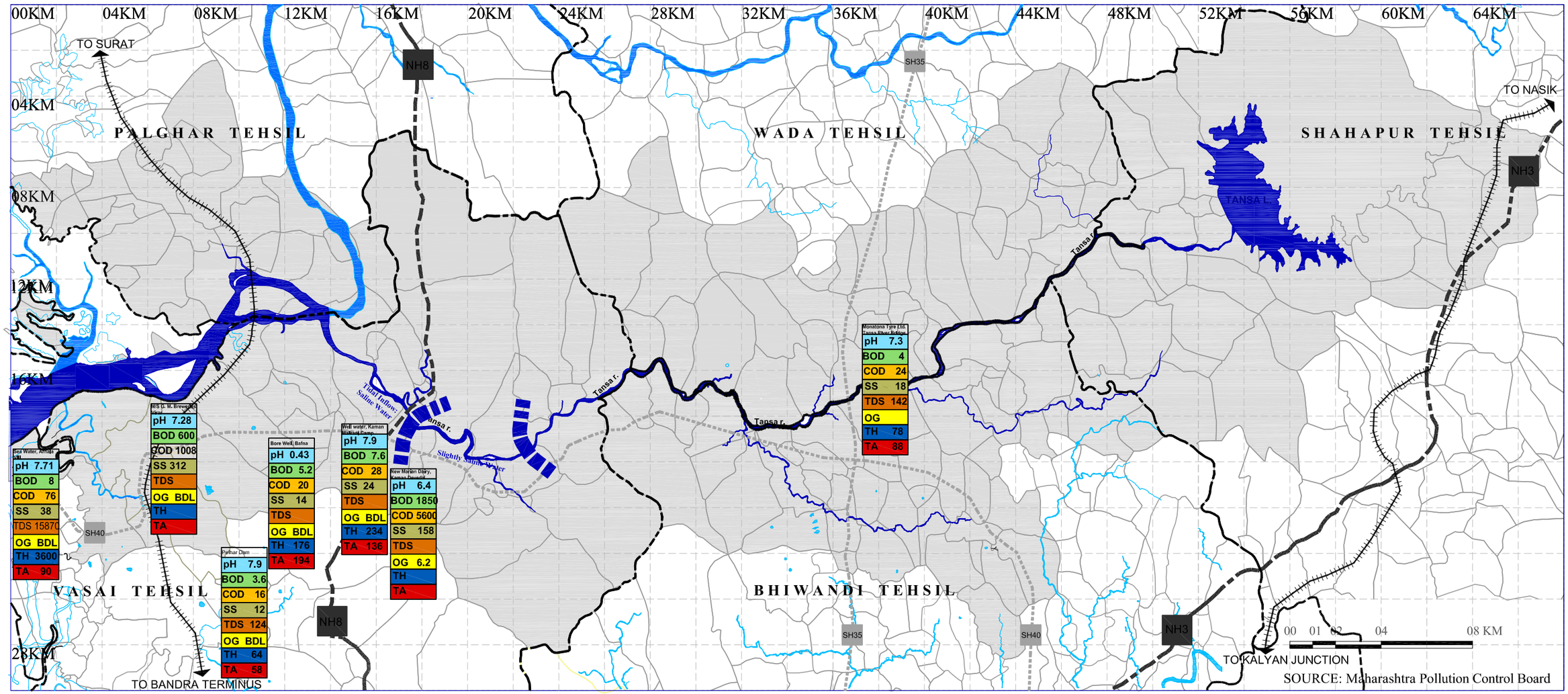
  Unchecked flows of sewage , industrial effluents, toxic materials, agricultural run offs have affected coastal and marine ecosystems, resulted in algal blooms, fish kills, crash in populations of marine organisms and the failure of their reproductive capacities. Bolinj lying along the edge of Virar, shows high levels of water pollution, (Refer map no.) related to urbanisation and polluting activities. Construction activity leads to soil erosion in the catchment areas and the deposition of construction debris and silt in river channels.

- **Solid waste**

  Lack of adequate garbage disposal facilities in villages and areas of tourist interests causes littering

  Garbage disposal and littering by tourists increases due to increase in commercial and recreational tourism activities. Littering in forest areas has been reported in forest areas especially during festivals such as Mahashivratri when hawkers and tourists litter within the forest.[6]

[6] As reported in *Protected Area Update*, Kalpvriksh, April 2007



The data for water pollution was compiled from the data provided by MPCB. The water of the Tansa is classified as A2 (suitable for public water supply after treatment) from the reservoir till the coast. although there is a level of COD, which may be attributed to fertilizer chemicals used through the region
There are high levels of BOD and COD found in Virar in the study area, and at Arnala the levels of COD in the sea water as defined by the safety levels of the MPCB is Not fit for Fish & Wildlife Propagation.

LEGEND:

- TEHSIL BOUNDARY
- RAILWAY LINE
- NH4 NATIONAL HIGHWAY
- SH35 STATE HIGHWAY
- TANSA RIVER
- STUDY AREA
- pH
- BOD BIOLOGICAL OXYGEN DEMAND
- COD CHEMICAL OXYGEN DEMAND
- SS SUSPENDED SOLIDS
- TDS TOTAL DISSOLVED SOLIDS
- OG OIL AND GREASE
- TH TOTAL HARDNESS
- TA TOTAL ALAKALINITY

DEMOGRAPHIC PATTERNS : WATER POLLUTION

00 01 02 04 08 KM

3.5 Resource depletion and loss of livelihoods

The science of environmental economics has brought out the connection between human activity and the finiteness of resources. The region has a limited resource base and overexploitation and insensitive development in the area would lead to the loss of valuable resources.

- **Marine resources Estuaries and Mangroves**

  Mangroves are exploited for their fuel and timber resources. The satellite image shows large areas having degraded mangrove habitats with stunted growth. Their importance as breeding grounds for marine fish and other creatures has declined. This has affected the traditional fishermen who depend on fish which breed on the mangrove swamps for their livelihood.

  In the estuaries, not only has the quantity of fresh water flowing down from the uplands reduced, the water that flows in shows marked temperature ups and downs that kill the fish spawn. The reasons for this are dams built for irrigation and pollutants from industries.

  Marine resources have been over-exploited resulting in the exhaustion of fisheries. Local fishermen also have to face stiff competition from trawler owners who demand that they should be allowed to fish during the monsoon season, the breeding season for fish (when no traditional fisherman goes out to sea.)

- **Fertile Topsoil and agricultural lands:**

  There is seen within the region a replacement of agricultural activity, through conversion of fertile agricultural land to brick kilns. This is in response to the growing demand due to the regions proximity to the Mumbai and greater profitability of brick making as compared to agriculture.

  This results in a loss of fertile agricultural lands and is a threat as it affects food security.

3.6 Privatization of Common Property Resources

Tribals and local communities are dependent on resources such as forest, water bodies etc. Privatisation or change in ownership of land would deprive them of the source of sustenance and livelihood. Luxury and commercial tourism is promoted with disregard of the interests of the residents and local fishing communities. Commercial tourism, intensive mechanical fishery, lead to heavy pollution, degradation of biodiversity and accentuated social inequalities in terms of access to natural resources such as ground water,forests etc. .

- **Hot springs**

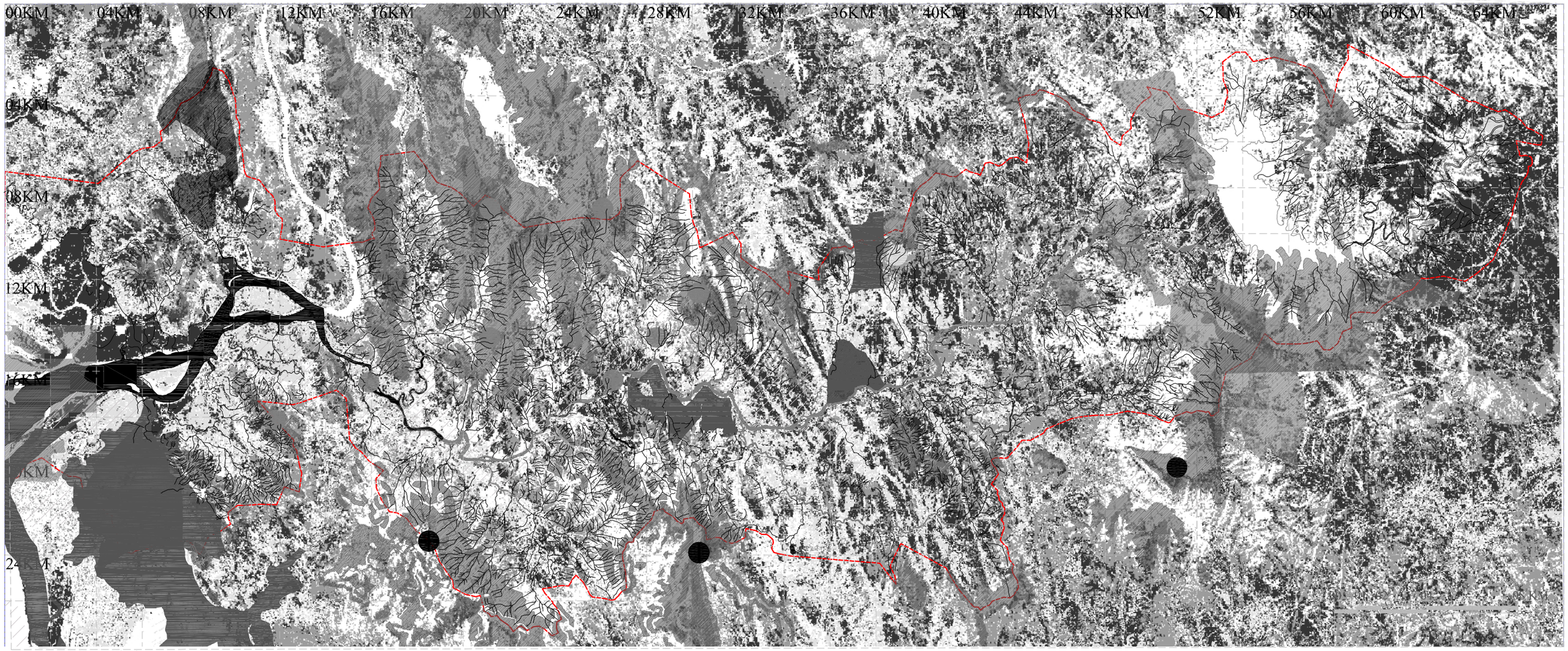
  There hot springs within the villages of Akloli, Ganeshpuri are currently a resource that is a part of the everyday lives of the local communities. Currently at Akloli, based on local interviews we learnt that access to these has already been restricted as the influx of tourists into the areas, during the day means that the springs are polluted and dirty during these hours and can be used by locals only late in the evenings.

  A greater threat however, is the fact that the Temple Trusts are in the process of acquiring large tracts of land, around 163 hectares of land is held by various trusts in Vajreshwari and Ganeshpuri. While the Siddhapeeth Trust has fenced land exclusively for its own activities, the lands owned by other two trusts have indigenous tenants inhabiting them.[7]

3.7 Conclusion:

The study indicates that the environment of the Tansa river Basin, being in close proximity to Mumbai, is subject to pressures put upon it from outside. The pressures of development such as urbanization, new recreational zones being carved out of existing systems of livelihood and sustenance are incremental changes that are unrelated to the natural processes on site. But the aggregate consequences of each development have to be calculated. Natural processes are unitary whereas human interventions tend to be fragmentary and incremental. The effect of filling estuarine marshes or felling the upland forests is related to the water regimen. The felling of upland forests is related to flood and drought. Certain developments are deleterious to natural processes at large (for example clear felling of forests or conversion of farmland into subdivisions) It is unlikely that long term benefits accrue from the rupture of natural processes; and it is quite certain that substantial costs will result from this. Finally in general any benefits that do occur- usually economic tend to accrue to the private sector, while remedies and long term costs are usually the loss of resources that belong to the public domain. **Map 3.7 indicates areas of high moderate and lower stress within the region.**

[7] *Preliminary study of Akloli, Vajreshwari And Ganeshpuri Tourism Region, Suggestions and recommendations towards preparation of Development Plan*, Collective Resources initiatives Trust, June 2004



The map has been created by overlaying the various stress-related maps. to generate a spatial understanding of stressed areas and intensities within the study area.
the various stresses were graded from high to moderate to low on the basis of their cumulative stresses on the envionment. Polluting, and activities that transform the environment completely were graded as high. High stress activities also included natural stresses in sensitive areas such as steep slope and stream areas susceptible to erosion. Areas of low stress were fallow lands, however due to the inability to mark each and every brick kiln through the region these had to be included within low stress areas.

HIGHLY STRESSED AREAS (URBANISED, PROPOSED RTDZ, POLLUTED AREAS, DEGRADED MANGROVES, SAND DREDGING ACTIVITIES, DENUDED/ERODING SLOPES, CHRONIC FLOODINGPOINTS OF HIGH DISTURBANCE INDE- 8)

HIGHLY STRESSED AREAS 2(AREAS WITH STREAM EROSION STEEP, SLOPES SUSCEPTIBLE TO EROSION)

MODERATELY STRESSED AREAS (SPARSE/DISTURBED FORESTS, RIVER CHANNEL IN AREAS OF SETTLEMENT, STEEP SLOPES SUSCEPTIBLE TO EROSION)

LOW STRESS AREAS (BARREN AND FALLOW LANDS/ BRICK KILNS)

ENVIRONMENTAL STRESSES IN THE STUDY AREA

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3.6