HARIPAD MUNCIPALITY

&

LOCAL SELF GOVERNMENT DEPARTMENT PLANNING, ALAPPUZHA

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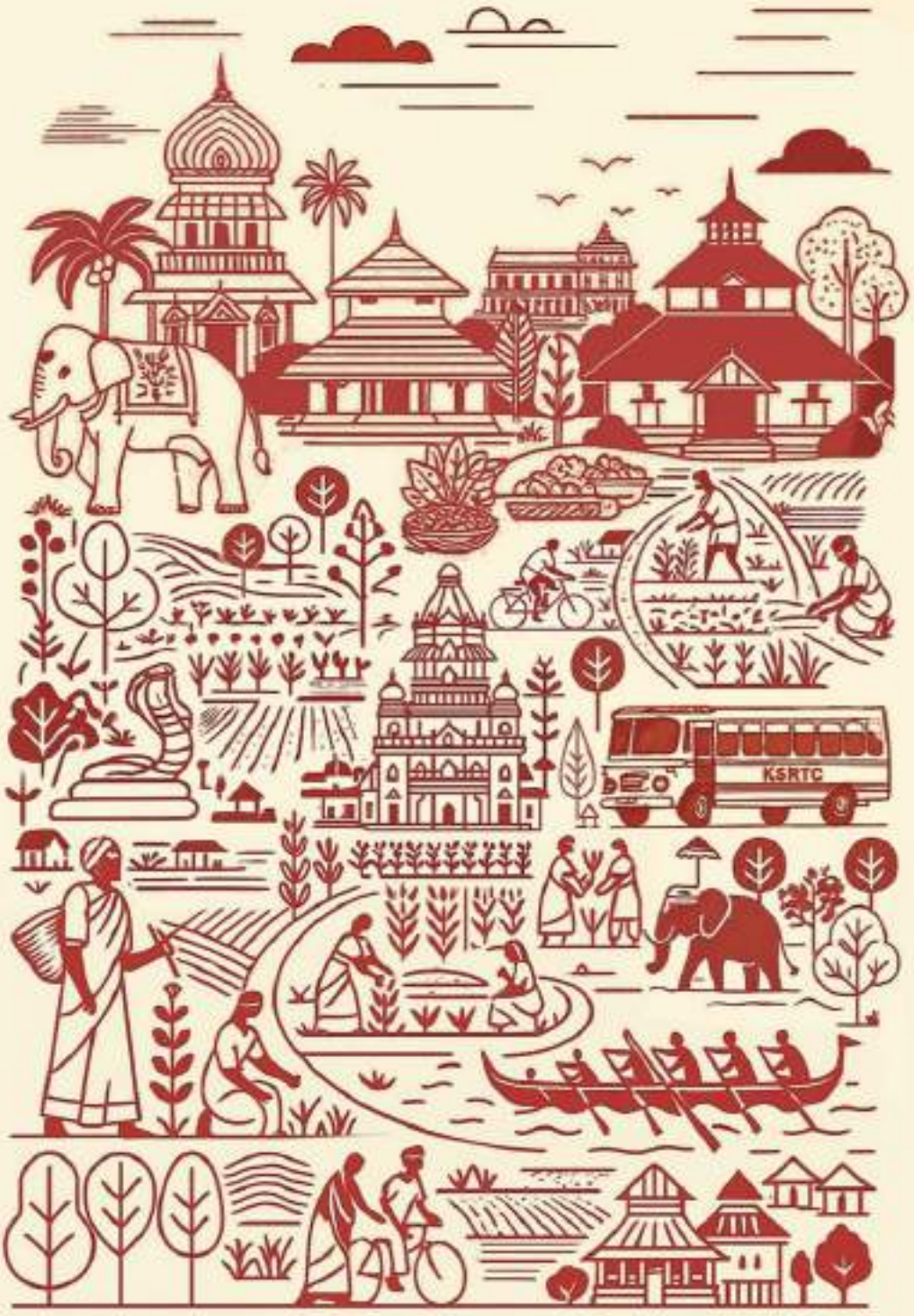

MASTER PLAN FOR HARIPAD TOWN -2045 (DRAFT)

MARCH 2026

VOLUME - II

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ABBREVIATIONS

ABC Centre	Animal Birth Control Centre
ADSs	Area Development Societies
AFD	Agence Française de Développement
AFPCNT, France	Association Française pour la Prévention des Catastrophes Naturelles et Technologiques
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy
BDL	Below Detection Limit
BHSS	Boys Higher Secondary School
BIS	Bureau of Indian Standards
BOD	Biochemical Oxygen Demand
BOT	Build-Operate-Transfer
BPCL	Bharat Petroleum Corporation Limited
BPL	Below Poverty Line
BPO	Business Process Outsourcing
CBs	Catch Basins
CDSs	Community Development Societies
CEREMA	Centre for Studies and Expertise on Risks, the Environment, Mobility and Urban Planning
CFCs	Common Facility Centres
CNG	Compressed Natural Gas
CPHEEO	Central Public Health & Environmental Engineering Organisation
CRF	Central Road Fund
CSI	Crash Severity Index
CSR	Corporate Social Responsibility
CWRDM	Centre for Water Resources Development and Management
dB	Decibel
DDMA	District Disaster Management Authority
DLI4	Disbursement Linked Indicator 4
DMO	District Medical Officer
DoECC	Directorate of Environment and Climate Change
DPC	District Planning Committee
DPR	Detailed Project Report
DRR	Disaster Risk Reduction
DTPC	District Tourism Promotion Council
DUR	District Urbanization Report
ECS	Equivalent Car Space
ENT	Ear, Nose, and Throat
ERTs	Emergency Response Teams
EV	Electric Vehicle
EWDS	Early Warning Dissemination System
EWS	Economically Weaker Sections

FC	Faecal Coliform
FGDs	Focus Group Discussions
FFDA	Fish Farmers Development Agency
FPA	Flood Prone Area
FSTP	Faecal Sludge Treatment Plant
GDP	Gross Domestic Product
GIS	Geographic Information System
GL	Ground Level
HQ	Headquarters
HDFC Bank	Housing Development Finance Corporation Bank
IAG	Inter Agency Group
ICDS	Integrated Child Development Services
ICICI Bank	Industrial Credit and Investment Corporation of India Bank
ICT	Information and Communication Technology
ID	Identity Document
IDF	Intensity–Duration–Frequency
IAG	International Airlines Group
IL	Invert Level
IMD	India Meteorological Department
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IPT	Intermediate Public Transport
IRC	Indian Roads Congress
IT	Information Technology
ITI	Industrial Training Institute
ITC	Information Technology Centre
ITS	Intelligent Transportation Systems
IWT	Inland Water Transport
JMK	Janakeeya Matsya Krishi
KILA	Kerala Institute of Local Administration
KITCO	Kerala Industrial and Technical Consultancy Organisation Limited
KPO	Knowledge Process Outsourcing
KSDMA	Kerala State Disaster Management Authority
KSEB	Kerala State Electricity Board
KSRTC	Kerala State Road Transport Corporation
KSSM	Kerala Social Security Mission
KSWMP	Kerala Solid Waste Management Project
KTCP Act	Kerala Town and Country Planning Act
KWA	Kerala Water Authority
KWH	kilowatt-hour
LANDSAT 8 TIR OLI	LANDSAT 8 Thermal InfraRed Operational Land Imager
LANDSAT 9 TIR OLI	LANDSAT 9 Thermal InfraRed Operational Land Imager

LAPCC	Local Action Plan for Climate Change
LCV	Light Commercial Vehicle
LDMP	Local Disaster Management Plan
LIFE	Livelihood, Inclusion and Financial Empowerment
LIG	Low-Income Groups
LiDAR	Light Detection and Ranging
LISS 4	Linear Imaging Self-Scanning Sensor-IV
LPG	Liquefied Petroleum Gas
LSG DM Plan	Local Self Government Disaster Management Plan
LSGD	Local Self Government Department
LSGI	Local Self-Government Institutions
LST	Land surface temperature
LULC	Land Use Land Cover
MAT	Multimodal Accessibility Target
MCF	Material Collection Facilities
MDR	Major District Road
MDMC	Municipal Disaster Management Committee
MLA	Member of the Legislative Assembly
MLD	Million Litres per Day
MoRTH	Ministry of Road Transport and Highways
MSL	Mean Sea Level
MSME	Micro, Small and Medium Enterprises
NATPAC	National Transportation Planning and Research Centre
NDBI	Normalized Difference Built-up Index
NDMA	National Disaster Management Authority
NDVI	Normalized Difference Vegetation Index
NGO	Non-governmental organization
NHAI	National Highways Authority of India
NH	National Highway
NHED	National Health Education and Development
NHGs	Neighbourhood Groups
NIR	Near-Infrared
NMT	Non-Motorised Transport
NOCs	No Objection Certificates
NTPC	National Thermal Power Corporation
NULM	National Urban Livelihoods Mission
NW-3	National Waterway 3
OA	Office Attendant
OD Matrix	Origin-Destination Matrix
OP	Outpatient
PCB	Pollution Control Board
PCU	Passenger Car Units
PH	Potential of Hydrogen

PHC	Primary Health Centre
PIU	Project Implementation Unit
PIP	Pampa Irrigation Project
PM	Particulate Matter
PMAY	Pradhan Mantri Awas Yojana
PMEGP	Prime Minister's Employment Generation Programme
PMMSY	Pradhan Mantri Matsya Sampada Yojana
PPP	Public Private Partnership
PS	Public & Semi-public
PVC	Poly Vinyl Chloride
PWD	Public Works Department
PV²	Pedestrian Vehicular Volume Method
Method	
RCP	Representative Concentration Pathways
RIMP	Risk-Informed Master Plan
RKDP	Rebuild Kerala Development Program
ROBs	Railway Over Bridges
ROW	Right of Way
RRTs	Rapid Response Teams
RUB	Road Under Bridge
SABLA	Rajiv Gandhi Scheme for Empowerment of Adolescent Girls
SAI	Sports Authority of India
SBI	State Bank of India
SC	Scheduled Caste
SH	State Highway
SHGs	Self Help Groups
SSK	Samagra Shiksha Kerala
ST	Scheduled Tribe
STP	Sewage Treatment Plant
SWIR	Shortwave Infrared
SWOT	Strengths, Weaknesses, Opportunities, and Threats Analysis
Analysis	
TDS	Total Dissolved Solids
TC	Total Coliforms
TCPO	Town and Country Planning Organisation
TPD	Tonnes Per Day
TPN	Thulaparambu North junction
Junction	
TVU	Train Vehicle Unit
UHI	Urban Heat Island
UHS	Urban Heat Hotspots
URDPFI	Urban and Regional Development Plans Formulation and
Guidelines	Implementation Guidelines
USGS	United States Geological Survey

UWSS	Urban Water Supply Scheme
V/C Ratio	Volume-to-Capacity (V/C) ratio
WPR	Work Participation Rate
WTP	Water Treatment Plant



PART II : INTEGRATED DEVELOPMENT VISION



PART II : INTEGRATED DEVELOPMENT VISION

1. DEVELOPMENT VISION
2. DEVELOPMENT CONCEPT
3. GENERAL POLICIES AND STRATEGIES

CHAPTER
28

DEVELOPMENT VISION



The Development Vision chapter defines the long-term aspirations that will guide Haripad's growth and transformation over the next twenty years. A well-articulated vision provides a unifying direction for sustainable, inclusive and resilient development, reflecting the town's priorities, opportunities and unique character. Goals and objectives serve as the actionable components of this vision, offering clear and measurable steps to steer planning decisions, sectoral strategies and infrastructure investments. Together, these elements ensure that Haripad's development remains coordinated, future-ready and aligned with community needs. This chapter presents the overall vision for Haripad and the set of goals and objectives adopted to achieve it.

- Vision Statement
- Goals and Objectives

28. DEVELOPMENT VISION

28.1 Vision Statement

A development vision shall be realistic and should represent the future direction of development. It sets the direction for long-term goals, which outline the overall development aims, and defines clear objectives that guide the strategies and actions needed to achieve them.

Haripad, with its rich historical background, was once a thriving trade centre, cultural hub, and administrative headquarters. Over time, changes in transportation modes and economic systems led to a decline in its traditional economic base. Despite these challenges, the town is gradually progressing by exploring new opportunities, particularly in the tourism sector.

This Master Plan aims to support a strategic revival of Haripad town by addressing the negative impacts of past transitions and making use of the town's inherent strengths and development potential. The vision is based on three key pillars of sustainable development: economic growth, improved quality of life, and environmental sustainability, and incorporates the principles of risk-informed planning.

Major challenges identified include the need for environmental conservation, provision of recreational facilities, and improvement of basic infrastructure such as water supply, sewerage, solid waste management, and drainage systems. Special priority is given to strengthening basic infrastructure and incorporating disaster risk reduction measures, especially considering the 2018 flash floods that severely impacted the Haripad region. This highlights the need for resilience in urban planning.

The Master Plan seeks not only to improve the living conditions and environment for the people of Haripad but also to ensure long-term, inclusive, and sustainable urban development. The vision has been developed through a detailed assessment of existing issues and opportunities, supported by the findings and recommendations of sectoral studies.

Considering this reality, the development vision of the town is defined as:

"To transform Haripad into a vibrant, resilient, and inclusive urban centre that harmonizes economic growth, environmental sustainability, agricultural potential, and social equity, while preserving its religious significance and cultural heritage, and enhancing its tourism potential to improve the overall quality of life for all residents."

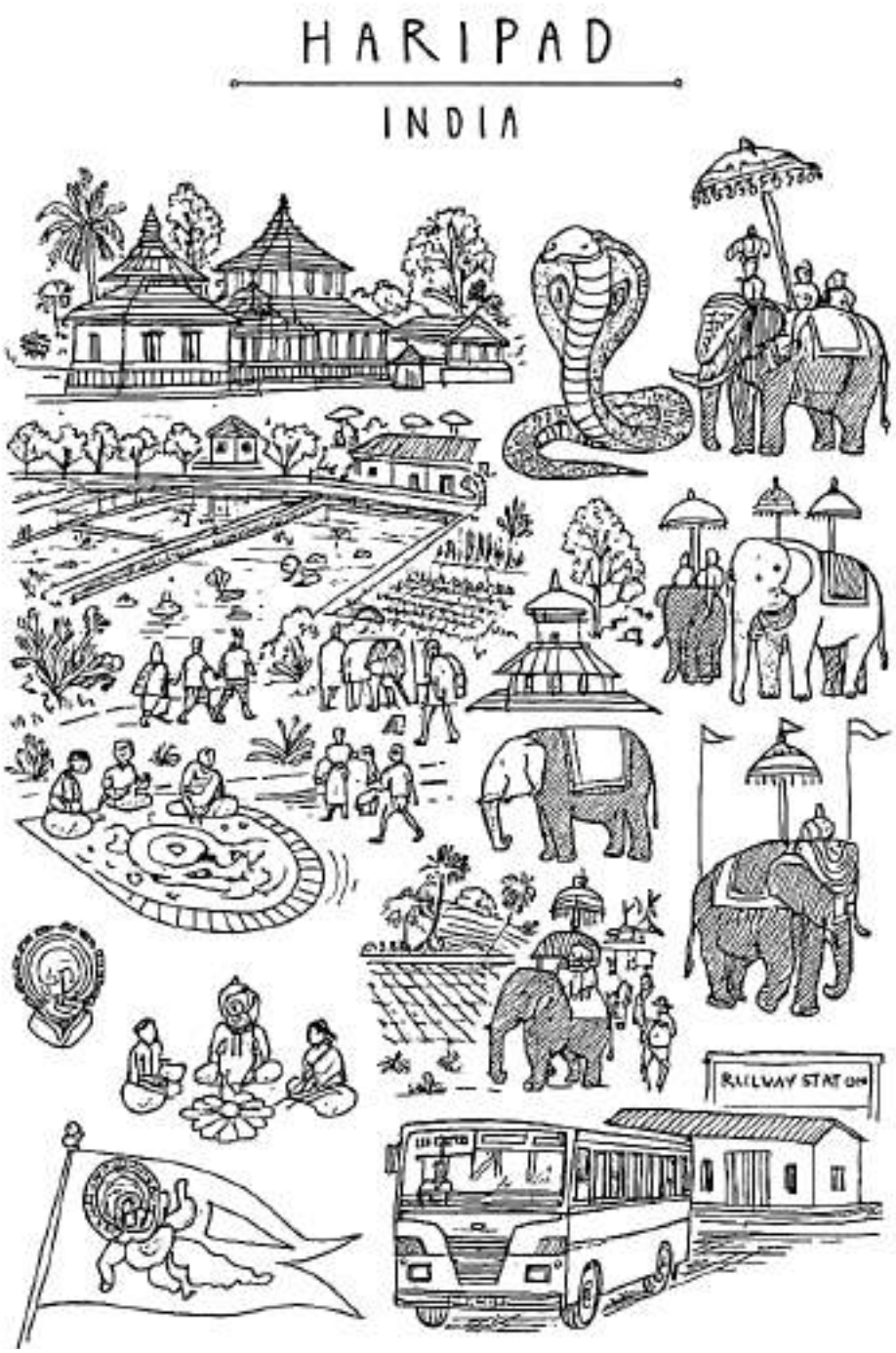


Figure 28.1 : Artistic illustration of Haripad's potential

DEVELOPMENT VISION

HARIPAD: A RESILIENT, INCLUSIVE, AND VIBRANT URBAN CENTRE WHERE HERITAGE, SUSTAINABILITY, AGRICULTURE, AND TOURISM DRIVE SHARED PROSPERITY.

"To transform Haripad into a vibrant, resilient, and inclusive urban center that harmonizes economic growth, environmental sustainability, agricultural potential, and social equity, while preserving its religious significance and cultural heritage, and enhancing its tourism potential to improve the overall quality of life for all residents."

28.2 Goals and Objectives

The objective of the Master Plan is to establish a comprehensive spatial and land use planning framework that facilitates the realization of the town's envisioned development. The development goals have been formulated based on insights drawn from a thorough analysis of the existing situation, including sectoral studies, local-level assessments, and spatial evaluations.

28.2.1 Goals

- To promote tourism through the advancement of cultural, heritage, and pilgrimage resources.
- To promote agriculture and allied sectors within the town.
- To protect ecologically sensitive areas and enhance the town's resilience to disasters.
- To ensure adequate and efficient drainage infrastructure in the town.
- To promote the development of small-scale industries in the town.
- To enhance quality of life by providing safe living conditions and inclusive environment.



Figure 28.2 : Development Goals for Haripad

28.2.2 Objectives

1. **To promote tourism through the advancement of cultural, heritage, and pilgrimage resources.**
    - Identify and conserve important heritage and pilgrim structures and sites within the town.
    - Improve infrastructure and amenities such as accommodation, parking, etc.
    - Enhance connectivity to major tourist and heritage sites.
    - Promote local arts, crafts, and cultural events as part of tourism development.
2. **To promote agriculture and allied sectors within the town.**
    - Promote farm tourism.

- Encourage the use of modern agricultural practices to improve productivity.
- Support the development of allied sectors such as animal husbandry and fisheries.
- Strengthen infrastructure for storage, marketing, and distribution of agricultural produce.
- Promote organic farming and eco-friendly cultivation techniques.

3. **To protect ecologically sensitive areas and enhance the town's resilience to disasters**
    - Identify and map ecologically sensitive zones such as wetlands, riverbanks, and sacred groves areas.
    - Regulate land use and development activities in environmentally vulnerable zones through zoning and enforcement.
    - Promote conservation and restoration of natural ecosystems to maintain ecological balance.
    - Improve early warning systems, emergency preparedness, and response mechanisms.
    - Strengthen infrastructure and building codes to withstand natural disasters such as floods.
4. **To ensure adequate and efficient drainage infrastructure in the town.**
    - Assess the existing drainage network and identify gaps and bottlenecks.
    - Design and implement a comprehensive drainage master plan based on topography and land-use.
    - Construct, upgrade, and maintain stormwater drains to prevent waterlogging and urban flooding.
    - Integrate drainage planning with road, building, and land use development.
    - Ensure regular cleaning and de-silting of drains and canals.
    - Prevent encroachments and waste dumping in natural and man-made drainage channels.
5. **To enhance local livelihoods and strengthen the town's overall economic base**
    - Identify suitable zones for establishing small-scale industrial units.
    - Provide necessary infrastructure and utilities such as roads, power, and water to support industrial growth.
    - Promote the production of value-added animal husbandry products.
    - Encourage local entrepreneurship through skill development and training programs.
    - Provide support for the establishment of agro-based industries.
    - Facilitate financial assistance and incentives for small-scale industries.
    - Strengthen linkages between small-scale industries and larger markets.
6. **To enhance quality of life by providing safe living conditions and inclusive environment**

- Raise public awareness about proper waste disposal and the importance of maintaining drainage systems.
- Develop accessible open spaces and recreational facilities.
- Create awareness among residents and stakeholders about the town's tourism and heritage value.

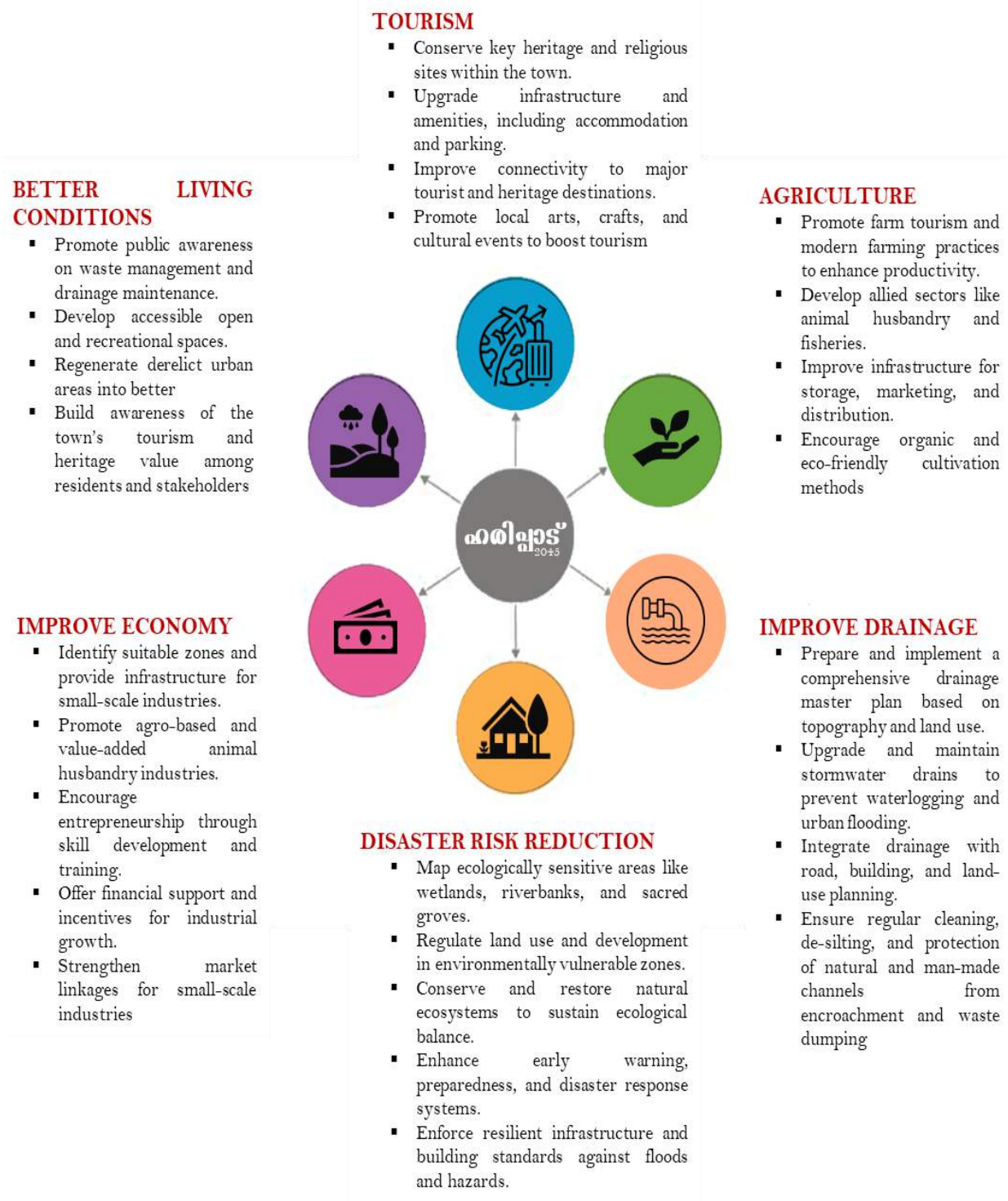


Figure 28.3 : Development Objectives for Haripad

CHAPTER
29

DEVELOPMENT CONCEPT



The Development Concept chapter outlines the overarching spatial vision for guiding a town's long-term growth and development. It explains how major land use components - such as residential neighbourhoods, commercial areas, public and semi-public uses, agricultural zones, recreational spaces and conservation areas - should be arranged and integrated to support sustainable and well-functioning urban development. The concept emphasizes balanced growth, efficient land use, environmental protection and improved quality of life. It also incorporates principles of risk reduction and resilience to ensure that future development remains safe, adaptable and sustainable. This chapter provides the strategic framework upon which detailed proposals and interventions are built in the Master Plan.

- Formulation of Development Concept
- Development Concept for the Town
- Projections

29. DEVELOPMENT CONCEPT

The development concept outlines the future growth and structure of the area. It presents an ideal pattern of development based on the goals and objectives with a spatial focus. The concept is based on the proposed spatial structure. It provides a clear vision of how the planning area is expected to develop and gives an overall idea of the location of major development proposals. The formulation of a development concept typically involves the following steps:

- **Identify and analyze** the existing spatial structure.
- **Project the likely future spatial structure** based on the proposed developments aligned with the vision and goals.
- **Refine the projected structure** by incorporating key development sectors to evolve a coherent and comprehensive development concept

29.1 Formulation of Development Concept

The development concept for Haripad Town adopts a people-oriented and sustainable planning approach, grounded in detailed spatial and sectoral analysis and aligned with the State and District development goals. As a third-order urban centre within the Alappuzha Urban Cluster, Haripad occupies a strategically advantageous position that enables peri-urban expansion, balanced regional growth, and enhanced connectivity across surrounding settlements.

Haripad holds deep cultural, religious, and ecological significance, with its temples, festivals, and natural landscape defining its unique identity. Its strategic location - connected by NH 66, multiple state highways, the railway network, and proximity to National Waterway III - enables multi-modal connectivity and offers potential for environmentally sustainable transport systems that enhance regional integration



Figure 29.1 : Formulation of Development Concept for Haripad Town

Economically, the town's growth is anchored in pilgrimage tourism, agriculture, commerce, and small-scale industries. Among these, religious tourism and agriculture are the key thrust sectors, capable of driving long-term development when supported by targeted investments in transportation, commerce, and services. Together, these sectors strengthen the local economy, generate livelihoods, and enhance regional competitiveness

Haripad's central location within a network of major religious and cultural destinations - such as Alappuzha, Ambalappuzha, Mavelikara, Edathua, Kayamkulam, Chettikulangara, Chengannur, and Thiruvalla - coupled with its inherent religious tourism potential, positions

it as an ideal hub for regional pilgrimage tourism. The town itself is home to over 42 temples, reflecting its rich spiritual heritage and cultural depth. Its excellent transport connectivity, with NH 66 passing through and 27 trains, including 18 daily services, halting at Haripad Railway Station, enables easy access for pilgrims and visitors alike. These advantages reinforce Haripad's emerging role as a gateway for faith-based tourism and highlight its capacity to manage and attract substantial tourist footfall.

From a land-use perspective, approximately 36% of the municipal area is devoted to agriculture, while 6% consists of water bodies, underscoring the town's strong agro-ecological character and potential for sustainable agricultural development. This fertile resource base provides a foundation for agro-based industries, organic farming, and food security initiatives, offering significant scope for economic diversification and livelihood enhancement.

Recognizing Haripad's flood vulnerability, the development framework emphasizes climate resilience, disaster preparedness, and sustainable land use planning. Conservation of ecologically sensitive areas, wetlands, and drainage networks is prioritized to mitigate flood risks and enhance urban resilience. Simultaneously, investments in urban infrastructure, mobility systems, and public amenities aim to strengthen liveability and promote inclusive growth.

Overall, the development concept envisions Haripad as a balanced, resilient, and inclusive urban centre - one that harmonizes economic growth, environmental sustainability, and cultural continuity. By leveraging its religious tourism appeal, agricultural strengths, and strategic connectivity, Haripad is poised to evolve into a model regional node that integrates tradition with progress and community well-being with sustainable urban transformation.

29.1.1 Environment and Topography

The topography of Haripad Town plays a pivotal role in shaping its sustainable and environment-friendly development strategies. The town's landscape - characterized by low-lying paddy fields, intricate canal networks, and wetlands - presents both opportunities and challenges that necessitate thoughtful integration into the urban planning process.

The overarching objective is to promote environmentally sustainable, flood-resilient, and inclusive urban development by leveraging the town's natural terrain and ecological assets while enhancing the quality of life for residents. This approach emphasizes harmonious coexistence between built and natural environments, ensuring that development complements rather than compromises ecological integrity.

Future planning efforts should focus on designating ecologically sensitive areas as agricultural conservation zones, undertaking infrastructure upgrades, and preparing urban flood risk maps to guide zoning and land-use decisions. The guiding principle is to allocate future activities judiciously, permitting only compatible land uses to preserve the region's environmental balance and long-term sustainability.

Key strategic initiatives include the cleaning and restoration of the Pillathodu and Danapady canals, conservation of paddy fields and sacred groves, and the revival of the Pampa irrigation canal. Together, these measures will strengthen Haripad's natural resilience and lay the foundation for a climate-adaptive and ecologically balanced urban future.

29.1.2 Proposed Population Distribution

The demographic profile of Haripad town provides a foundation for formulating inclusive, service-oriented, and space-efficient development strategies. Population stability, high literacy, and a favourable sex ratio offer opportunities for planned growth. The projected spatial distribution of population in town shows higher population in the north-eastern wards and in certain wards in the southern and eastern parts of the town. Agriculture dominated area have less population density.

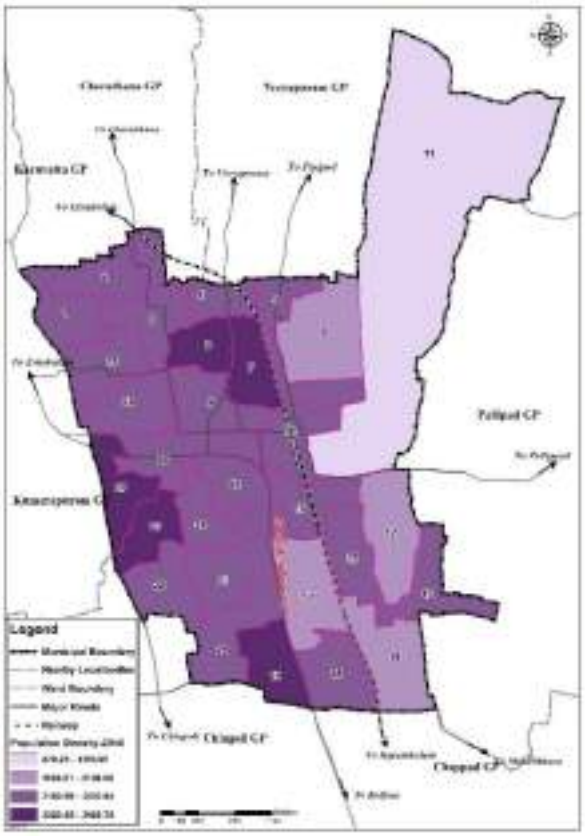


Figure 29.2 : Proposed Population Density

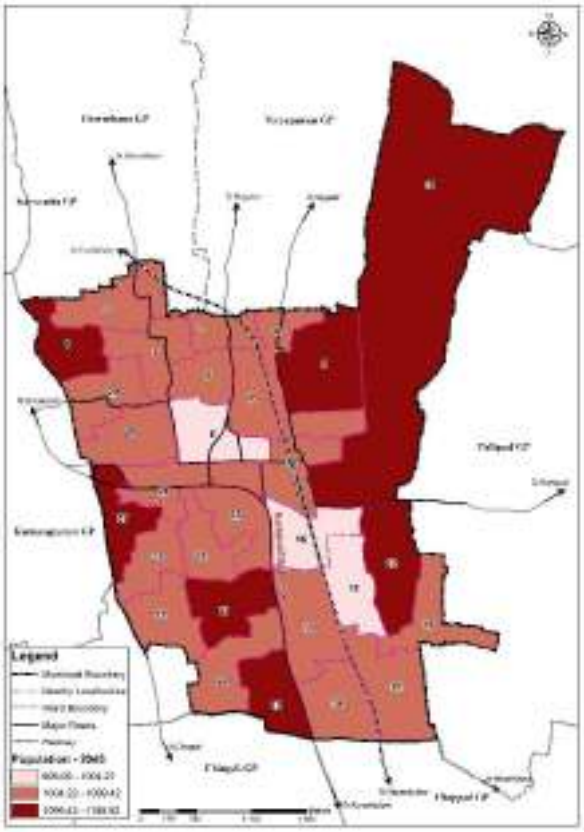


Figure 29.3 : Proposed Population Distribution

29.1.3 Connectivity plan

The proposed connectivity plan for Haripad should focus on improving multi-modal transportation, reducing traffic congestion, and enhancing both regional and intra-town mobility. Strengthening of major road corridors such as NH 66 and SH 80, widening of narrow road sections, and upgrading junctions at Madhava Junction and Nangiarakulangara should be prioirtized. A ring road network can be proposed to ease traffic pressure on the town core. Upgradation of the KSRTC bus stand and its related facilties will help improve public transport. To promote non-motorized transport, dedicated pedestrian walkways and bicycle lanes can be developed, particularly along canals and within residential areas. Organized parking areas should be established near commercial and institutional zones to reduce roadside encroachments. The plan shall aim to improve connectivity to nearby regional centres such as Cheppad, Kayamkulam, and Mavelikkara.

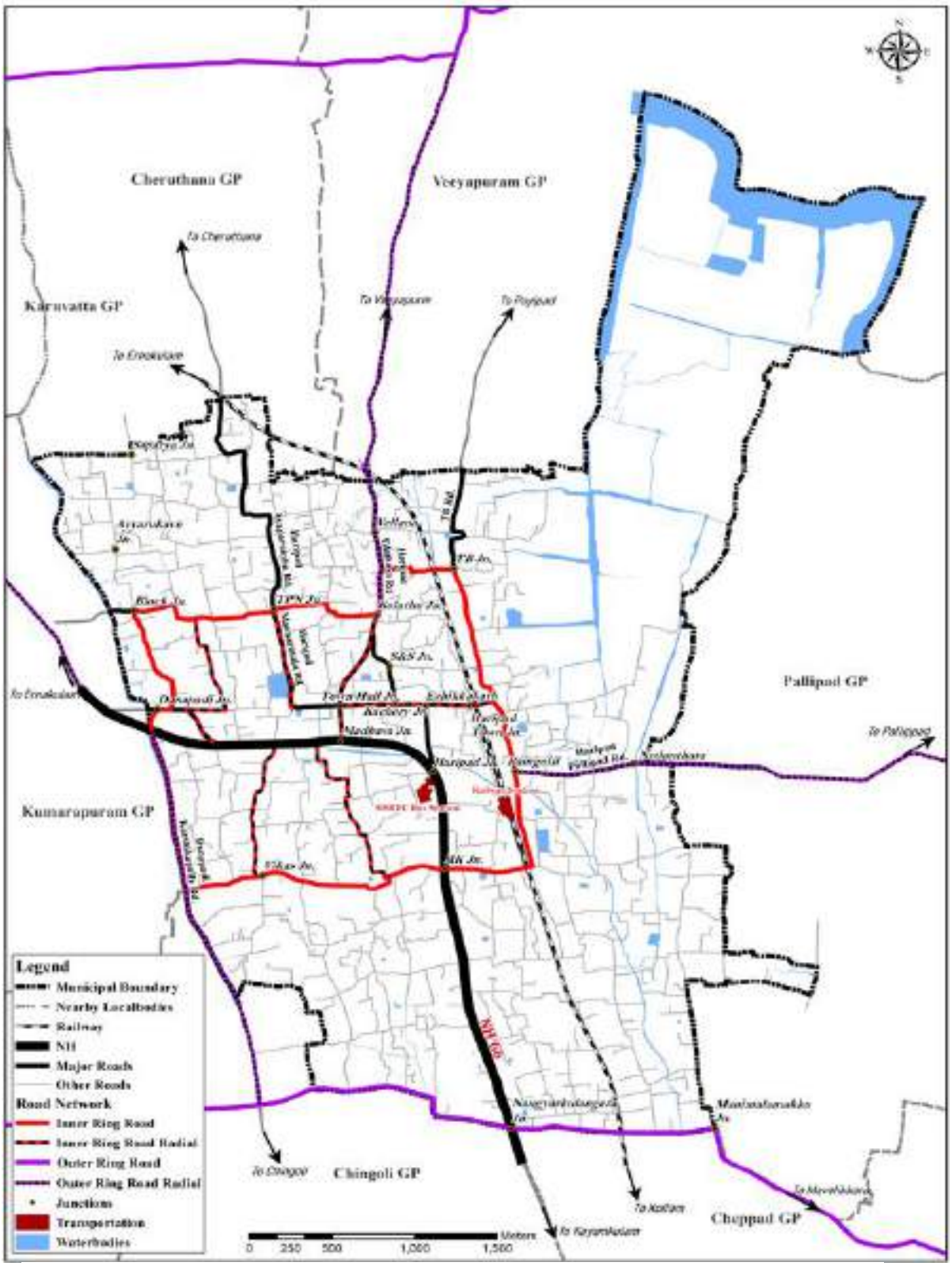


Figure 29.4 : Connectivity Plan

29.1.4 Proposed Hierarchy of Nodes

The proposed hierarchy of nodes for Haripad Town is designed to reinforce its role as a regional service centre while fostering balanced, accessible, and sustainable urban

development. The framework emphasizes a structured spatial organization that distributes growth equitably, reduces pressure on the town core, and enhances connectivity and access to essential services across all neighbourhoods.

The first-order nodes are proposed around the municipal core, where NH 66 intersects with major arterial roads - forming the primary urban activity zone of Haripad. These nodes will be strengthened with enhanced public infrastructure, integrated transport facilities, and high-density mixed-use development to promote compact and efficient urban growth. Specifically, Town Hall Junction, Madhava Junction, and Haripad Junction are designated as first-order nodes, serving as the principal commercial and administrative hubs of the town.

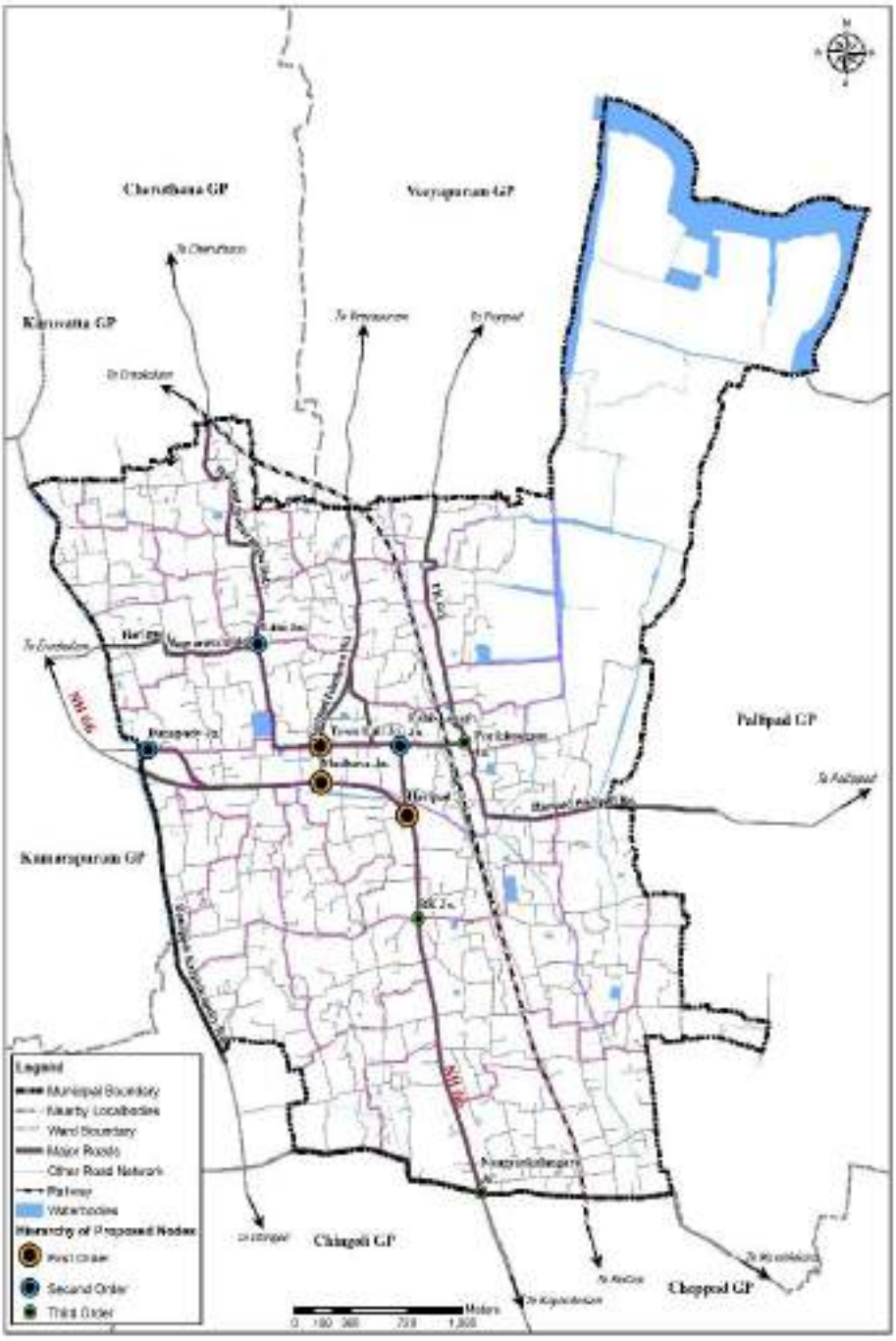


Figure 29.5 : Proposed Hierarchy of Nodes

The second-order nodes are strategically located along NH 66, the State Highway, and at major institutional and commercial corridors. These nodes - proposed at Danapady Junction, Tutu Junction, Ezhikkakathu Junction, Cheppad, Mavelikkara Road Junction, Nangiarakulangara, and Mannarasala Junction - will function as sub-centres supporting medium-density commercial, institutional, and residential activities. Their development will help decongest the town core and facilitate distributed economic and social activity.

The third-order nodes are identified at Prathimukham Junction, RK Junction, and Nangiarkulangara Junction, along with other emerging neighbourhood-level junctions. These nodes are intended to cater to localised community needs by accommodating small markets, local shops, and social infrastructure such as schools, health centres, and community halls.

This nodal hierarchy aims to create a functionally efficient and spatially balanced urban structure, enabling Haripad to evolve into a well-connected, service-oriented, and resilient regional centre, with each node contributing meaningfully to the town's economic vitality and liveability..

29.1.5 Suggested Spatial Structure

The proposed spatial structure of Haripad is derived from a comprehensive analysis of its functional character, activity patterns, transport network, nodal hierarchy, and land-use distribution. It emphasizes compact and sustainable development around key first- and second-order nodes - Haripad Junction, Madhava Junction, Town Hall Junction, Ezhikkakath Junction, Tutu Junction, and the Danapady Market area - to enhance accessibility and economic vitality. The northern and eastern parts of the Municipality are dominated by agricultural and eco-sensitive zones that act as ecological buffers and support local food security, while the north-western and east-central sectors feature mixed residential–agricultural uses, reflecting a peri-urban transition. The central region accommodates mixed residential and commercial

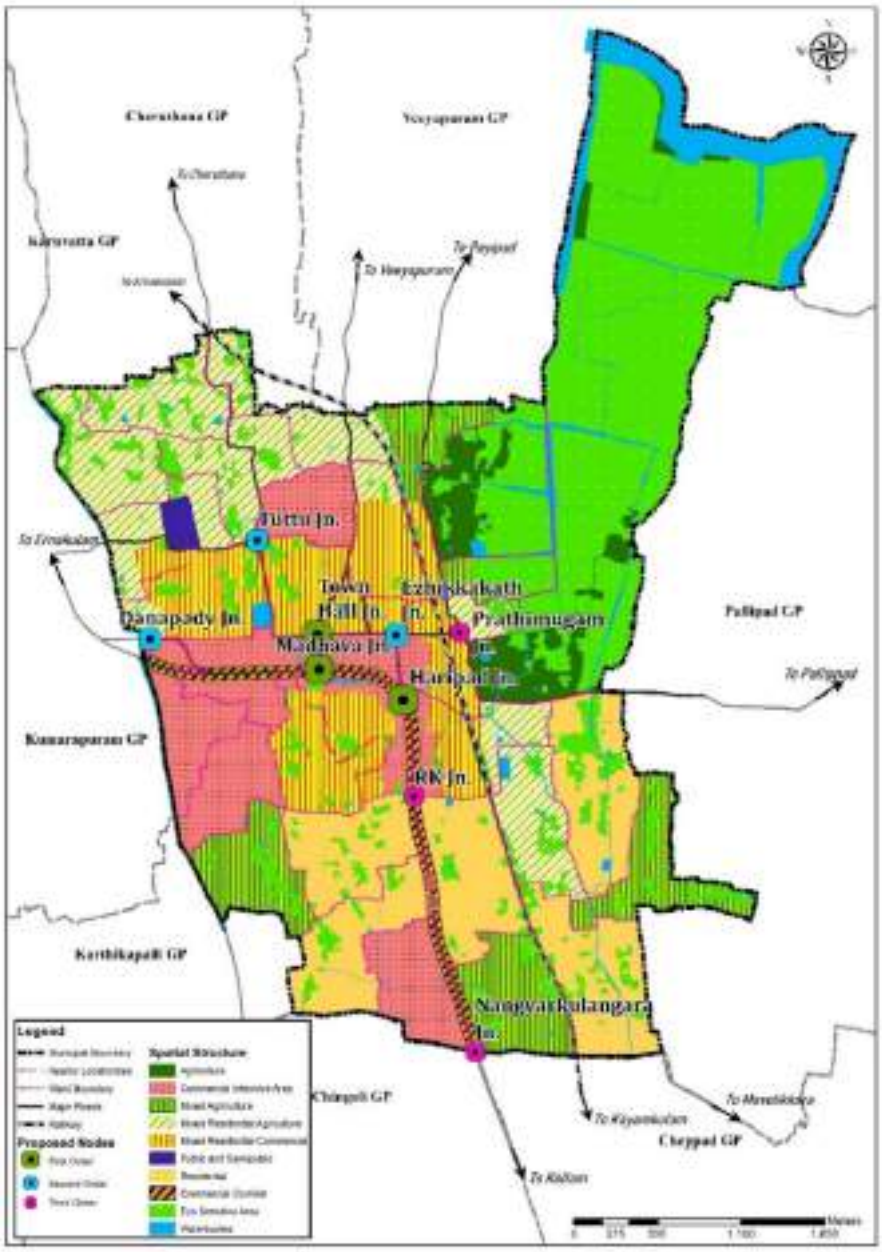


Figure 29.6 : Suggested Spatial Structure

zones along NH 66, arterial roads, and the railway, forming the town's main commercial spine. First-order nodes serve as major economic hubs, while second- and third-order nodes at the periphery promote decentralized and balanced growth, reducing congestion and ensuring equitable access to infrastructure and services across Haripad.

29.1.6 Hazard, Vulnerability and Risk

The development concept for hazard, vulnerability, and risk management in Haripad town aims to build a resilient and disaster-prepared urban environment. The town is particularly vulnerable to floods and waterlogging during the monsoon season due to its low-lying terrain and inadequate drainage systems. The northern and eastern parts are highly flood-prone, while the southern side is relatively less affected. To address these challenges, the plan proposes integrated flood mitigation measures such as improving the drainage network, restoring canals and water bodies, and implementing appropriate land use controls in vulnerable areas identified through hazard mapping. Public awareness programmes, early warning systems, and emergency preparedness initiatives will be strengthened to enhance community resilience. The overall goal is to ensure safe living conditions, protect life and property, and minimise disruptions to daily life and economic activities.

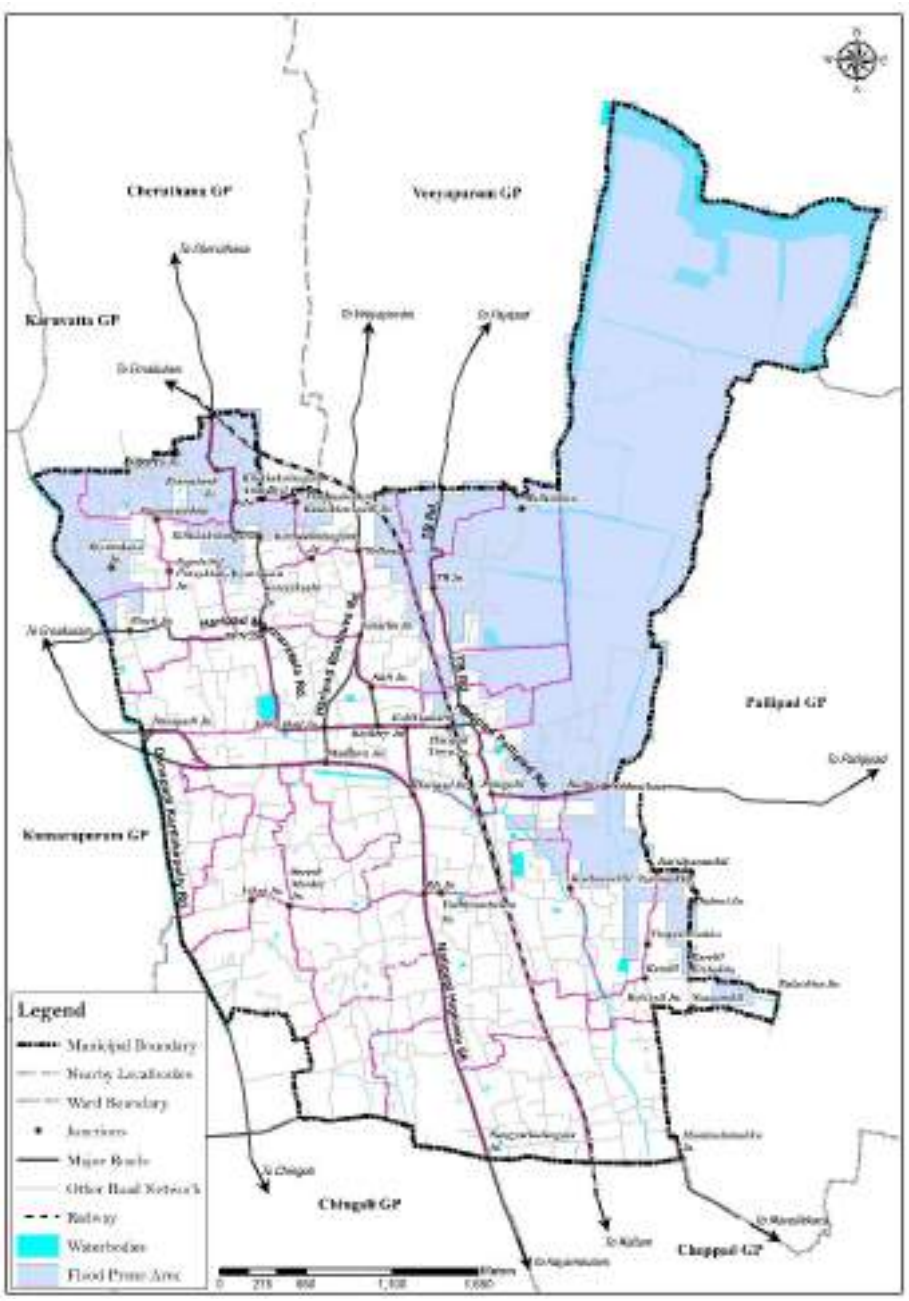


Figure 29.7 : Flood Prone Area (1 in 50 years Return Probability map by KSDMA)

29.1.7 Activity Zones

29.1.7.1 *Residential Land Use*

As per the URDPFI guidelines, the recommended residential land use for small towns is 45–50% of the developed area. In Haripad, the existing residential area constitutes 43.94% of the developable land, aligning with the recommended standards. While the URDPFI also recommends a population density of 100–150 persons per hectare in developed areas, Haripad currently has a lower density, 30 persons per hectare for the overall developed area and 43 persons per hectare for residential zones. This indicates considerable potential for densification within existing residential areas to accommodate future growth more effectively.

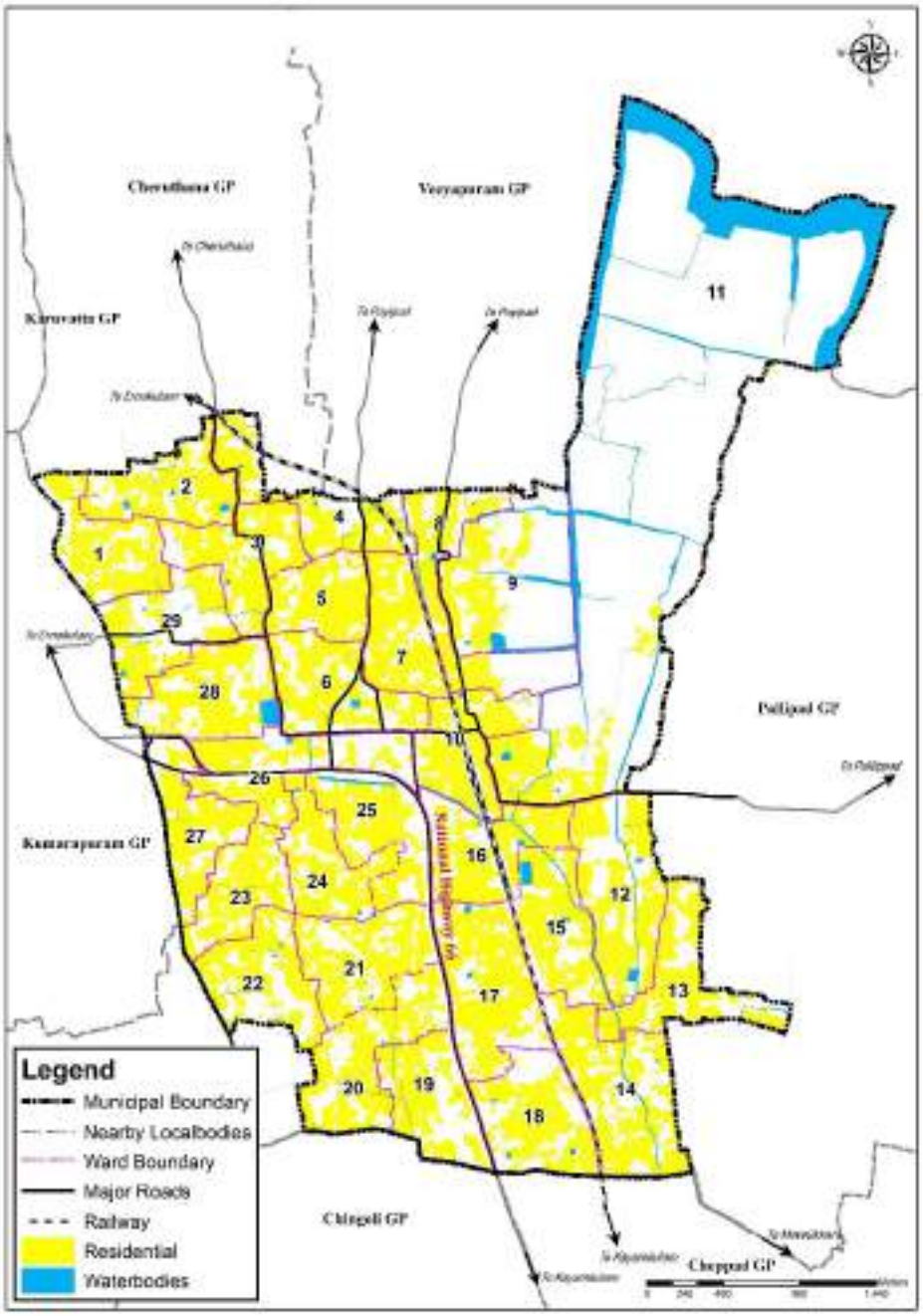


Figure 29.8 : Spatial Distribution of Residential Land Use within the town

29.1.7.2 Environmental Conservation Area

The concept of conserving areas of ecological importance involves carefully planning and allocating future activities within these zones to ensure that permitted uses do not negatively affect the overall environmental balance. Additionally, it emphasizes promoting the active involvement of local communities and NGOs in conservation efforts.

Key focus areas include protecting important natural areas like sacred groves, wetlands, and canals by involving local communities and linking them with eco-tourism and heritage routes. This way, these valuable ecosystems can be preserved through careful and thoughtful planning.

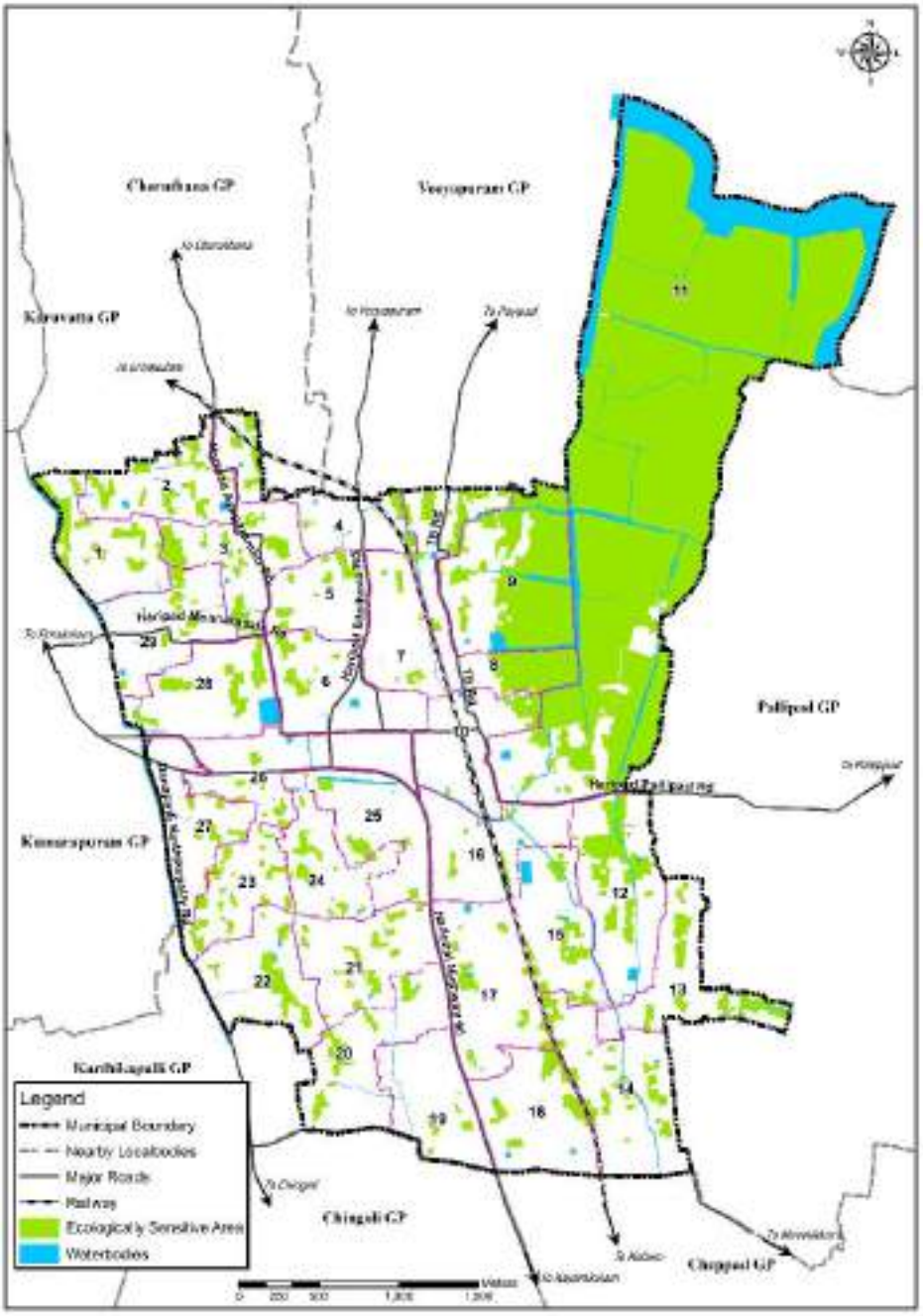


Figure 29.9 : Spatial Distribution of Ecologically Sensitive area within the town

29.1.7.3 Recreational Area

Improving the recreational infrastructure of Haripad town is essential for enhancing urban liveability, promoting public health, and supporting community well-being. Due to the limited availability of recreational spaces in the town, there is a need to develop inclusive and accessible open areas that can also help manage future growth. Proposed initiatives include the development of public parks, playgrounds, open-air theatres, and art galleries to encourage physical activity, cultural engagement, and social interaction. Establishing a network of public reading rooms across various wards will further support literacy and lifelong learning. The long-abandoned Town Hall should be renovated and revived as an active civic and cultural centre. The overall recreational zones in Haripad are planned to integrate green and blue

infrastructure, while catering to people of all age groups. Key components include the improvement of parks and open spaces for walkable access, the creation of waterfront promenades and eco-tourism spots along canals, and the development of green corridors connecting paddy fields and natural areas to promote non-motorized transport, environmental education.

29.1.7.4 Areas of Heritage Value

Haripad town is home to a rich cultural and historical heritage that reflects the town's unique identity. Significant buildings and monuments, many of which are centuries old, are spread across the area. Notable among them are Haripad Palace, a historic residence that showcases traditional Kerala architecture, and Karimpalil Palace, which represents the town's aristocratic heritage and historical lineage. In addition to these palaces and other historic structures, the town's heritage includes temple surroundings, sacred groves, and other culturally significant sites that hold traditional and spiritual value.

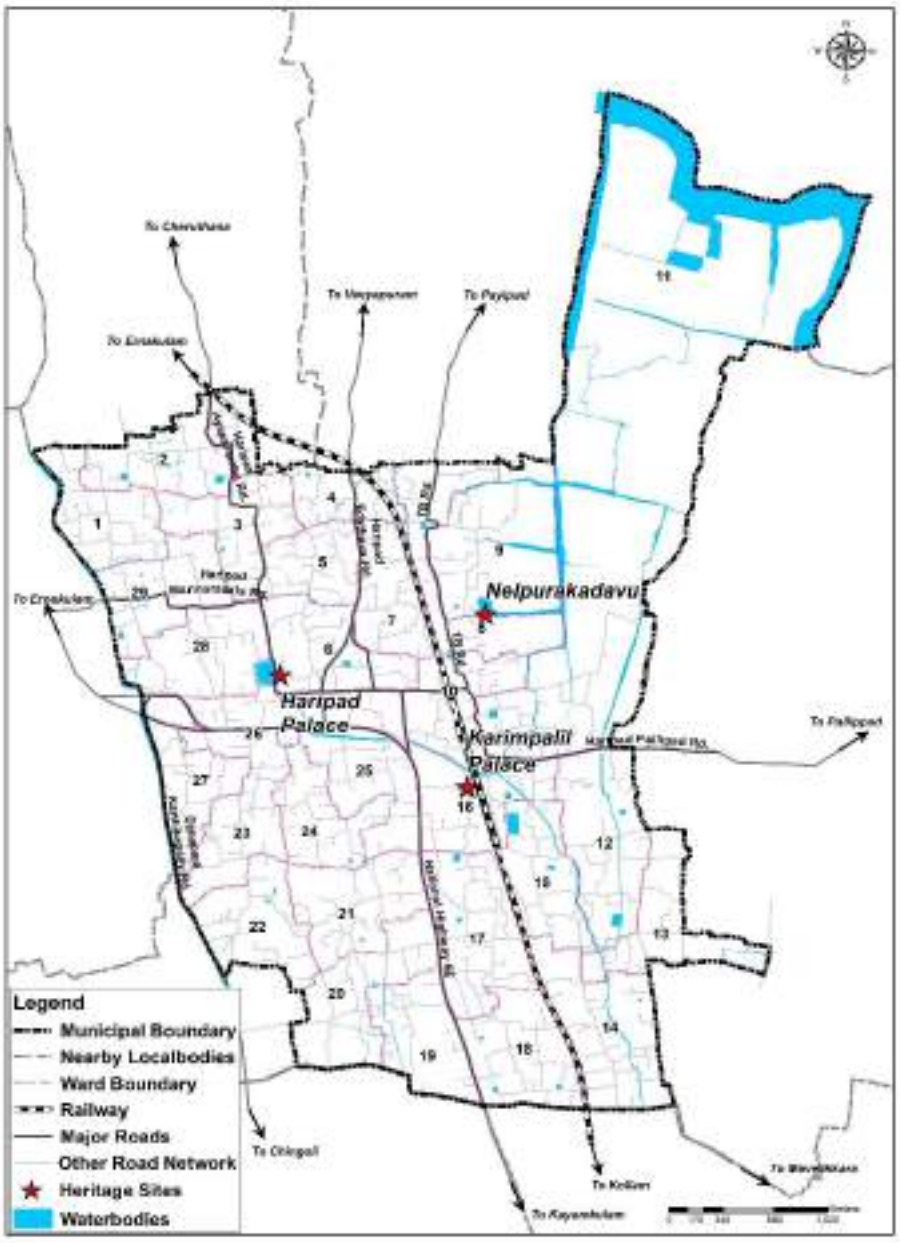


Figure 29.10 Buildings or Areas with Heritage Value

Conserving this heritage is essential for preserving the town's cultural fabric and community identity. Heritage conservation also brings socio-economic benefits by creating employment opportunities for local residents and encouraging their involvement in heritage protection efforts. Heritage tourism, which can be developed using existing infrastructure, further supports the local economy and is relatively easy to implement.

The Master Plan for Haripad identifies important heritage sites, including Haripad Palace and Karimpalil Palace, and proposes strategies to conserve and protect them. It emphasizes adaptive reuse of heritage structures and the integration of heritage management with tourism development. This approach aims to strengthen the town's cultural identity while promoting economic growth through sustainable and inclusive tourism.

29.1.7.5 Economic Development Zones

1. Commercial activity Areas

The future commercial development strategy for Haripad is guided by the existing spatial pattern of commercial activities, with the central part of the town identified as the primary zone for expansion. While this area has strong commercial potential, it is constrained by inadequate parking, limited accessibility for persons with disabilities, and narrow streets. Commercial growth has largely occurred as ribbon development along major roads. Strengthening the commercial sector is vital to support Haripad's economic base, generate employment, and address declining population trends. Existing commercial zones within the central business district should therefore be retained, upgraded, and efficiently managed to continue serving both residents and visitors effectively.

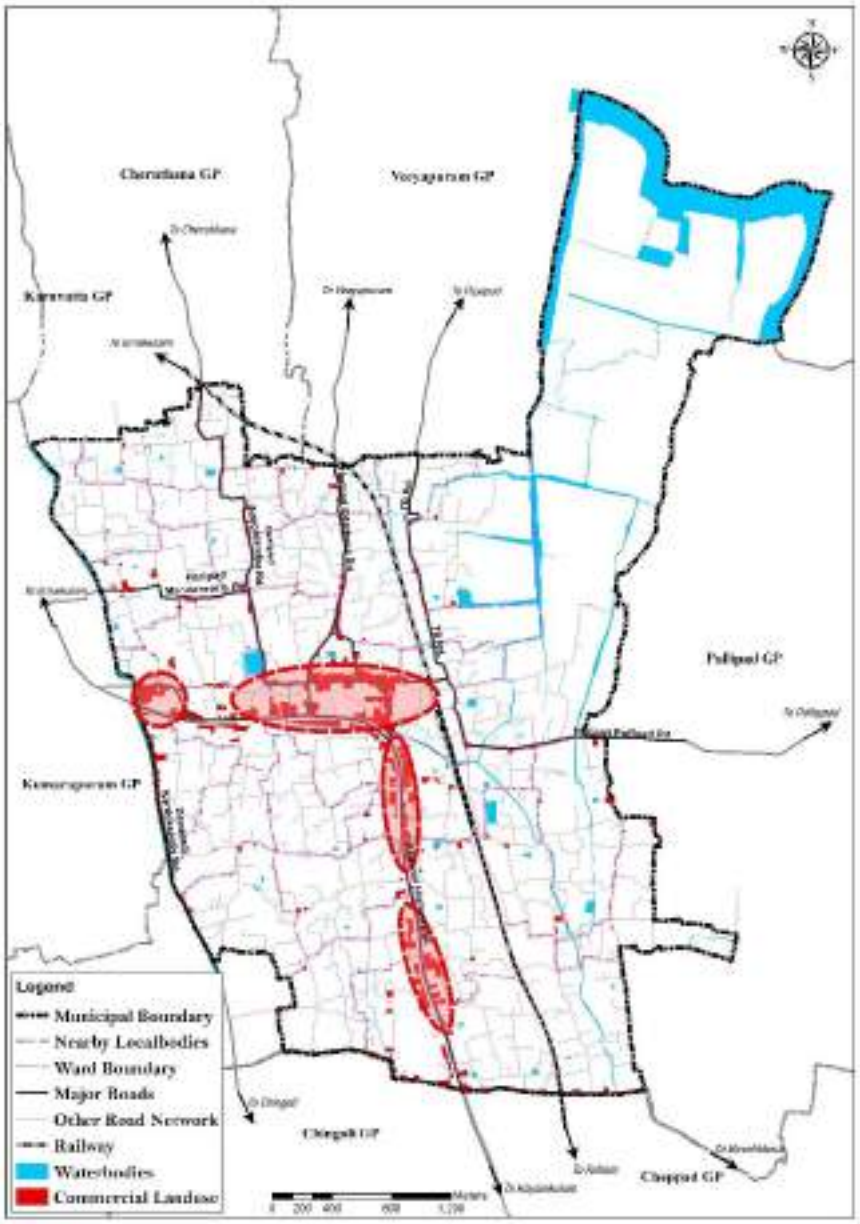


Figure 29.11 : Spatial Distribution of Commercial Land Use

2. Tourism Potential Areas

Haripad town possesses rich natural and cultural assets, including water bodies and significant religious, cultural, and historical landmarks, yet its tourism potential remains largely underutilized. Promoting tourism has therefore been identified as a key development objective. This can be achieved by leveraging the town's water resources, canals, and scenic surroundings, supported by its strong transport connectivity through road, rail, and proximity to National Waterway III.

There is substantial scope for heritage and pilgrimage tourism through the development of cultural circuits connecting major sites such as the Subrahmanya Swamy Temple, the renowned Mannarasala Temple, and other heritage and pilgrim destinations within and around the town. Leisure tourism opportunities can be developed along canal banks and other scenic areas, integrated with nearby tourist destinations to form a broader tourism network. These initiatives are expected to stimulate allied sectors such as hospitality, local crafts, and services, thereby generating employment, strengthening the local economy, and supporting the sustainable growth of Haripad.



Figure 29.12 : Tourism Potential Areas

There is also significant scope to promote heritage tourism by creating circuits that connect major cultural and religious sites within the town and outside the town. Important places such as the Subrahmanya Swamy Temple and the famous Mannarasala Temple, a well-known pilgrimage site for serpent worship, can be included in these circuits along with other heritage

sites and other pilgrim sites outside the town. Leisure tourism can be developed along canal banks and other scenic locations, which can also be linked to tourist spots in nearby areas to create a wider tourism network.

These efforts are expected to support related economic activities such as lodging, dining, and local crafts. Developing the tourism sector will help boost the local economy, create jobs, and contribute to the overall sustainable growth of Haripad.

3. Town Centre

The Town Centre of Haripad is located along NH 66, on either side of the Haripad Town Junction–Town Hall Junction corridor. It functions as the town's primary commercial and administrative core, accommodating a high concentration of shops, offices, and key public institutions such as the Police Station, Fire Station, Court Complex, Government Boys HSS, and the Sub Registrar Office. Owing to its strategic location and institutional presence, this area remains the most active and vibrant part of the town, attracting residents, commuters, and visitors throughout the day.

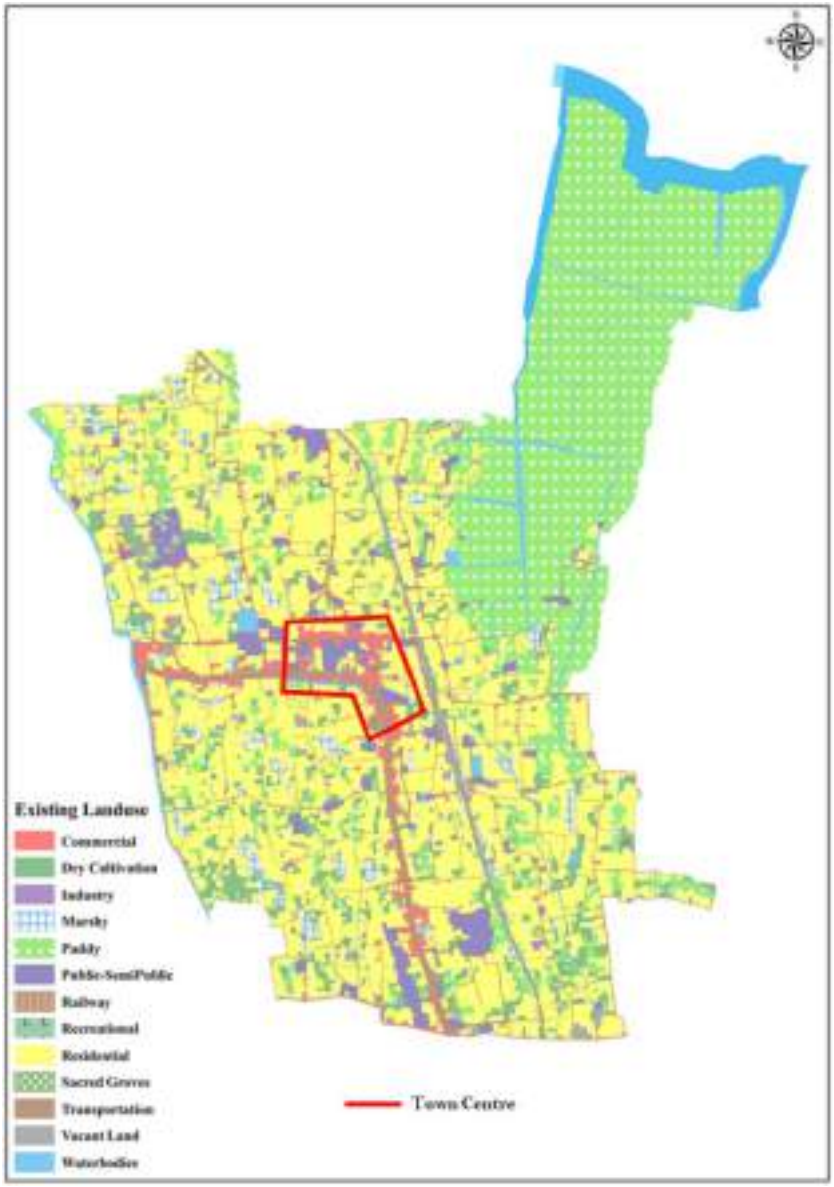


Figure 29.13 : Town Centre Area in Haripad Town

A well-defined and efficient town centre is vital for any town, as it supports economic activity, ensures access to public services, and shapes the town's identity. In Haripad, this area plays a central role in daily urban life and regional connectivity. Strengthening the Town Centre through improved infrastructure, pedestrian-friendly design, better traffic management, and enhanced public spaces is essential to support Haripad's future growth and to reinforce its role as a dynamic, accessible, and well-functioning urban core.

4. Industrial Activity Areas

Haripad's industrial development strategy is shaped by its predominantly agricultural and tourism-based economy and the limited presence of large-scale industries. In this context, the Master Plan focuses on promoting small-scale, agro-based, and value-addition industries that complement local resources and livelihoods. Emphasis is placed on Micro, Small and Medium Enterprises (MSMEs) engaged in processing, packaging, storage, and marketing of agricultural produce, organic vegetables, coconut-based products, floriculture outputs, and allied activities.

Given the dispersed nature of existing industrial units in Haripad, a cluster-based and network-oriented approach is proposed, prioritising areas with good road connectivity and basic infrastructure. Where physical clustering is not feasible, shared service networks and common facilities will be encouraged. Household-level and neighbourhood-scale enterprises will be promoted with appropriate regulatory support, enabling flexible and low-impact industrial growth.

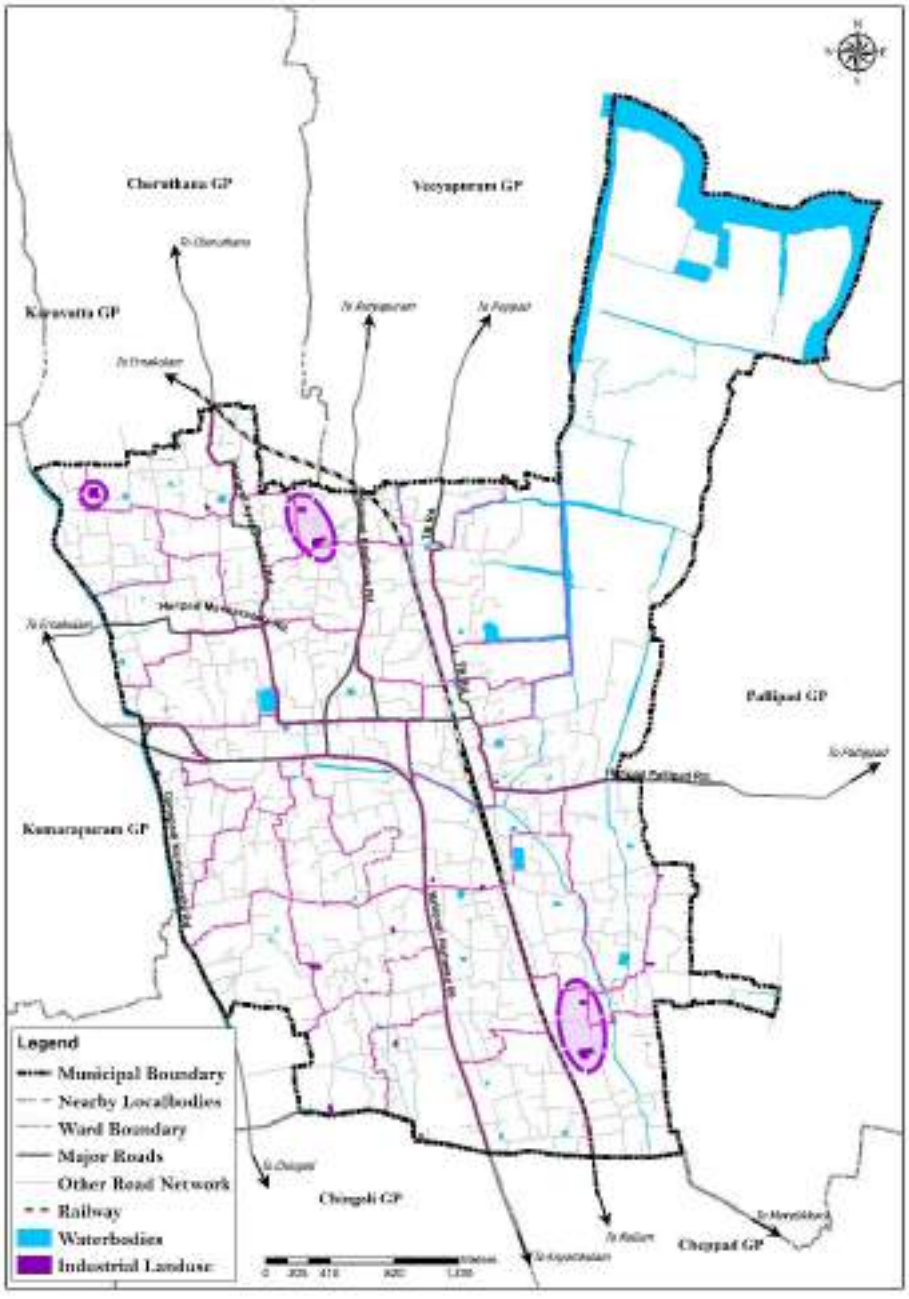


Figure 29.14 : Industrial Activity Area

Special focus will be given to encouraging women and youth participation through skill development, entrepreneurship support, and linkage with self-help groups and cooperatives. This approach aims to strengthen Haripad's economic base, generate local employment, and ensure

sustainable, inclusive industrial growth aligned with the town's character and environmental sensitivity

29.1.7.6 Public facilities and amenities

Public facilities and amenities in Haripad town play a crucial role in meeting the daily needs of residents, visitors, and the surrounding rural population. These services require careful planning and equitable spatial distribution to effectively serve both established residential areas and emerging neighbourhoods, while also accommodating future urban growth.

At the regional scale, key public amenities—including police stations, fire stations, fuel stations, public toilets, communication facilities, cremation and burial grounds, bus stands, and the railway station—must be strategically located to ensure easy access, efficient service delivery, and timely emergency response. In view of their established service catchments and functional importance, all existing facilities are proposed to be retained at their current locations to avoid service disruption.

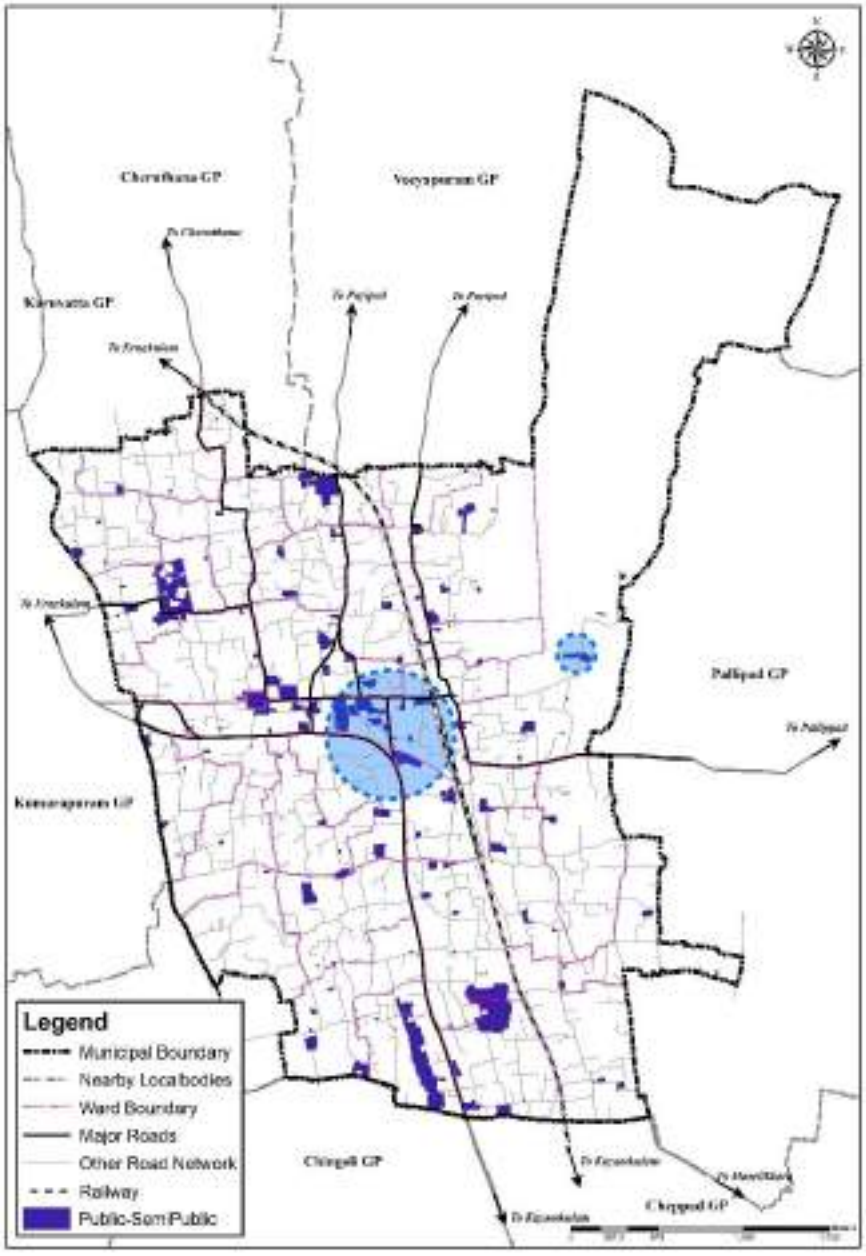


Figure 29.15 : Spatial Distribution of Public and Semi Public Areas within the town

Spatial analysis indicates that a majority of public facilities and amenities are presently concentrated in the central part of Haripad, which functions as the town's primary administrative and service hub. This centralization has ensured convenience for a large segment of the population but has also resulted in comparatively lower accessibility for residents in peripheral and newly developing areas.

Future planning initiatives should therefore prioritize improving physical and universal accessibility, upgrading infrastructure quality, and gradually decentralizing selected facilities where feasible. Ensuring a more balanced distribution of public amenities will not only reduce pressure on the town centre but also enhance service coverage, improve quality of life, and support the long-term sustainable development of Haripad.

29.1.7.7 Mixed Activity Areas

The mixed activity areas in Haripad aims to promote compact, vibrant, and walkable urban environments by integrating residential, commercial, institutional, and recreational functions. These areas will be planned to encourage diverse land uses in close proximity, thereby reducing travel demand and improving accessibility to daily needs. Mixed activity zones are proposed near key transport nodes such as the municipal core, Madhava Junction, Nangiarkulangara, and along major corridors like NH 66 and SH 80. By combining economic, social, and cultural activities, mixed-use areas will help create more jobs, encourage community interaction, and support a more sustainable way of developing the town.

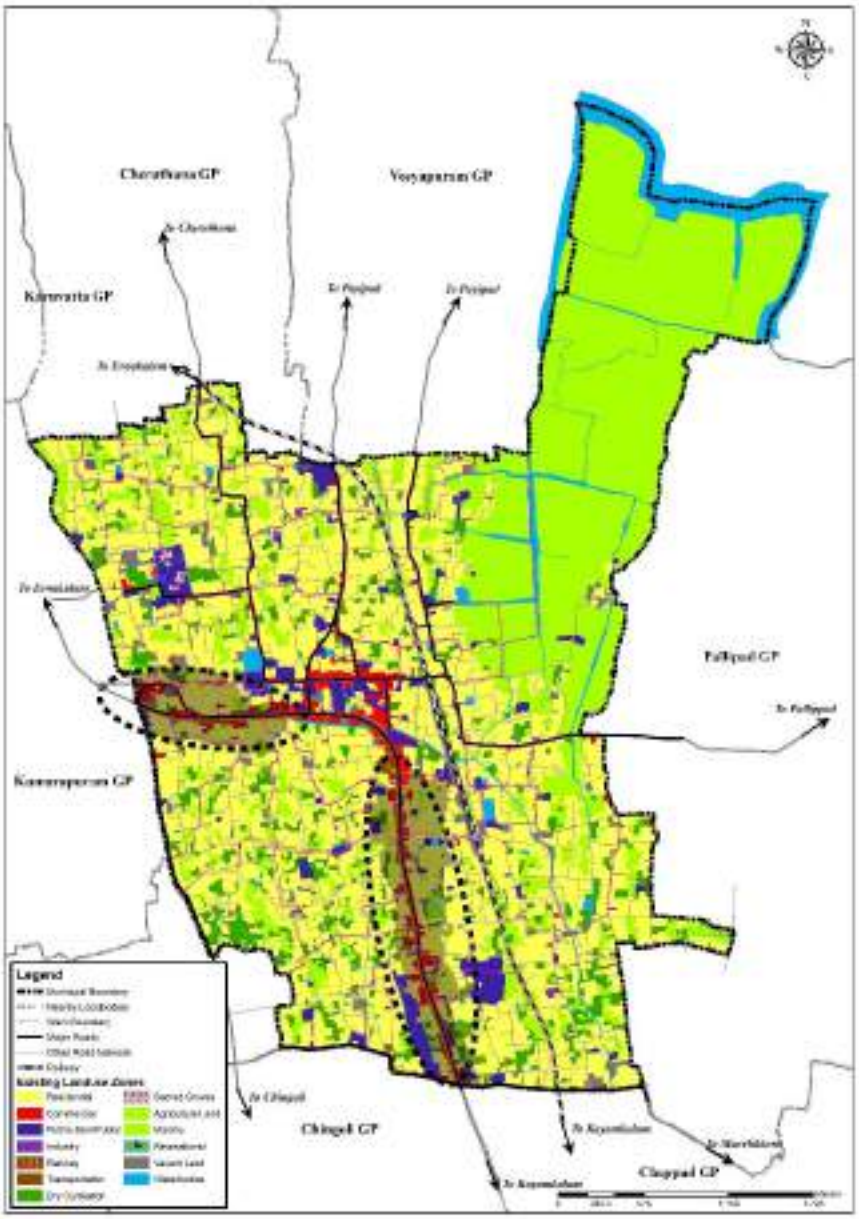


Figure 29.16 : Potential Areas for Mixed Development

29.2 Development Concept for Haripad Town

The development concept for Haripad Town integrates various sectoral strategies within the existing spatial framework, envisioning Haripad as a key district-level service centre supported by tourism, agro-based industries, traditional sectors, and a focus on cultural and

environmental conservation. The goal is to achieve sustainable, inclusive urban growth while ensuring a high quality of life for residents.

Future growth is proposed primarily along major road corridors such as NH 66, enabling compact and accessible urban development. The north-eastern area, comprising low-lying agricultural land, is identified as flood-prone and will be preserved and conserved as part of the town's ecological strategy.

The concept prioritizes strengthening multimodal transport connectivity - including road, rail, and water networks - supported by parking facilities and transport terminals. It proposes exclusive zones for agro-based and small-scale industries, a clear commercial hierarchy, mixed-use zones in high-growth areas, and eco-sensitive, low-density zones for eco-tourism and environmental protection. Special projects will also be undertaken to modernize and support the primary sector. Tourism is positioned as a key economic driver, with a proposed tourism circuit connecting pilgrimage centres, heritage sites, and eco-tourism destinations. Enhanced infrastructure, visitor amenities, and sustainable tourism practices will strengthen Haripad's cultural identity and economic base.

Overall, the strategy aims to decongest and decentralize the town core, guide planned expansion, enhance connectivity, and balance economic growth with environmental sustainability, positioning Haripad as a vibrant, resilient, and sustainable regional centre.

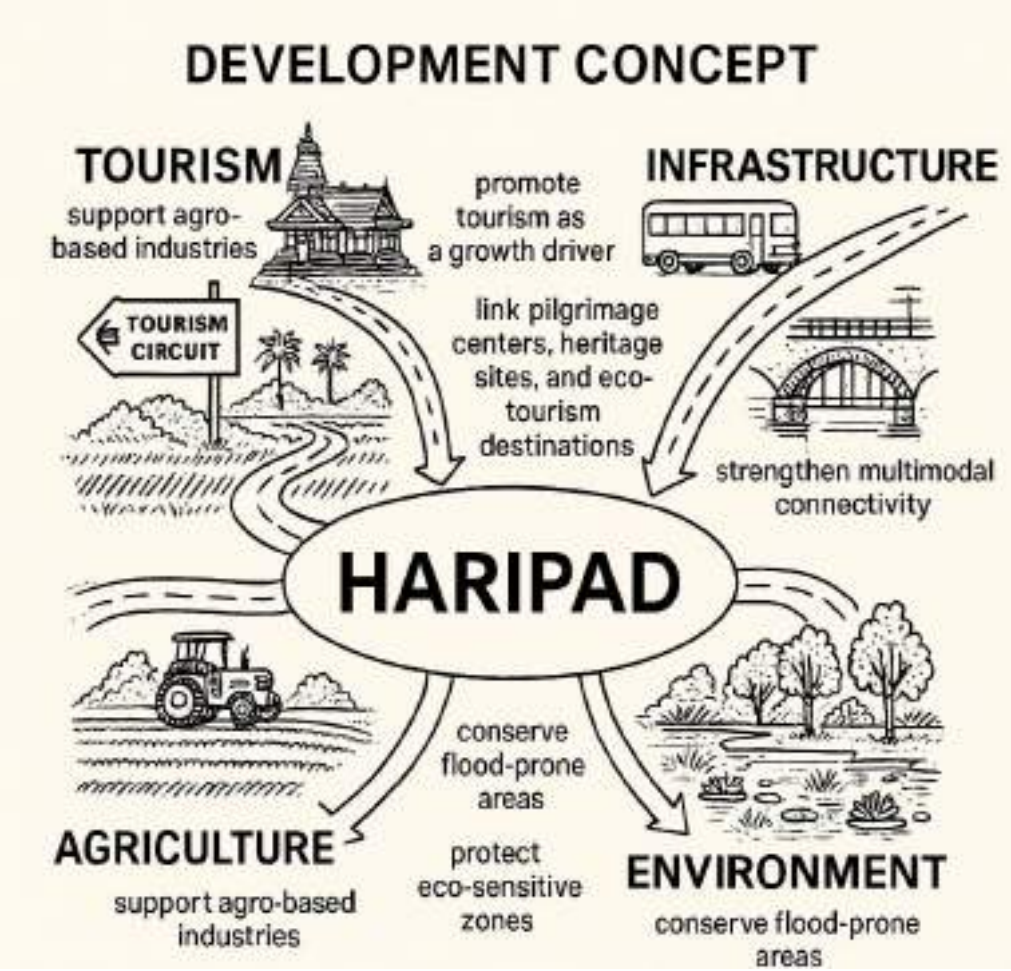


Figure 29.17 : Development Concept for Haripad

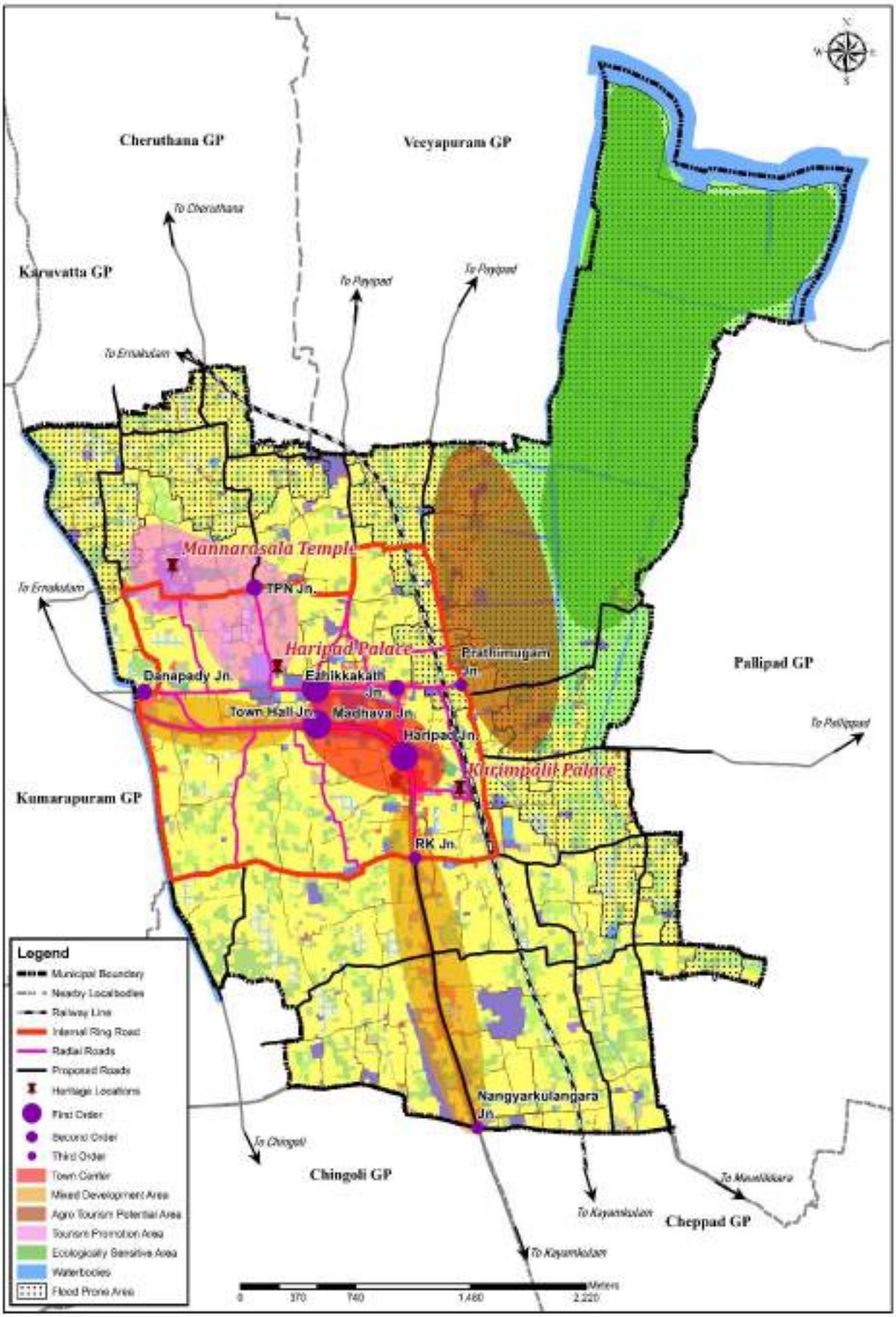


Figure 29.18 : Development Concept for Haripad Town

29.3 Projections

1. Population projection

The population projection for 2025, 2035 and 2045 of the town are made by assuming that same trend in the population growth continues. The population is projected by arithmetic method and arrive at the population figures in 2025,2035 and 2045.

Arithmetical Increase Method

In this method the average increase in population per decade is calculated from the past census reports. This value is added to the present population to find out the population of the next decade. By this method, the population growth rate of 2025, 2035 and 2045 are calculated by assuming that the population is increasing at constant rate for the succeeding decades. The projected population of the Town based on arithmetic increase method is shown in Table 29.1

Table 29.1: Projected municipal population – Arithmetical increase method

Arithmetical Increase Method		
Year	Total Population	Total Increment
1981	27666	
1991	29770	2104
2001	31206	1436
2011	31151	-55
2021	31038.12	-112.88
2025	31121.47	83.47
2035	31136.34	14.87
2045	31150.5	14.16

2. Sectoral projections

The projected population in 2045 is 31150.5. For the Purpose of assessment of sectoral requirements this is rounded off to 40,000.

a) Estimation of labour force for 2045

Haripad town is expected to accommodate 40,000 population by the year 2045. In 2025, 72% of the total population of the town was in the age group of 20-59. As no up-to-date data of the age structure of the town is readily available, almost the same age structure

is assumed to prevail in the town in the next decades. Thus 72% of the population is considered to be in the working age group during 2041 which works out to be 28,800.

Sex ratio for age group 0-6 in 2025 is 1158. So, the working age group population can be divided into 15454 females and 13346 males.

Assuming that all men in the working age group will be workers and that the participation rate of women will improve to 45% due to the increased literacy rate, female workers as on 2045 will be 15454 x 45/100 = 6954

Total number of workers = 6954 + 13346= **20300**

Proposed distribution of workers

Primary workers:

In 2011 the number of primary workers is 1207. It is 10.99% of the total workers. Expecting the same trend for next decades we can assume that 11% of total workers will come under primary sector.

20300 x 11/100 = ***2233***

Secondary workers:

In 2011 the number of secondary workers is 301. It is 2.7% of the total workers. Expecting the same trend for next decades we can assume that 3% of total workers will come under secondary sector workers.

20300 x 3/100 = **609**

Tertiary workers:

In 2011 the number of tertiary workers is 9468. It is 86.2% of the total workers. Expecting the same trend for next decades we can assume that 86% of total workers will come under tertiary sector workers.

20300 x 86/100 = **17458**

b) Trade and Commerce

As per existing land-use survey commercial area in the town comes to 30 hectares.

As per the URDPFI standards, for small towns, 2 to 3 percentage of the developed area should be earmarked for commercial use. In the case of Haripad the calculated area needed for commercial use is 50Ha.

The hierarchy of commercial centers for a small town like Haripad, as per URDPFI Guidelines is as indicated below:

Table 29.2: Hierarchy of Commercial Centers

Sl.No	Hierarchy of commercial centre	Population Served	Requirement (by 2045)
1	Cluster Centre	1000 - 4000	10 Nos with 880sq.m each
2	Sector Centre	5000 - 20000	2 Nos with 6000sq.m each
3	Community Centre	25000 – 1 lakh	1Nos with 2Ha area

c) Traffic and Transportation

Table 29.3: V/C Ratio of Various Road Sections

Sl.No	Name of Road	Existing V/C Ratio (2025)	Proposed V/C Ratio (2035)	Proposed V/C Ratio (2045)
NH 66 (Narakathara to Nangiarkulangara)		1.43	2.33	3.45
Danapady – Karthikapalli – Nangiarkulangara – Mavelikkara road				
1	Danapady – Karthikapalli	0.95	1.4	1.89
2.	Karthikapalli – Nangiarkulangara	0.71	1.05	1.42
3.	Nangiarkulangara to Manimala	1.13	1.67	2.25
Madhava Junction to Veeyapuram road				
4.	Madhava Junction to Veeyapuram road	1.03	1.52	2.04
5.	Townhall Junction to Thrippakkudam	0.92	1.36	1.83
Mannarasala – Townhall – Prathimukham				
6.	Mannarasala temple to Townhall Junction	0.51	0.69	0.84
7.	Townhall Junction to Kachery Junction	1.3	1.93	2.59
8.	Kachery Junction to Ezhikkakathu Junction	1.23	1.83	2.45
9.	Ezhikkakathu Junction to Prathimukham	0.99	1.48	1.98
Other roads				
10.	Ezhikkakathu Junction to Taluk hospital Junction	0.97	1.44	1.93
11.	RK Junction to Karthikapalli – Danapady road	0.96	1.29	1.57

12.	Narakathara - Danapady	0.8	1.07	1.31
13.	Townhall Junction to Subramanya Swami temple	0.99	1.33	1.62
14.	Subramanya Swami temple to Mannarasala temple	0.61	0.82	1
15.	Karthikapalli to Thrikkunnappuzha	0.82	1.22	1.64
16.	Prathimukham Jn to Nedumthara	1.09	1.62	2.18
17.	Prathimukham Jn to Vellamkulangara	0.34	0.45	0.55

d) Water Supply

Domestic purpose: requirement of water for domestic purpose for a population of 40,000 for the year 2045 = 40,000 x 150 = **6 MLD**

Medical: requirement of water for 233 beds in the various hospitals at the rate of 450 per bed = 233 x 450 = **0.1 MLD**

Colleges: requirement of water for 1350 students in colleges

= 1350 x 45 = **0.06 MLD**

Schools: requirement of water for 9070 students at the rate of 45 lpcd

= 9070 x 45 = **0.41 MLD**

Industries: water requirement for 10977 workers in various factories at the rate of 30 lpcd = 10977 x 30 = **0.33 MLD**

Total = 6 + 0.1 + 0.06+ 0.41 + 0.33 = **6.9 MLD**

Adding 25 % (ie 1.725 MLD) for commercial, public institutions, park and open spaces, street taps etc. the total requirement of water for 2045 = 6.9 + 1.725 = **8.625 MLD**

- Current water supply = **0.5 MLD**
- Additional requirement = **8.125 MLD**

e) Solid waste management

- Waste generated = 11.62 tons/day
- Waste generation in 2045 (20% Excess) = 13.9 ton/day
- Waste collected/day = 1.1 tons
- Hence additional **12.8 tons/day** to be collected and treated

f) Energy

The electric power requirement in the town is computed at the rate of 1 KWH per capita per day for residential use and 4 KWH per worker per day for industrial purposes.

- Residential use = 50000 KWH
- Workers in industries = 609
- Power Required = 609 x 4 = 2436 KWH
- Total Power Requirement = 50000 + 2436 = **52436 KWH**

g) Education

1. High School (8th Std to 10th Std)

As per the TCPO guidelines manageable Student strength of a High School is 700-750 students. The total number of population with 700 students of age group 13-15, can be obtained from the age structure. The age structure of Alappuzha District is shown in the table below.

Table 29.4: Various age groups in Alappuzha District

Percentage of People in various age groups Alappuzha District	
Age	**Percentage**
0-4	7.87
5-9	7.01
10-14	8.15
15-19	8.07

- Total % of students in the age group (13-15) = (8.15x3)/5 = 4.89 %
- Total No. of people = 700x100/4.89 = 14315 (say 14000)
- *Threshold Population of a High School with student strength of 700-750 is 14000*

In 2045 number of high school needed = 40000/14000 = 2.85 schools with 700 strength. ie schools with a capacity of 2000 (2.85 x 700) students is needed.

2. Higher Secondary School

It is derived that for a population of 14,000, a High School with strength 700 is sufficient. Assuming a 60% pass from the HS, the number of students opting for Higher Education from within a population of 14,000 = 700 x 0.6 = 420

Assuming 80% of students from this 420 is opting for higher secondary Education

i.e., 420x0.8= 336

The number of divisions of an HSS, if the strength of the first division is 50 and that the subsequent divisions are at 45 each = 8

One Higher Secondary School with 8 divisions for 14,000 populations

In 2045 number of higher secondary school needed = 40000/14000 = 2.85 schools with 336 strengths. i.e., schools with a capacity of 960 (2.85 x 336) students is needed.

3. Arts & Science Colleges

It is derived that for a population of 14,000, a Higher Secondary School with strength 336 is needed. Assuming 80% pass from the HSS, and majority of this (Say 60%) opt for college Education the number of students opting for College Education (including Professional Colleges) from within a population of 14,000 =336x0.6= 202

- Assuming that 65% of the 202 students are opting for Arts & Science Colleges, the number of students opting for higher education from Arts and science college = 202x0.65=131
- The total students strength of an Arts & Science College = 500 (BSc-120, BA-120, BCom-120, Others-120)
- So the total number of population having 500 students for Arts & Science College = 14,000x500/132 =53030 (Approximately 53000)
- For 53,000 populations 1 college with 500 student's capacity is needed.

In 2045 number of colleges needed = 40000/53000 = 0.75 colleges with 500 strengths. i.e. colleges with a capacity of 375 (0.75 x 500) students is needed.

4. Professional College

No professional college in the town as per secondary data.

5. Other Professional Institutes (Polytechnic, ITI & ITC)

Assuming 20 % of the students from HSS pass are opting Polytechnic colleges

- Total number of students opting for Polytechnic=336X0.2 = 68
- Total strength at the entry level of a polytechnic = 150
- *Threshold population of a Polytechnic = 14000 *150/68= 30882 (say 30000)*
- Polytechnic needed = 40000/30000 = 1.3
- Polytechnic with student strength 195 (1.3 x 150) is needed. There is no polytechnic in the town as per the secondary data.
- Assume that 10% of the students failing HSS and 1% of the students failing HS and 15% of students passing HS and 2% of the students passing Higher Secondary Schools are opting for ITI or ITC. No. of students opting for ITI or ITC = 34+ 4+63+7 (10% of 336+1% of 420+ 15% of 420+ 2% of 336)= 108

Students strength at the entry level on an ITI or ITC = 300

Threshold population of an ITI or ITC = 14000x300/108 = 38888.88 ≈39000 (say)

- *Threshold population of an ITI or ITC = 39000*
- ITI/ITC needed = 40000/39000 = 1.02(say 1)
- ITI/ITC with student strength **300** is needed.

h) Health

At present there are 233 beds in various Allopathic hospitals. Out of 233 beds, 83 are in the private hospitals. There is a total of 150 beds in the government sector.

- Assuming a standard of 4 beds per 1000 population, the number of beds needed by 2045= (40000/1000) x 4 = **160**

i) Housing

As per the secondary data collected, the existing number of houses in Haripad town is 9129. Average household size for the town is 3.4.

- Number of houses needed by 2045 = 40000/3.4= 11765
- Housing shortage = 11765 – 9129 = 2635
- Number of kutcha houses to be reconstructed as per the 10% sample survey conducted is 9129 x 0.066 = 603 (6.6% of total HH sample is found to be kutcha)
- 1% removed due to developmental activities = 9129/100 = 91

Total houses to be built = 2635+ 603 + 91 = ***3329***

j) Recreational facilities

Category	Standard recommended	Demand 2045
Park & open spaces (overall town)	10-12 sq.m /persons	40-48 hectare
Neighbourhood Park	1 for 15,000 persons	3 Nos
Open spaces (variations by size of settlement)	1.0-1.2Ha/1000 persons	48 Ha
Community room	1/5000 persons	8 Nos
Community hall & library	1/15000 persons	3 Nos
Recreational Club	1 for 1 lakh persons	1 Nos

CHAPTER
30

GENERAL POLICIES AND STRATEGIES



The General Policies and Strategies chapter outlines the guiding framework for Haripad's planned development, ensuring that land use, infrastructure, environment and social needs are addressed in a balanced and sustainable manner. Policies provide clear direction for regulating growth and guiding decision-making, while strategies translate these policies into actionable measures tailored to the town's challenges and opportunities. Developed through stakeholder consultations and community inputs, these principles aim to promote economic vitality, social equity, environmental protection and long-term resilience. This chapter presents the sector-wise policies and strategies that will steer Haripad toward a well-planned, inclusive and sustainable future.

- Trade and Commerce
- Industry
- Tourism and Heritage
- Agriculture and Allied Sectors
- Physical Infrastructure
- Social Infrastructure
- Traffic and Transportation
- Special Concern Areas
- Environment
- Development Administration and Municipal Finance

30. GENERAL POLICIES AND STRATEGIES

The development policies and strategies for Haripad are formulated to guide the implementation of a 20-year development vision, ensuring that all initiatives progress in a coordinated, integrated, and conflict-free manner. These strategies aim to create synergy across sectors, aligning development potential with emerging demands while safeguarding the town's cultural, environmental, and natural resources.

All sectors - spanning tourism, agriculture, infrastructure, environment, commerce, and social development - will work together toward achieving a shared vision for Haripad's sustainable and inclusive growth. Among these, tourism and agriculture, along with their related activities, are envisioned as the primary thrust sectors driving Haripad's future economic and spatial development.

Priority initiatives include tourism enhancement, agricultural modernization, the creation of better social infrastructure for residents, and improvements to transport connectivity and mobility networks. These efforts are intended to elevate the town's liveability and competitiveness while ensuring that all development interventions incorporate disaster risk reduction, climate resilience, and environmentally responsible planning principles.

Overall, the policy framework seeks to balance growth and preservation, fostering a development process that is collaborative, resilient, and aligned with the long-term vision for Haripad..

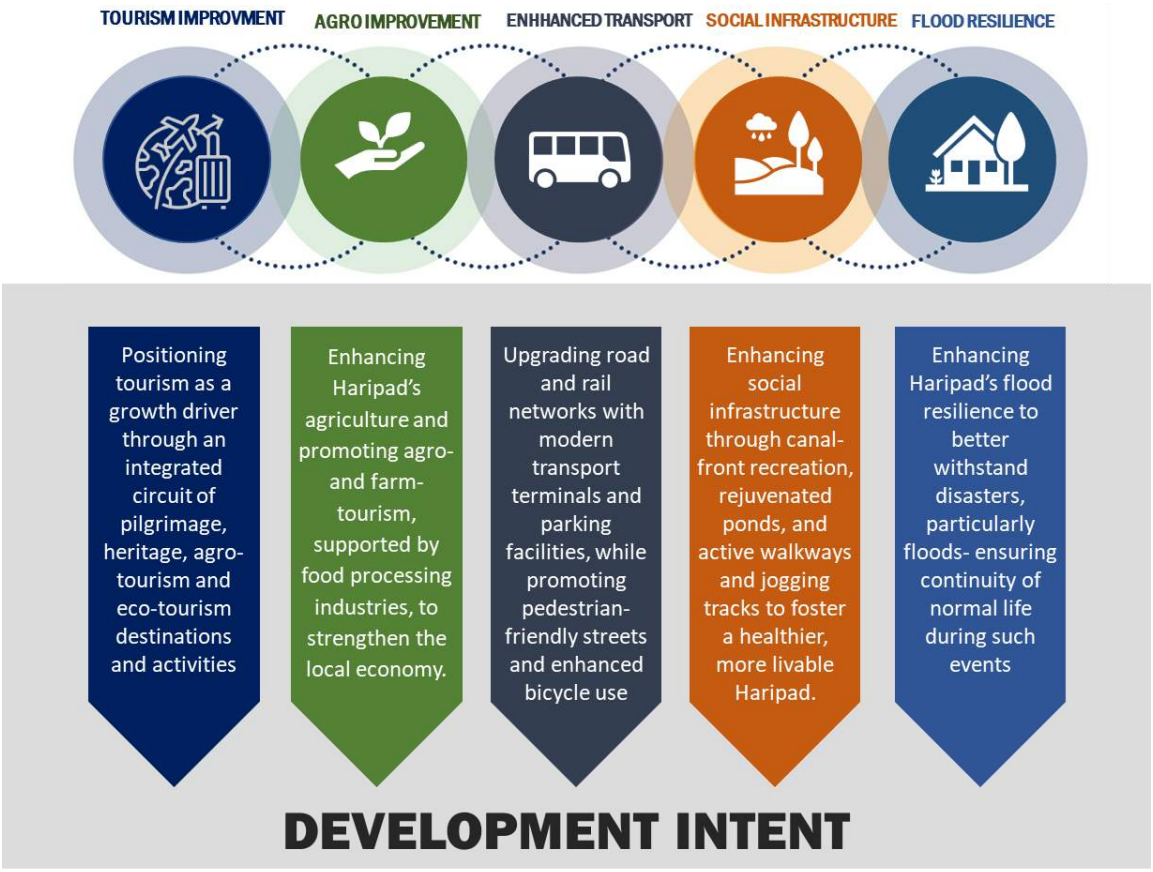


Figure 30.1 Development Intent for Haripad Town

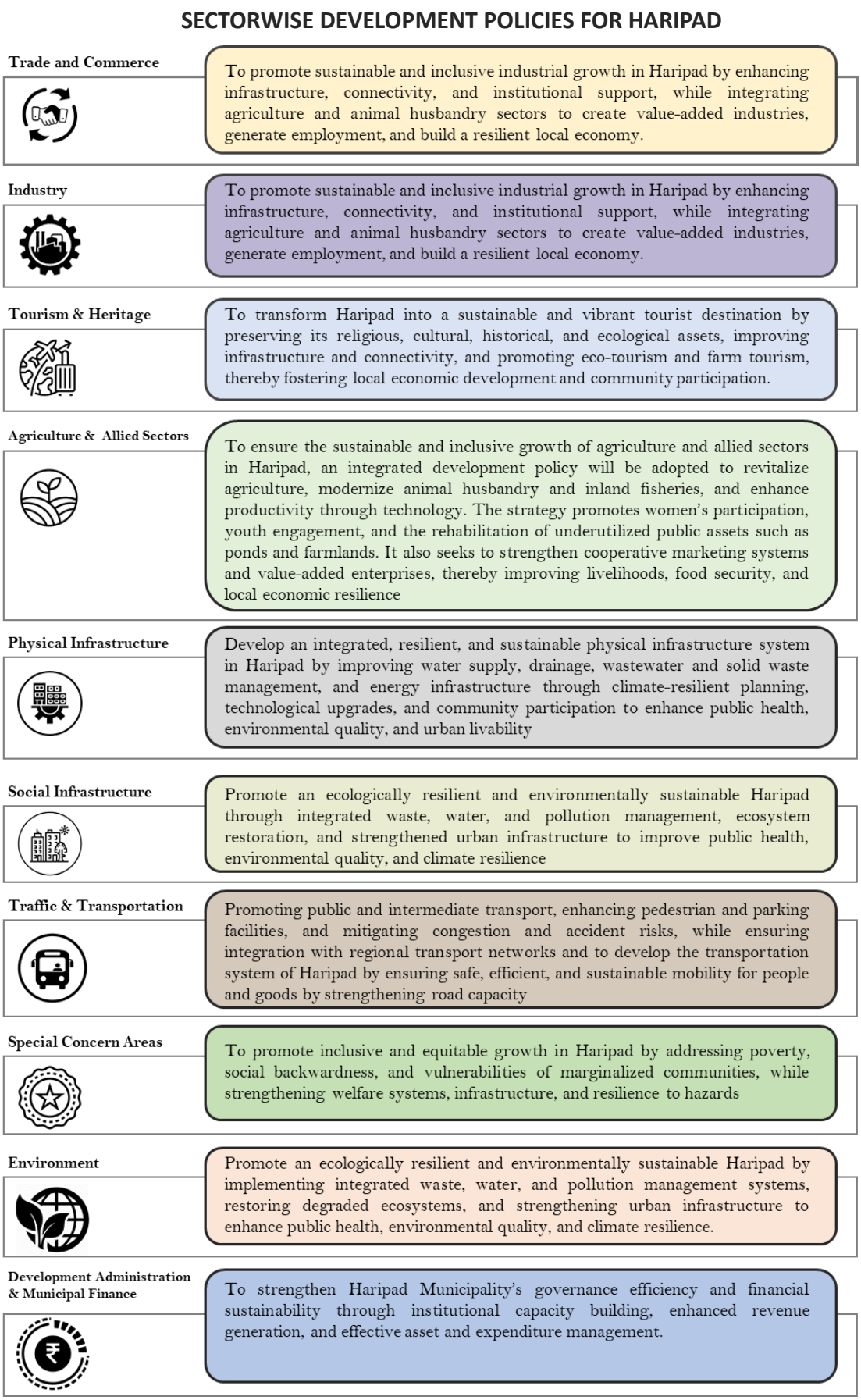


Figure 30.2 : Sector wise Development Policies for Haripad

30.1 Trade and Commerce

***Policy**: To enhance the efficiency, sustainability, and inclusiveness of the trade and commerce sector of Haripad town, the Municipality aims to improve infrastructure, proper waste management system, decentralize commercial activities, formalize street vending, and modernize market systems, while ensuring environmental resilience and accessibility for all.*

Strategies:

- Upgrade road networks, footpaths, and drainage systems along key commercial corridors (e.g., Town Hall–Ezhikkakathu–Taluk Hospital Road).
- Establish centralized parking facilities and improve traffic circulation.
- Improve accessibility features, including ramps and signage, especially in high-footfall areas.
- Promote development of new commercial hubs along NH 66 and inner town areas.
- Ease congestion by encouraging businesses to spread beyond the central commercial zone.
- Upgrade parallel roads to divert traffic and stimulate commercial activity in underutilized areas.
- Designate and develop dedicated vending zones near Town Hall, KSRTC Bus Stand, and Taluk Hospital.
- Issue ID cards to all vendors and regulate vending through licensing and spatial planning.
- Provide basic infrastructure such as waste bins, shelters, and sanitation for vending zones.
- Renovate Danappadi Market with proper zoning (vegetables, fish, meat), drainage, and roofed stalls.
- Develop modern fish and meat markets with hygienic facilities.
- Integrate Subramanya Temple surroundings with market functions in a heritage-sensitive manner.
- Implement a dedicated waste management plan for commercial areas by introducing a separate collection and processing systems for biodegradable, non-biodegradable, and liquid waste from shops and vendors.
- Promote awareness and enforce penalties for improper waste disposal.
- Encourage use of flood-resistant construction materials and retrofitting of older buildings vulnerable to flood damage.
- Provide technical support and incentives for shop owners to adopt flood-proofing measures.

30.2 Industry

***Policy:** To promote sustainable and inclusive industrial growth in Haripad by enhancing infrastructure, connectivity, and institutional support, while integrating agriculture and animal husbandry sectors to create value-added industries, generate employment, and build a resilient local economy.*

Strategies:

- Create Common Facility Centres (CFCs) for coir, food processing, and small manufacturing units.
- Upgrade power, water, and waste management facilities for industrial use.
- Facilitate access to MSME and start-up schemes (e.g., PMEGP, Start-up Kerala).
- Set up a Business Incubation Centre for supporting micro-enterprises.
- Launch skill development programs aligned with local industry needs.
- Explore inland waterway transport for suitable goods.
- Improve internet connectivity to support IT-based micro-enterprises.
- Promote value-added industries in food, dairy, fish, and coir processing.
- Establish cold storage and packaging units to support perishables.
- Support cluster-based development with farmer producer groups and SHGs.
- Encourage eco-friendly, low-pollution industries.
- Implement flood-resilient industrial layouts and drainage.
- Mandate in-facility waste treatment and pollution control systems.
- Partner with IT firms, colleges, and NGOs to conduct courses in software development, digital marketing, cybersecurity, etc.
- Set up a municipal skill development centre focused on digital skills aligned with Kerala's IT policy.
- Encourage registration under Start-up India and access to seed funding or mentorship.
- Promote small-scale BPO/KPO operations by offering suitable spaces and connectivity.
- Target youth employment through IT-enabled services like data entry, e-commerce support, and digital documentation.

30.3 Tourism and Heritage

Policy: *To transform Haripad into a sustainable and vibrant tourist destination by preserving its religious, cultural, historical, and ecological assets, improving infrastructure and connectivity, and promoting eco-tourism and farm tourism, thereby fostering local economic development and community participation.*

Strategies:

- Upgrade basic amenities such as public toilets, drinking water facilities, rest areas, signage, and street lighting at major tourist sites.
- Develop organized parking facilities near temples and major attractions to reduce congestion.
- Improve solid waste and wastewater management systems, especially near water bodies and pilgrimage centers.
- Develop drainage networks in flood-prone tourism zones to reduce waterlogging during monsoons.
- Establish integrated pilgrimage circuits connecting Subrahmanya Swamy Temple, Mannarasala Temple, Chakkulathukavu Temple, Chettikulangara Temple, Ambalappuzha Sree Krishna Swami Temple and nearby churches.

- Develop eco-tourism and farm tourism circuits focusing Nelpurakadavu and surrounding paddy fields, with boating, guided field visits, and local farming experiences.
- Enhance public transport facilities during peak pilgrimage seasons with shuttle services and route adjustments.
- Restore and clean up canals and backwaters like those in Nelpurakadavu to allow boat access and improve visual appeal.
- Encourage homestays and farm stays near fields and temples to retain visitors overnight.
- Create flood-resilient infrastructure like raised pathways, elevated toilets, and temporary shelters at key tourism locations.
- Develop a disaster management plan for tourism events, especially during monsoons and festivals.
- Train local youth and women as tourist guides, eco-tour operators, and hospitality providers.
- Conduct targeted promotion through Kerala Tourism platforms, local festivals, and social media campaigns.

30.4 Agriculture and Allied Sectors

Policy: *To ensure sustainable and inclusive growth of agriculture and allied sectors in Haripad Town, an integrated development policy shall be adopted to revitalize agriculture, modernize animal husbandry and inland fisheries infrastructure, promote women's participation and youth engagement, enhance productivity through technological interventions, rehabilitate unused public resources like ponds and farmlands, and strengthen organized marketing channels through cooperative models and value-added enterprises, thereby improving livelihoods, food security, and local economic resilience.*

Strategies:

- Promote **organic farming** and **integrated farming systems** combining crops, livestock, and aquaculture.
- Develop community-managed irrigation schemes using treated wastewater and rainwater harvesting.
- Establish a modern authorized slaughterhouse with waste treatment facilities to improve hygiene and meat processing standards.
- Upgrade veterinary polyclinics and mobile vet units with modern facilities and equipment.
- Rehabilitate and desilt public ponds and canals to restore them for fish farming and irrigation.
- Promote breeding programs with high-yield, disease-resistant livestock varieties (especially in dairy and poultry).
- Subsidize cattle feed and incentivize local fodder cultivation to reduce feed costs.
- Provide insurance coverage for livestock and timely compensation during disasters.
- Promote cage fish farming in suitable sections of rivers and water bodies.
- Provide quality fingerlings and feed subsidies to fish farmers under PMMSY and FFDA.

- Partner with Krishi Bhavans, Dairy Development Department, FFDA, Matsyabhavan, and academic institutions for technical support and training.

30.5 Physical Infrastructure

Policy: *Develop an integrated, resilient, and sustainable physical infrastructure system in Haripad by improving water supply, drainage, wastewater and solid waste management, and energy infrastructure through climate-resilient planning, technological upgrades, and community participation to enhance public health, environmental quality, and urban liveability.*

Strategies:

1. **Water Supply:**

   - Establish a Water Treatment Plant (WTP) for UWSS.
   - Expand UWSS coverage to Wards 9–29 and connect more households.
   - Promote rainwater harvesting through well recharge and watershed management interventions.
   - Rejuvenate Pampa Irrigation Project canals for groundwater recharge and supplemental supply.
   - Install smart water meters and leakage detection systems.

2. **Drainage:**

   - Desilt and reconnect existing drains to natural canals/rivers (Pillathodu, Danappady Thodu).
   - Construct climate-resilient drains with proper gradients and culverts.
   - Enforce zoning regulations to prevent encroachments on drains and water bodies.
   - Launch community monitoring programs to prevent waste dumping into drains.

3. **Waste water:**

   - Implement a centralized sewerage network starting with the most congested wards.
   - Construct a Sewage Treatment Plant (STP) at a suitable site.
   - Enforce regulation to disconnect direct discharge of wastewater into open drains.
   - Conduct awareness campaigns on safe sanitation and water protection.

4. **Solid waste disposal:**
   - Make source segregation mandatory, supported by local awareness drives.
   - Strengthen door-to-door collection system.
   - Fully operationalize and scale up Mini MCFs and Thumboormuzhi compost units.
   - Set up a central composting and material recovery facility.
   - Ensure safe sanitary waste collection and disposal systems.

5. **Energy:**

- Promote solar rooftop installations on municipal buildings, schools, and households through subsidies.
- Launch a Municipal Solar Mission to expand solar street lighting and public infrastructure.
- Provide incentives for energy-efficient appliances and buildings.
- Promote community-based solar microgrids in areas prone to outages.
- Provide Piezoelectric flooring technology at convenient location

30.6 Social Infrastructure

Policy: *Promote equitable access to inclusive, resilient, and sustainable social infrastructure in Haripad by enhancing quality education, healthcare, housing, recreational spaces, and civic amenities through integrated planning, innovation, and disaster preparedness - ensuring improved quality of life, social well-being, and community resilience for all residents.*

Strategies:

1. **Education:**

- Upgrade existing school infrastructure by providing adequate furniture, classrooms, laboratories, libraries, and computer facilities.
- Equip schools with safe drinking water, playgrounds, and electricity backup.
- Strengthen existing Industrial Training Institutes (ITIs) by introducing courses aligned with emerging local industries (renewable energy, agro-processing, etc.).
- Provide training to teachers in ICT-based teaching methods and blended learning.
- Introduce more special education programs and deploy trained special educators across public schools.
- Develop school safety plans and conduct regular disaster preparedness drills.
- Provide counseling and bridge programs for students at risk of dropping out.
- Use GIS mapping to identify service gaps and plan future institutions or upgrades.

2. **Health:**

- Upgrade existing PHCs and wellness centres with adequate medical staff, diagnostics, and modern equipment.
- Expand testing facilities in public hospitals to support timely diagnostics and early treatment.
- Train health workers in disaster response and first aid, and equip facilities with emergency kits and communication systems.
- Increase **frequency of vaccination services**, especially in Pallippadu and Nangiarkulangara centers.
- Scale up free medical camps for elderly and vulnerable groups under schemes like Vayomithram and Harsham.
- Create awareness on substance abuse and behavioral disorders through the Punarjani and Sadgamaya programs.

- Strengthen Ayurveda and Homoeopathy services by upgrading public institutions and ensuring supply of medicines.
- Increase awareness and community engagement on vector-borne and waterborne disease prevention, especially during the monsoon.
- Encourage PPP for establishing diagnostic labs, telemedicine services, and mobile health units.

3. Housing:

- Promote flood-resistant construction techniques and materials to strengthen foundations and reduce damage from waterlogging.
- Accelerate completion of ongoing PMAY housing units and identify additional vulnerable households for inclusion.
- Facilitate access to housing finance and subsidies for marginalized groups.
- Promote eco-friendly and sustainable building practices to enhance energy efficiency and reduce environmental impact.
- Encourage integration of basic amenities such as clean water, sanitation, and electricity in all housing.
- Prevent unplanned development in hazard-prone areas thr
- ough land-use zoning and enforcement.
- Involve local communities in planning and decision-making to ensure housing initiatives meet their needs.

4. Recreation:

- Identify underutilized public land and convert it into green recreational zones, prioritizing flood-resilient landscaping.
- Encourage use of school and college grounds for public recreational use after school hours through shared-use agreements.
- Renovate and reopen the Town Hall as a multifunctional space for civic events, cultural programs, and indoor recreation.
- Ensure structural safety upgrades to make the Town Hall suitable for use as an emergency shelter during disasters.
- Upgrade existing libraries with digital facilities, children's sections, and community learning areas.
- Ensure all recreational developments are accessible to women, children, senior citizens, and persons with disabilities.
- Leverage water bodies and canals for eco-friendly recreational activities such as boating, walkways, and nature trails.
- Use permeable surfaces and tree planting in parks to reduce urban heat island effects and increase rainwater percolation.
- Encourage weekend cultural events and workshops in existing auditoriums to improve public participation.

5. Other civic Amenities:

- Expedite the completion of the partially built crematorium and burial ground, ensuring it is fully functional with necessary infrastructure and sanitation.
- Construct additional public toilets and comfort stations, particularly in crowded and transit-heavy areas such as bus stands, markets, and near temples.
- Equip the fire station with modern fire-fighting tools, rescue equipment, and an increased number of vehicles.
- Ensure all civic amenities, including police stations, fire stations, and public toilets, are accessible to the elderly and differently abled.
- Improve stormwater drainage around key civic facilities to prevent service disruptions.
- Promote the use of digital communication platforms for public alerts and municipal updates.

30.7 Traffic and Transportation

Policy: *Promoting public and intermediate transport, enhancing pedestrian and parking facilities, and mitigating congestion and accident risks, while ensuring integration with regional transport networks and to develop the transportation system of Haripad by ensuring safe, efficient, and sustainable mobility for people and goods by strengthening road capacity.*

Strategies:

- Upgrade road network through widening, junction improvements, and bypass development.
- Strengthen public transport by enhancing KSRTC facilities, constructing a new private bus stand, and improving bus–rail integration.
- Improve pedestrian and NMT facilities with continuous footpaths, safe crossings, and cycle tracks.
- Introduce organized parking through off-street facilities and regulated on-street parking.
- Enhance traffic safety by redesigning accident-prone spots, improving signage, and prioritizing blackspot treatments.
- Regulate goods movement with designated loading/unloading zones and controlled truck timings.
- Promote sustainable transport by integrating IWT and IPT modes to reduce road congestion.
- Adopt smart traffic management using ITS, real-time monitoring, and regular traffic surveys.

30.8 Special Concern Areas

Policy: *To promote inclusive and equitable growth in Haripad by addressing poverty, social backwardness, and vulnerabilities of marginalized communities, while strengthening welfare systems, infrastructure, and resilience to hazards.*

Strategies:

- Upgrade housing, sanitation, water supply, and road access in backward settlements and SC/ST nagars.
- Strengthen poverty alleviation and livelihood programs with emphasis on skill development, vocational training, and market linkages.
- Expand and modernize Anganawadi centers and improve service delivery for women and children.
- Enhance social security coverage for elderly, differently-abled, and vulnerable households.
- Promote women's empowerment through Kudumbashree, self-help enterprises, and equal wage opportunities in the informal sector.
- Improve healthcare and education access for marginalized communities through targeted infrastructure and service delivery.
- Implement community-based disaster risk reduction programs to build resilience in vulnerable settlements.
- Ensure effective outreach and monitoring of welfare schemes like PMAY, NULM, and ICDS.

30.9 Environment

Policy: *Promote an ecologically resilient and environmentally sustainable Haripad by implementing integrated waste, water, and pollution management systems, restoring degraded ecosystems, and strengthening urban infrastructure to enhance public health, environmental quality, and climate resilience.*

Strategies:

- Create decentralized biogas and organic composting units, especially in markets and residential areas.
- Strictly enforce penalties for illegal dumping, especially around canals and wetlands like Pillathodu Canal.
- Rehabilitate and maintain defunct borewells and idle irrigation canals.
- Introduce water testing and monitoring programs for ponds, wells, and taps.
- Implement a Green Mobility Plan with designated cycle lanes and electric vehicle charging stations.
- Declare critical wetlands and paddy fields as protected zones and prevent further encroachment.
- Restore silted ponds, canals, and backwaters through community-based conservation programs.
- Undertake bio-remediation projects in polluted water bodies like temple ponds and Pillathodu Canal.
- Promote the conservation and public awareness of sacred groves like Mannarasala, with local eco-clubs.

- Develop an eco-disaster response strategy focusing on flood-prone areas and sacred groves.
- Conduct environmental risk mapping for soil erosion, saltwater intrusion, and ecosystem degradation.
- Promote mangrove cultivation in appropriate locations as a natural remedial measure for salt water intrusion, flood control etc.

30.10. Development Administration and Municipal Finance

Policy: *To strengthen Haripad Municipality's governance efficiency and financial sustainability through institutional capacity building, enhanced revenue generation, and effective asset and expenditure management.*

Strategies:

- Strengthen institutional capacity by upgrading administrative systems, e-governance platforms, and staff training.
- Improve financial self-reliance by enhancing property tax coverage, rationalizing user charges, and diversifying non-tax revenues.
- Ensure timely revision and collection of taxes, fees, and service charges to reduce arrears and leakages.
- Promote participatory budgeting and transparent financial management for accountable governance.
- Optimize utilization of plan and non-plan grants by aligning them with priority development needs.
- Implement Asset Management Plans for systematic maintenance, monitoring, and expansion of infrastructure.
- Introduce innovative financing mechanisms like PPP models, CSR partnerships, and project-based funding.
- Strengthen audit, monitoring, and reporting systems to ensure financial discipline and efficiency.





PART III : PROPOSALS

CHAPTER
31

PROPOSED LAND USE



The Proposed Land Use chapter outlines the planned spatial structure that will guide Haripad's growth and development in the coming years. It provides a forward-looking framework that allocates land for various uses- such as residential, commercial, industrial, public and semi-public , transportation, agriculture, recreation and conservation- ensuring that development is well-organized, sustainable and aligned with the town's long-term vision. As a core component of the Master Plan, the proposed land use framework supports informed decision-making, coordinates sectoral investments and helps balance economic development with environmental protection and community well-being.

- Residential Zone
- Town Centre
- Mixed Use
- Industrial Zone
- Public & Semi-Public Zone
- Traffic and Transportation Zone
- Tourism Promotion Zone
- Agro Tourism Promotion Zone
- Environmental Cponservation Zone
- Wet Agriculture Zone
- Recreation zone
- Detention/ Retention Basin
- Wetland Park
- Sacred Groves
- Buffer Zone
- Water Bodies
- Special Zones

31.PROPOSED LAND USE

Proposed Land Use forms a fundamental component of the Municipality's long-term spatial planning framework, as it translates the overall development vision and sectoral strategies into a structured and legally enforceable spatial pattern. It delineates the intended distribution, extent, and intensity of various land use categories across the municipal area, thereby guiding future growth in a planned, sustainable, and climate-responsive manner.

Based on the adopted development concept and sectoral assessments, the Proposed Land Use Plan for Haripad has been prepared for the horizon year 2045. The plan integrates findings from land use analysis, hazard vulnerability assessment, infrastructure capacity studies, environmental sensitivity mapping, and stakeholder consultations. It seeks to achieve a balanced allocation of residential, commercial, industrial, public and semi-public, recreational, transportation, and environmentally sensitive zones, while ensuring the protection of flood-prone areas, wetlands, paddy fields, and heritage precincts.

The Proposed Land Use Plan also aims to correct existing spatial imbalances by strengthening economic corridors, safeguarding ecological buffers, enhancing open spaces, and promoting mixed-use development where appropriate. By aligning growth with infrastructure provision, risk reduction strategies, and environmental conservation measures, the 2045 Land Use Plan provides a structured roadmap for sustainable urban expansion, improved quality of life, and long-term resilience in Haripad Municipality. The Proposed Land Use Breakup, Area Breakup of each of the Land Use Zones and the Proposed Land Use map is given in Table 31.1, Figure 31.1 and Figure 31.2 respectively:

31.1 Residential Zone

The residential fabric of Haripad Municipality is characterised by a predominantly low- to medium-density, dispersed settlement pattern, interwoven with stretches of dry agricultural lands and homestead plots. This spatial structure reflects the town's semi-urban character and its gradual transition from agrarian land use to urban functions. In recognition of this existing pattern, the Master Plan proposes to designate the current residential areas and compatible dry agricultural lands as Residential Zones, thereby consolidating the built form while enabling planned and orderly growth.

The URDPFI Guidelines recommend that approximately 45% of the net urbanisable area be allocated for residential use to ensure balanced development, adequate housing supply, and the integration of supporting social and physical infrastructure. In the case of Haripad Municipality, the proposed residential land use accounts for 40.77% of the total municipal area. Although this proportion is marginally lower than the recommended benchmark, it remains appropriate and sufficient when assessed in the context of the town's projected population growth, existing density patterns, and settlement morphology.

The slightly lower allocation is strategically aligned with Haripad's development trajectory, which emphasises compact growth, protection of environmentally sensitive areas, and the preservation of productive agricultural and wetland systems. Rather than indiscriminately expanding residential zones, the proposal seeks to optimise the utilisation of existing residential clusters through infill development, infrastructure augmentation, and improved service delivery. This approach supports sustainable land management, reduces urban sprawl,

and enhances the efficiency of public investments in roads, drainage, water supply, and community facilities.

Table 31.1: Proposed Land Use Break up of Haripad - 2045

Sl. No.	Proposed Land Use Zones	Area (in Sq.Km.)	% of Total Area
1.	Residential Zone	6.66	40.77
2.	Town Centre	0.37	2.28
3.	Mixed Zone	0.83	5.08
4.	Industrial Zone	0.03	0.25
5.	Public & Semi-public Zone	0.56	3.41
	A) PS-01 (Karimpalil Palace Renovation)	0.01	0.05
	B) PS-02 (Haripad Culture Centre)	0.01	0.03
	C) PS-03 (Pilgrim Amenity Centre)	0.0001	0.001
	D) PS-04 (Waste Treatment Plant)	0.0031	0.02
6.	Traffic & Transportation Zone	0.99	6.90
7.	Tourism Promotion Zone	0.24	1.50
8.	Agro Tourism Promotion Zone	0.63	3.85
9.	Environmental Conservation Zone	4.06	24.87
10.	Wet Agriculture	0.91	5.59
11.	Recreational Zone	0.01	0.05
12.	Detention/ Retention Basins	0.03	0.17
13.	Wetland Park	0.01	0.06
14.	Sacred Groves	0.02	0.14
15.	Buffer (2m) – For Water bodies having width > 5m	0.06	0.35
16.	Water bodies	0.91	5.60
17.	Special Zone		
	A) Special Zone A (Private Bus Stand)	0.013	0.01
	TOTAL	**16.34**	**100.00**

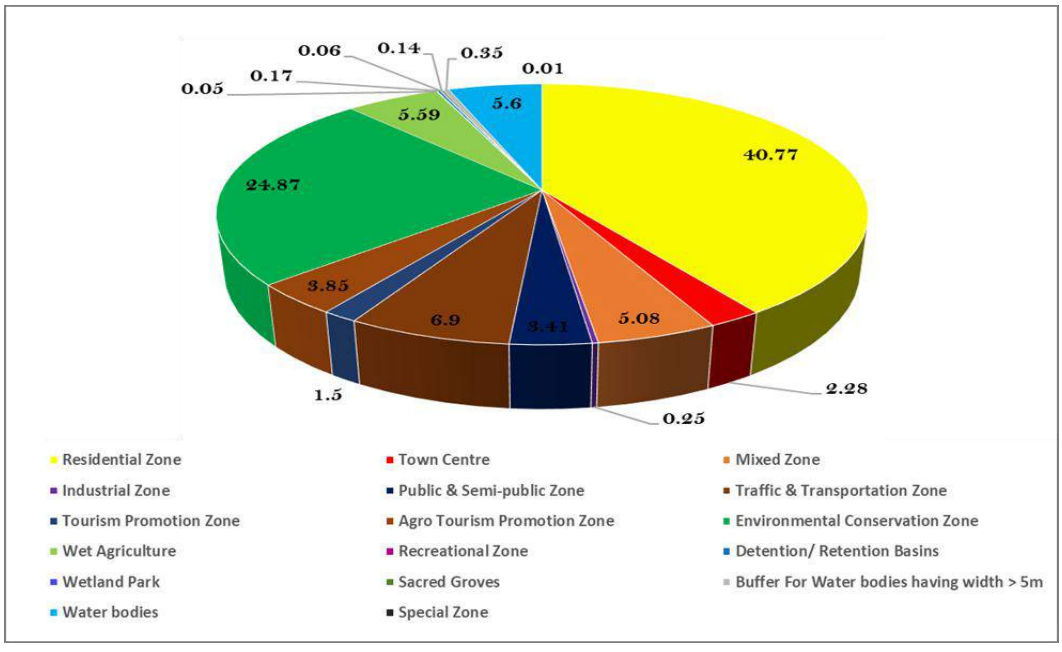


Figure 31.1 : Proposed Land Use Split-Up in Percentage

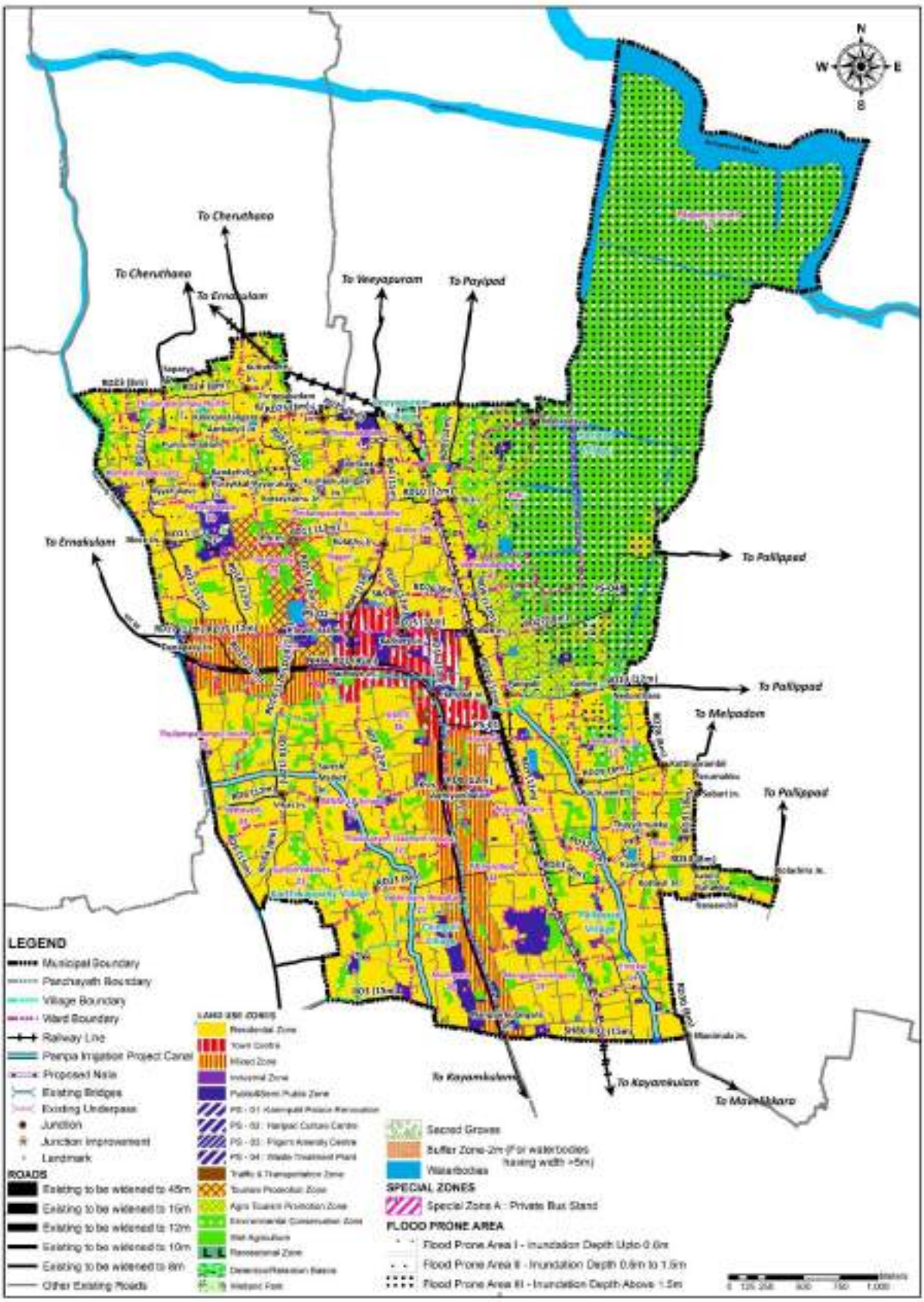


Figure 31.2 : Proposed Land Use Map of Haripad Town- 2045

Furthermore, the proposed residential zoning framework provides adequate flexibility to accommodate future housing demand through redevelopment, mixed-use integration along activity corridors, and phased expansion in identified growth areas. Thus, the 40.77% allocation not only satisfies present requirements but also establishes a resilient and environmentally responsive framework for long-term urban development within Haripad Municipality.

31.2 Town Centre

Haripad town demonstrates a clearly defined and functionally vibrant urban core distinguished by a high concentration of commercial activity, institutional presence, and superior accessibility. The town centre is strategically positioned along National Highway 66, a principal regional transport corridor that ensures seamless connectivity across districts and strengthens Haripad's linkage to major urban centres along the Kerala coast. This locational advantage significantly enhances the town's regional importance, facilitating the movement of goods, services, and people, and contributing to its sustained economic vitality.

A defining structural characteristic of the urban core is the closely spaced network of major junctions—Madhava Junction, Town Hall Junction, Kachery Junction, Ezhikkakathu Junction, Haripad Town Junction, and Haripad Junction—which collectively function as an integrated circulation system. These junctions form a functional ring that enables efficient internal traffic distribution while also accommodating through-traffic along the highway corridor. The spatial arrangement of these nodes reduces congestion pressures at any single point and supports multi-directional accessibility within the town.

Each of these junctions operates not merely as a traffic intersection but as a dynamic urban node. They anchor clusters of commercial establishments, retail outlets, financial institutions, public offices, and service-oriented activities, thereby generating continuous economic interaction and pedestrian movement. The high accessibility of these nodes has fostered dense commercial frontages and mixed-use development patterns, reinforcing the vibrancy and intensity of the town centre.

The convergence of regional highways, arterial roads, and key urban junctions within this compact core provides Haripad with pronounced locational and functional advantages. This integrated transport structure enhances the efficiency of trade and commerce, supports administrative functions, and strengthens the town's role as a primary service centre for the surrounding rural and peri-urban hinterland. Consequently, the urban core of Haripad functions as a pivotal commercial, administrative, and socio-economic hub, consolidating its position within the broader regional settlement hierarchy.

31.3 Mixed Zone

The Mixed Zone in Haripad town is conceived as an integrated urban zone that accommodates compatible residential and commercial activities, thereby promoting compact development and reducing travel demand. This zone is predominantly proposed along both sides of National Highway 66, beginning from Danapady, extending through Madhava Junction and Haripad Junction within the town centre, and further continuing up to Nangiarkulangara Junction at the southern boundary of the Municipality. Owing to its strategic location along a major regional transport corridor and its proximity to key commercial nodes, the Mixed Zone

supports higher land-use intensity and active frontage development. Mixed Zones are also proposed along inner roads having a minimum road access width of 12 metres, in order to encourage structured commercial growth and neighbourhood-level economic activity in these areas.

The total area designated under the Mixed Zone is 0.83 sq.km, accounting for approximately 5.08% of the total municipal area. This zoning approach is intended to enhance land-use efficiency, support economic activity, and facilitate convenient access to services while maintaining residential liveability along the highway corridor. By integrating residential and commercial functions within walkable distances, the proposal strengthens street vitality and encourages transit-supportive development patterns. Furthermore, the concentration of mixed-use development along major corridors helps to optimise infrastructure investments, improve surveillance and safety through active frontages, and create a more resilient and economically dynamic urban environment.

31.4 Industrial Zone

The proposed Industrial Land Use in Haripad Municipality adopts a limited and context-sensitive approach, reflecting the town's predominantly service-oriented and agrarian character. Industrial allocation is intentionally minimal, with no provision for heavy or polluting industries. Instead, the focus is on accommodating micro, small, and medium enterprises (MSMEs), primarily in the form of small-scale and household-level industries.

The proposed industrial areas are envisaged to promote agro-based and value-added production activities that build upon the region's existing agricultural base and local skills. This approach aims to strengthen the local economy, generate employment opportunities, and encourage entrepreneurship without imposing significant environmental or infrastructural burdens. By prioritising small-scale, resource-efficient, and non-polluting enterprises, the industrial land use strategy ensures economic development while preserving the ecological and residential character of Haripad.

31.5 Public and Semi-Public Zone

The Public and Semi-Public Zone includes the existing public and semi-public institutions within the municipal area. This zone comprises essential facilities such as educational institutions, healthcare establishments, administrative offices, cultural and religious institutions, and welfare infrastructure that collectively support the social and civic needs of the population. In Haripad, the Public and Semi-Public Zone covers an area of 0.56 sq.km, accounting for 3.41% of the total municipal area. The zone also includes key proposed initiatives aimed at strengthening the town's cultural and heritage assets, notably the Karimpalil Palace Renovation (PS-01), Haripad Culture Centre (PS-02), Pilgrim Amenity Centre (PS-03) and Waste Treatment Plant (PS-04). Together, these uses and proposals reinforce the town's role as a centre for public service delivery, cultural identity, and community development.

The spatial distribution of this zone ensures equitable access to essential services across the Municipality, thereby enhancing overall liveability and social inclusion. By consolidating institutional and civic functions within well-defined areas, the proposal facilitates efficient infrastructure provisioning and coordinated urban management. The inclusion of heritage-

oriented and cultural projects further strengthens Haripad's historical significance while fostering tourism potential and community engagement. Overall, the Public and Semi-Public Zone contributes to building a resilient social infrastructure framework that supports both present and future population needs.

1. PS-01 - Karimpalil Palace Renovation

Karimpalil Palace (also known as Karimpalil Koyikkal Palace) (Figure 31. 3), a significant heritage monument associated with the legacy of the Travancore royal rule, forms an important component of the Public and Semi-Public Zone of Haripad town. Located in close proximity to the Haripad railway station and under the custodianship of the Travancore Devaswom Board, the palace holds immense historical and cultural value, with a recorded history spanning over four centuries. Despite its prominence in both historical records and local traditions, the structure is presently in an advanced state of deterioration, marked by partial roof collapse, decayed wooden members, termite-infested structural elements, and damage caused by falling tree branches. The visible neglect of this landmark, despite its daily exposure to hundreds of commuters, underscores the urgent need for immediate conservation and restoration interventions.



Figure 31.3 : Location of PS-01- Karimpalil Palace

Renovation of Karimpalil Palace is critical not only to safeguard a monument of regional and cultural importance but also to integrate heritage conservation into the broader framework of public and semi-public development. Timely restoration would enable the palace to serve as a cultural and heritage asset for the town, contributing to civic identity, educational value, and potential heritage-based tourism, while preventing the irreversible loss of an irreplaceable historical structure. The proposal for the renovation of Karimpalil palace is detailed in Chapter 34- Priority Action Plan.

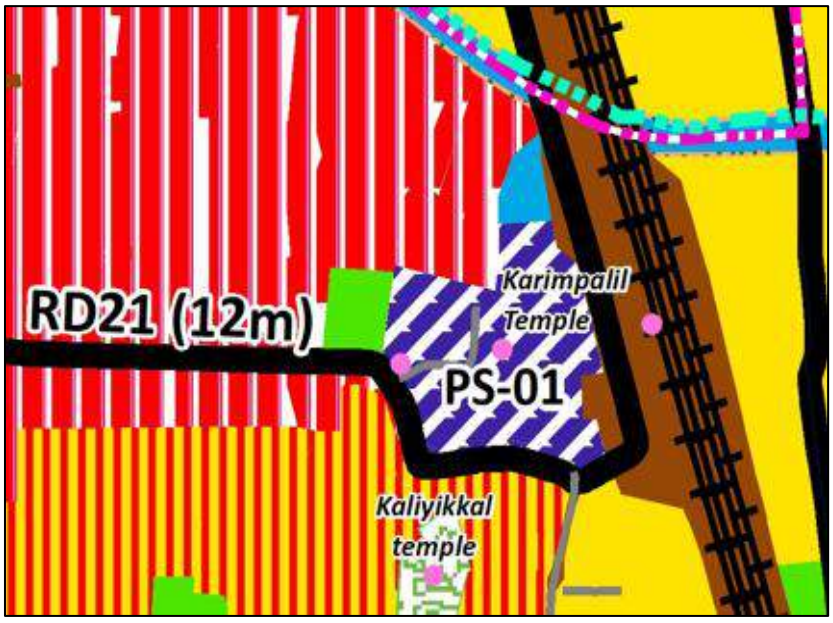


Figure 31.4 : Location of PS-01- Karimpalil Palace in the Proposed Land Use Map

2. PS-02 – Haripad Cultural Centre

The proposal to establish a dedicated Cultural Centre at the Karimpalil Palace site presents an important opportunity to both enhance the town's cultural infrastructure and conserve a valuable heritage asset. While a portion of the palace building is currently in use by the office of the Deputy Commissioner of the Devaswom Board, the remaining structure is in a dilapidated and underutilized condition. Adaptive reuse of this heritage building as a cultural centre would facilitate its systematic restoration and long-term preservation, while creating a platform for cultural activities, exhibitions, performances, and community events.



Figure 31.5 : Location of PS-02- Haripad Culture Centre

Such an initiative would ensure that the architectural integrity and historical significance of the structure are retained through sensitive conservation practices aligned with heritage management principles. The revitalisation of the palace precinct can also stimulate cultural tourism and reinforce Haripad's identity as a town with a rich historical legacy. By integrating heritage conservation with contemporary cultural programming, the project would transform an underutilised asset into a vibrant civic space that fosters community engagement, artistic expression, and intergenerational cultural continuity.



Figure 31.6 : Location of PS-02- Haripad Culture Centre in the Proposed Land Use Map

3. PS-03 – Pilgrim Amenity Centre

A Pilgrim Amenity Centre (Figure 31.7) is proposed near the Haripad Sree Subrahmanya Swamy Temple, an area that experiences consistently high pilgrim movement throughout the day, with significant surges during festival seasons. The project envisions a compact yet thoughtfully planned support facility that delivers essential amenities to pilgrims in an organised, hygienic, and culturally appropriate manner. The centre is intended to streamline visitor movement, provide designated spaces for rest and basic services, and thereby reduce congestion and unregulated activities within the immediate temple precinct.

Designed in the traditional Kerala vernacular style—with sloping tiled roofs, laterite and wooden detailing, shaded verandahs, and climate-responsive architectural features—the structure seeks to harmonise with the sacred and historical character of the surroundings. Passive design strategies such as natural ventilation, shaded courtyards, and rainwater management systems will enhance environmental performance while ensuring user comfort. By integrating functional efficiency with contextual architectural expression, the proposed Pilgrim Amenity Centre aims to elevate the overall visitor experience while preserving the sanctity and visual integrity of the temple environment.



Figure 31.7 : Location of PS-03 - Pilgrim Amenity Centre

4. PS-04 – Waste Treatment Plant

PS-04 – Waste Treatment Plant at Choorelakkal is proposed as a dedicated Special Project to address one of Haripad Municipality's most pressing urban challenges—scientific waste management. The facility is strategically located in Ward 11, opposite to the existing Municipal Crematorium, and has been allocated an area of 0.0031 sq.km (approximately 0.02% of the total area of the town).

Conceived as an integrated treatment facility, the project aims to handle both town-level sewage and solid waste management in a systematic and environmentally sustainable manner. The plant is intended to incorporate decentralized and centralized treatment components as appropriate, ensuring safe processing, resource recovery, and environmentally compliant disposal. By consolidating waste treatment functions within a scientifically designed infrastructure framework, the facility will significantly reduce indiscriminate dumping, groundwater contamination, and pollution of canals and paddy fields.

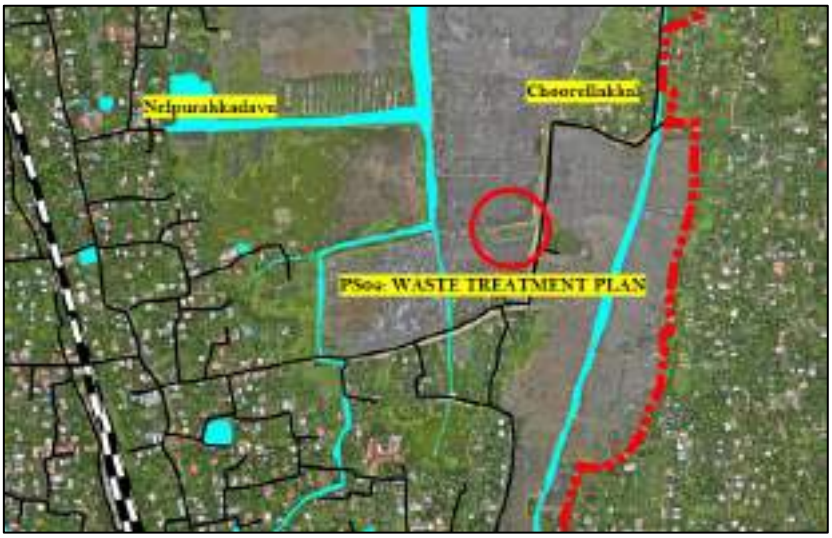


Figure 31.8 : Location of PS-04 – Waste Treatment Plant

Given the technical complexity and long-term implications of the project, the final capacity, process design, treatment technologies, and operational mechanisms will be determined

through a comprehensive scientific assessment, including population projections, waste generation studies, environmental impact evaluation, and hydrological analysis. A Detailed Project Report (DPR) will be prepared to define technical specifications, phasing, cost estimates, and implementation strategies. Further considering the urgency of addressing waste disposal issues in Haripad, the PS04 Waste Treatment Plant represents a critical intervention for improving public health, environmental quality, and overall urban sustainability. It is expected to serve as a foundational infrastructure investment supporting the town's long-term resilience and planned growth.



Figure 31.9 : Location of PS-04 – Waste Treatment Plant in the Proposed Landuse Map

31.6 Traffic and Transportation Zone

The Traffic and Transportation Zone serves as the backbone of mobility in Haripad town, playing a decisive role in accessibility, economic vitality, and sustainable urban growth. In view of the town's strategic location, cultural assets, and projected population growth, the formulation of comprehensive and future-oriented transportation proposals is essential to improve both internal circulation and regional connectivity. An enhanced road network—through measures such as road widening, development of an inner ring road with radial connections, completion of missing links, and improvement of railway overbridges and underpasses—will significantly reduce congestion and improve travel efficiency. These interventions are particularly important for promoting tourism-centric development, as improved accessibility facilitates easier movement of visitors to heritage sites, cultural landmarks, waterfront areas, and regional tourist circuits, thereby strengthening Haripad's potential as a tourism node.

Proposals for upgraded public transport infrastructure, including the development of a new private bus stand and the modernization of the existing KSRTC bus terminal, are expected to significantly improve the operational efficiency and service quality of Haripad's road transport system. These interventions aim to streamline passenger movement, reduce congestion in core areas, and ensure better scheduling and circulation of buses within the town. Additionally, the provision of adequate off-street parking facilities and the upgradation of roads connecting the railway station will strengthen multimodal integration and improve last-mile connectivity for both residents and visitors. The integration of bus, rail, para-transit, and highway connectivity within a coordinated transport framework will support seamless modal transfers and reduce travel delays. Improved pedestrian infrastructure, traffic management measures, and junction enhancements around major transport nodes will further enhance safety and mobility. The detailed Traffic and Transportation Plan, outlining these strategies and their phased implementation, is discussed in Chapter 32 of this Master Plan.

31.7 Tourism Promotion Zone

A Tourism Promotion Zone is proposed to connect the two major pilgrimage centres of Haripad—Mannarasala Nagaraja Temple and Haripad Sree Subrahmanya Swamy Temple—which are located within a distance of approximately 2 km. This initiative aims to streamline and manage the movement of pilgrims and tourists, particularly during peak festival periods, through planned infrastructure, pedestrian-friendly linkages, and visitor support facilities. By designating an area of 0.24 sq.km (1.50% of the town area) for this purpose, the proposal seeks to enhance the piligrim tourism potential of Haripad while preserving and showcasing its cultural and traditional values.

The zone is envisaged to incorporate improved wayfinding systems, organised parking facilities, streetscape enhancements, and amenities such as rest areas, information centres, and sanitation infrastructure to ensure a seamless visitor experience. Strengthening the physical and visual connectivity between the two temples will help distribute pilgrim movement more efficiently and reduce congestion at individual nodes. The initiative also presents opportunities for promoting local crafts, traditional art forms, and small-scale commerce, thereby generating livelihood support for the local community. The Tourism Promotion Zone is intended to position Haripad as a well-managed and culturally vibrant pilgrimage destination of regional significance.

31.8 Agro Tourism Promotion Zone

The Agro-Tourism Promotion Zone in Haripad town is envisaged as a strategic land use aimed at leveraging the town's rich agricultural landscape to promote sustainable tourism and local economic development. Located predominantly in the north-eastern part of the Municipality, this zone encompasses extensive paddy fields that function as the agrarian backbone of the town. Following the harvest season, these fields remain fallow and become naturally waterlogged during the monsoons, transforming into a unique ecological landscape adorned with seasonal white and violet water lillies. The presence of an interconnected canal network further enhances the experiential value of the area, offering opportunities for boat rides and immersive nature-based tourism. The designation of approximately 0.63 sq.km., constituting 3.85% of the town's total area, for agro-tourism provides a platform to diversify the local economy, generate supplementary income for farmers, and create employment opportunities linked to tourism services.

The zone is envisioned to support low-impact, environmentally sensitive activities such as guided farm visits, seasonal festivals, traditional agricultural demonstrations, and local produce markets. By integrating tourism with existing farming practices, the proposal seeks to reinforce agricultural livelihoods while fostering greater appreciation for the region's rural heritage and ecological systems. Careful planning and regulation will ensure that tourism development remains compatible with agricultural productivity and wetland conservation. The Agro-Tourism Promotion Zone represents a balanced approach that aligns economic diversification with environmental stewardship and cultural continuity.

31.9 Environmental Conservation Zone

The Environmental Conservation Zone is a critical component of Haripad town's land use structure, serving as a key natural system that supports flood mitigation, drought resilience,

and long-term urban sustainability. Covering 4.06sq.km and constituting 24.87% of the total town area, this zone includes extensive paddy fields in the north-eastern part of the town, scattered land parcels with active cultivation, and wetlands. These areas play a vital role in regulating the hydrological cycle by acting as natural flood buffers during monsoon periods, facilitating surface water retention, and enhancing groundwater recharge. At the same time, they contribute to drought resilience by sustaining soil moisture and supporting water availability during dry seasons.

Beyond hydrological functions, these ecosystems support local biodiversity, maintain ecological balance, and sustain traditional agricultural livelihoods that are integral to the town's socio-economic fabric. The conservation of these areas is particularly essential given their proximity to the Achankovil River, as they function as natural retention basins and protective buffers that moderate flood surges and reduce downstream vulnerability. The interconnected network of wetlands and cultivated lands also plays a significant role in carbon sequestration and microclimatic regulation, thereby contributing to climate change mitigation efforts at the local level.

Protecting and restoring these zones through appropriate land use controls, wetland conservation measures, and sustainable agricultural practices will strengthen Haripad's climate adaptation capacity and environmental resilience. By safeguarding these ecologically sensitive landscapes from unregulated development, the Municipality can ensure balanced growth that harmonises urban expansion with the preservation of its natural systems. Ultimately, the Environmental Conservation Zone forms the ecological backbone of Haripad, securing both environmental stability and socio-economic sustainability for future generations.

31.10 Wet Agriculture

Paddy fields, wetlands, and marshy areas that possess regulated development potential are included within this zone, subject to strict environmental safeguards and land-use controls. These areas represent productive wet agricultural landscapes that continue to play an important role in the local agrarian economy while also performing critical ecological functions. Wet Agriculture in Haripad covers an extent of 0.91 sq.km, constituting 5.59% of the total municipal area. In addition to supporting paddy cultivation and allied farming activities, these lands contribute significantly to stormwater retention, groundwater recharge, and microclimatic regulation. Any permissible development within this zone shall be carefully guided to ensure that the intrinsic hydrological and ecological characteristics of the wetlands are preserved, thereby maintaining their agricultural productivity and environmental value.

31.11 Recreational Zone

Recreational and open spaces play a vital role in enhancing the quality of urban life by providing safe, inclusive, and accessible environments for leisure, social interaction, and physical activity. In Haripad town, open recreational spaces occupy a very limited area of 0.01 sq.km, accounting for only 0.05% of the total town area, indicating a significant scope for improvement. Facilities such as the Municipal Ground, Taluk Central Library, theatres, auditoriums, convention centres, and sports coaching institutions currently serve as important community anchors for cultural, recreational, and sporting activities. However, the limited

spatial extent of designated recreational areas underscores the need for planned development and expansion of such spaces.

The existing facilities, while functionally important, are insufficient to meet the growing demands of an expanding population and changing lifestyle patterns. There is a clear need to integrate additional neighbourhood parks, waterfront promenades, green corridors, and multi-functional public spaces within the urban fabric to ensure equitable access across all wards. Enhancing recreational infrastructure will not only promote public health and social cohesion but also contribute to environmental benefits such as improved air quality and urban heat mitigation. A strategic and phased approach to expanding open spaces will be essential to strengthening the liveability and resilience of Haripad town.

31.12 Detention/Retention Basins

Detention/Retention Basin (Figure 31.11) is proposed in Haripad town as an effective structural intervention for flood mitigation and integrated stormwater management. These basins are designed to temporarily detain excess surface runoff during periods of intense rainfall and release it in a controlled manner, thereby attenuating peak discharge and minimising downstream flooding. In addition, retention basins function as permanent or semi-permanent water bodies that enhance the capacity to store surplus stormwater, support groundwater recharge, and improve water quality through natural filtration, sedimentation, and biological processes.

Covering an area of 0.03 sq.km, constituting 0.17% of the total town area, this proposal represents a strategically located hydraulic buffer within the broader drainage network. The basin is envisaged to work in conjunction with existing canals, thodus, and proposed stormwater infrastructure to create a more resilient and responsive urban water management system. Beyond its engineering function, the basin can be designed with ecological edges and landscaped buffers to contribute to urban biodiversity and microclimatic regulation. The project will play a critical role in strengthening the town's resilience to flooding, protecting low-lying and vulnerable areas, and advancing a sustainable and climate-responsive approach to urban water management.

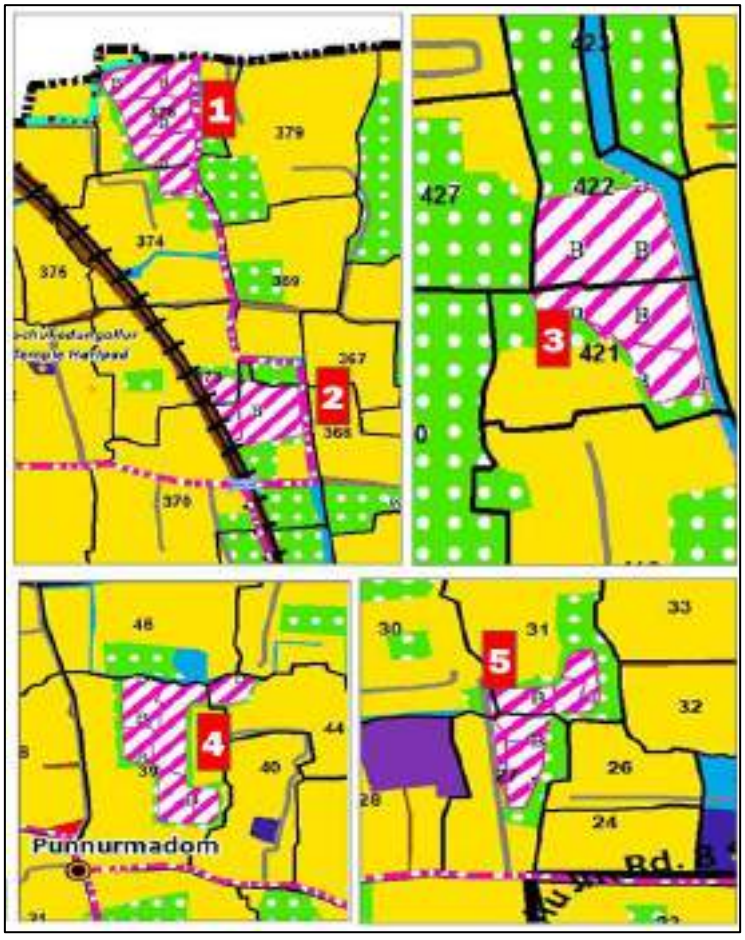


Figure 31.10 : Location of Detention/Retention Basin in the Proposed Land Use Map

31.13 Wetland Park

A Wetland Park (Figure 31.12) is proposed at the southern part of the Padasekharams (paddy fields), adjacent to the Agro-Tourism Zone. Envisioned as a flood-adaptive landscape, the park will function as a natural retention and overflow area during periods of high rainfall, thereby reducing downstream flood risk while maintaining the hydrological integrity of the surrounding agricultural lands. At the same time, it will serve as an accessible open space for the local community, integrating ecological functionality with passive recreation.



Figure 31.11 : Location of Wetland Park

The proposal emphasises conservation-oriented development, with no permanent built structures permitted, ensuring that the intrinsic ecological character of the wetland is preserved. Any interventions within the park will be limited to low-impact features such as nature trails, elevated walkways, observation decks, and interpretative signage designed to minimise disturbance to sensitive habitats. In addition to supporting flood regulation, biodiversity conservation, and micro-climatic moderation, the Wetland Park will enhance the visual quality and environmental aesthetics of the town. By creating opportunities for nature-based recreation, environmental education, and community engagement, the project strengthens Haripad's commitment to sustainable urban development and climate resilience.

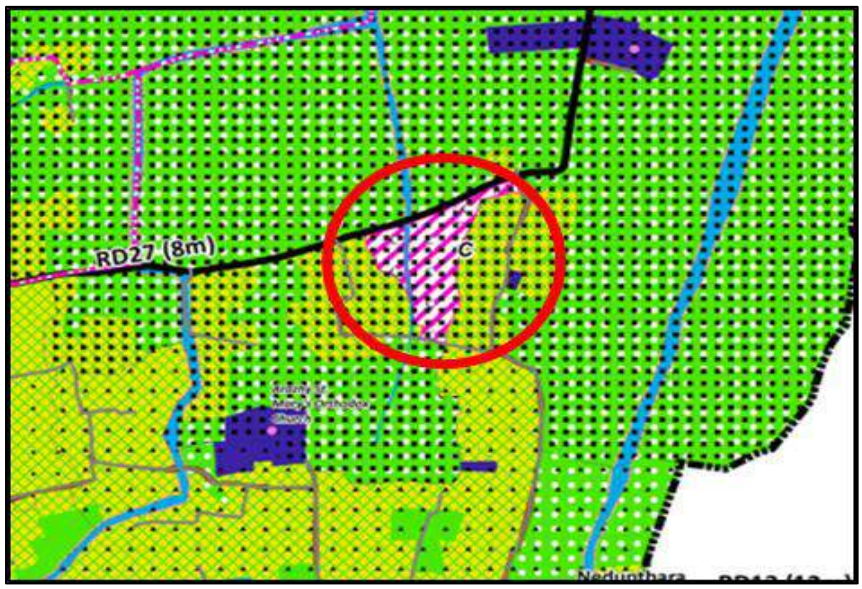


Figure 31.12 : Location of Wetland Park in the Proposed Land Use Map

31.14 Sacred Groves

Sacred groves represent a traditional and community-driven approach to biodiversity conservation, deeply rooted in cultural and spiritual practices. It is proposed to identify, preserve, and regenerate traditional sacred groves (locally known as Kavus), which are vital for biodiversity conservation, cultural heritage, and ecological stability. In Haripad town, the

presence of sacred groves—most notably the Mannarasala Nagaraja Temple sacred grove, one of the largest and most significant in the region—underscores their ecological and cultural value. Covering an area of about 0.02 sq.km, accounting for 0.14% of the town's total area, these groves serve as repositories of native flora and fauna, supporting micro-ecosystems and contributing to local ecological balance.

Beyond their ecological importance, sacred groves function as living cultural landscapes that embody traditional knowledge systems and community stewardship practices. They play a crucial role in conserving endemic plant species, supporting pollinators, and maintaining soil and moisture regimes within the urban ecosystem. The proposed measures aim not only to safeguard these ecologically sensitive areas from encroachment and degradation but also to strengthen their role as educational and cultural assets. By integrating sacred grove conservation into the broader environmental planning framework, Haripad can reinforce both its ecological resilience and its rich cultural identity.

31.15 Buffer Zone

A two-metre buffer zone has been proposed for all water bodies having a width greater than 5 metres. These buffer zones are envisaged as protective margins along the edges of canals, streams, and other significant watercourses, forming an integral part of the town's environmental management framework. Such designated setbacks will act as protective barriers that help prevent encroachment, regulate land-use activities along channel edges, and reduce the direct discharge of pollutants, solid waste, and untreated surface runoff into the water bodies. In addition to safeguarding water quality, the buffer zones will help stabilise embankments, minimise erosion, and preserve the natural flow characteristics of the channels. They also provide opportunities for introducing vegetative strips that enhance ecological connectivity and support local biodiversity. By ensuring a clear and regulated edge condition along watercourses, the proposal strengthens flood management measures and contributes to the long-term sustainability of Haripad's hydrological network.

31.16 Waterbodies

The existing water bodies in Haripad town cover an area of 0.91 sq.km, accounting for approximately 5.60% of the total municipal area. The major water bodies include Pillathodu, Danappady Thodu, and the Achankovil River, which flows along the north-eastern boundary of the town and forms a significant component of its natural drainage system. Together, these channels and associated ponds constitute the backbone of the town's hydrological network, playing a crucial role in stormwater conveyance, flood moderation, groundwater recharge, and ecological balance.

As outlined in the Drainage Plan for the town (discussed in Chapter 33), a series of new nalas are proposed to strengthen stormwater management and improve the efficiency of surface runoff disposal. In addition, existing thodus, ponds, and interconnected water channels will be systematically desilted, widened where necessary, and cleaned to restore their carrying capacity and ensure uninterrupted flow, particularly during peak monsoon periods. These interventions aim to enhance hydraulic performance, reduce waterlogging, and reinforce the overall resilience of Haripad's drainage infrastructure.

31.17 Special Zone

Special Zones are designated areas reserved for specific uses or identified projects, within which no activities other than those explicitly permitted shall be allowed. These zones are intended to safeguard the planned development and functional integrity of such projects, ensuring that land earmarked for strategic interventions is protected from incompatible or premature development. By clearly delineating these areas, the plan provides certainty in land-use regulation and facilitates coordinated implementation of priority infrastructure and development initiatives. In the event that a designated project is not implemented within a period of seven years from the date of approval of the plan, the area shall be treated as part of the proposed land use zone as specified in the zoning regulations of this Master Plan. This provision introduces flexibility within the planning framework while preventing long-term land stagnation. At the same time, it ensures that any alternative development remains consistent with the broader spatial structure and objectives of the Master Plan.

1. Special Zone A – Private Bus Stand

The Proposed Private Bus Stand is designated as a Special Zone with an allocated area of 0.013 sq.km (approximately 0.01% of the total area of the town). Strategically located in close proximity to NH 66, the existing KSRTC Bus Stand, and the Haripad Railway Station, the project is conceived as a key mobility intervention to enhance intra-town and inter-city connectivity.



Figure 31.13 : Location of Special Zone A– Private Bus Stand

The clustering of multiple transport modes—including the proposed private bus terminal, KSRTC services, railway access, existing auto stands, and highway connectivity—is intended to function as an integrated transportation hub. This spatial integration will improve passenger convenience, reduce congestion in the town core, and ensure seamless modal transfers. With a forward-looking emphasis on tourism promotion and economic revitalization, the Special Zone – Private Bus Stand is expected to strengthen visitor accessibility, stimulate commercial activity within the proposed Town Centre Zone, and support Haripad's emergence as a well-connected regional urban node.

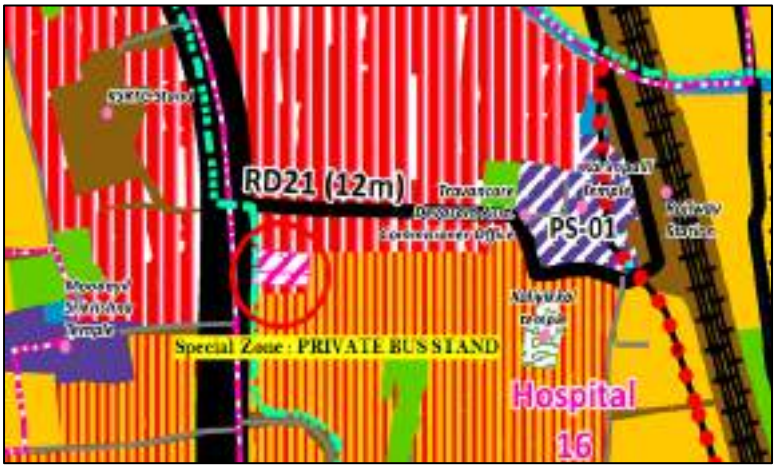


Figure 31.14 : Location of Special Zone A – Private Bus Stand in the Proposed Landuse Map


MASTER PLAN FOR HARIPAD TOWN - 2045

CHAPTER
32

TRAFFIC AND TRANSPORTATION PLAN



The Traffic and Transportation Plan provides the strategic framework for developing a safe, efficient, inlcusive and resilient mobility network for the people of Haripad. Building on the vision, goals and objectives outlined in the Master Plan, this chapter focuses on enhancing connectivity, supporting economic growth, improving accessibility and ensuring equitable mobility for all residents. It emphasizes a balanced road hierarchy, human-centric street design and a ring–radial structure to create an integrated and well-connected transport system. The plan also addresses traffic management, public transport, pedestrian and cycling infrastructure, disaster preparedness and long-term sustainability - ensuring that the town's transportation network supports future urban development and overall quality of life.

- Development Strategy
- Road Network Development Strategy
- Proposed Transport Development Plan
- Pedestrian Safety and Facilities
- Transport Terminals
- Parking
- Proposals for other modes of Transport
- Other Transport Infrastructure

32.TRAFFIC AND TRANSPORTATION PLAN

The Traffic and Transportation Plan for Haripad has been formulated based on an assessment of existing conditions and projected traffic growth across the municipal road network. While incorporating all committed transport development schemes and relevant stakeholder inputs, the chapter places strategic emphasis on positioning Haripad as a prominent cultural, pilgrimage, and environmentally significant tourism centre. Accordingly, the transport framework prioritizes the creation of a pedestrian-friendly town core, improved internal and regional connectivity, and the development of an efficient, well-integrated transport network. The overall approach seeks to balance mobility efficiency with heritage conservation, environmental sensitivity, and enhanced visitor experience, thereby supporting the town's long-term sustainable growth.

32.1 Development Strategy

An effective traffic and transportation development strategy is crucial for Haripad to support its emerging role as a prominent pilgrimage and eco-tourism destination. Efficient movement of residents, visitors, and goods must be ensured while responding to future growth and increasing seasonal travel demand. Rapid urbanization and rising traffic volumes - particularly during festival seasons - have made systematic traffic management at key intersections and along major corridors a priority. Detailed traffic and engineering studies will guide targeted interventions such as junction improvements, corridor upgrades, pedestrian enhancements, and better traffic control systems. Special emphasis is placed on creating a pedestrian-friendly town centre, strengthening public transport, and promoting non-motorized transport facilities to enhance visitor experience, safety, and accessibility. A proactive and participatory transport planning approach, aligned with local travel patterns and tourism needs, is therefore essential to sustain economic vitality, cultural prominence, and long-term urban development of the town.

Haripad functions as a strategic transit hub with strong road and rail connectivity, further supported by inland waterways along its outskirts and linkage to National Waterway–3. This multi-modal connectivity provides significant opportunities to integrate tourism-oriented mobility options, including improved last-mile access to pilgrimage centres and environmentally sustainable water-based transport. The town centre exhibits a grid/block pattern road network structured around NH-66 as the primary arterial spine. The development strategy focuses on strengthening existing corridors, bridging missing links, and optimizing network efficiency to accommodate both local and tourist traffic. Additionally, the underutilized water transport potential is proposed to be expanded to enhance eco-tourism, reduce road congestion, and promote sustainable mobility within the region.

32.2 Road Network Development Strategy for the Horizon Year

The proposed road network development strategy for Haripad is structured to strengthen the existing grid/block pattern through the widening of key corridors, upgradation of major roads, and development of new links to bridge connectivity gaps, thereby ensuring seamless access to important pilgrimage and tourism destinations. The favourable terrain and the systematically evolved road network connecting the town core provide a strong base for

transforming Haripad into a well-organized and visitor-friendly urban centre. The strategy also prioritizes the enhancement of pedestrian infrastructure, junction improvements, and strengthening of public transport systems, supported by efficient traffic management measures. Additionally, the provision of organized parking facilities and safe pedestrian spaces is expected to significantly reduce congestion and improve traffic circulation within the town centre.

The major traffic concerns - such as on-street parking, town centre congestion, roadside encroachments by the street vendors, inadequate pedestrian facilities, seasonal surges in pilgrim traffic, and significant cycle movement near schools - directly impact the visitor experience. The primary arterial corridor, a stretch of NH-66, currently operates beyond its capacity; however, ongoing widening works are anticipated to enhance mobility and accommodate future growth associated with tourism and urban expansion.

The long-term transport strategy has therefore been formulated not only to address existing mobility challenges but also to position Haripad as a prominent pilgrimage, heritage, and eco-tourism destination. Priority is accorded to junction improvements, strengthening of public transport connectivity, and promotion of non-motorized transport facilities such as pedestrian pathways and cycle tracks. By integrating efficient public transport, improved last-mile connectivity, and adequate off-street parking, the strategy aims to reduce congestion, minimize private vehicle dependency, and create a pedestrian-oriented, culturally vibrant town centre that enhances the overall tourism experience while ensuring sustainable urban mobility.

32.3 Proposed Transport Development Plan

The transport development plan for Haripad has been formulated in alignment with the projects proposed under the *Haripad Paithruka Veedhi*, which envisions the strengthening of heritage and cultural tourism within the town. Keeping the development of this cultural corridor as a central objective, and based on projected traffic volumes along with the evaluation of alternative network improvement options, a comprehensive transport strategy has been prepared. The plan focuses on optimizing the existing grid/block road network through capacity enhancement, improved connectivity, and efficient traffic circulation, thereby supporting both urban mobility needs and the seamless movement of visitors within the heritage precinct and the wider town area. The key constituents of this plan include:



32.3.1 Proposed Road Network

In view of the projected increase in vehicular traffic - particularly during peak pilgrimage and tourism seasons - and the high volume-to-capacity (V/C) ratios identified through traffic analysis; a phased road widening strategy is essential for Haripad. This approach will be aligned with functional road classifications and prescribed Right of Way (RoW) standards under urban road design guidelines. The strategy aims not only to accommodate future traffic growth but also to ensure smoother access to major pilgrim centres, heritage corridors, and tourism nodes, thereby enhancing overall mobility and safety within the town.

The network structure has been derived by widening key existing roads, thereby strengthening overall connectivity and circulation. The proposed road hierarchy has been formulated after analysing projected traffic volumes on each corridor, ensuring that the network can efficiently accommodate future growth while facilitating smooth access to major temple precincts, cultural sites, and other tourism destinations within the town. The proposed road network hierarchical system, structured according to the proposed road width (Right of Way) and the functional classification of each road.

The proposed hierarchical system includes four categories of roads:

A. First order roads
B. Second order roads
C. Third order roads
D. Fourth order roads

A. First Order Road

In Haripad, NH 66 serves as the main arterial road, and the National Highways Authority of India (NHAI) has proposed upgrading it to a six-lane configuration with a 45-meter right of way (ROW).

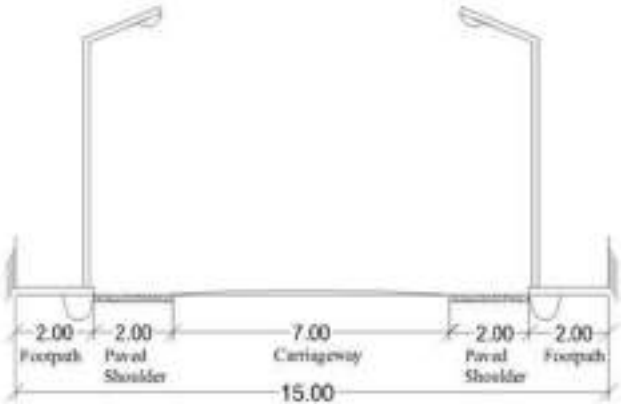


Figure 32.1 : Proposed cross section of dual-lane secondary distributor of Haripad town

B. Second Order Road

Second order roads function as key connectors linking Haripad to nearby towns within and beyond the district. Traffic analysis indicates that these corridors carry volumes exceeding their design capacities, with V/C ratios often above 1.0. Accordingly, these roads are proposed to be widened to a uniform 15 m RoW with dual-lane carriageways and paved shoulders to meet the secondary distributor standard. Typical cross section of secondary distributor road has been shown in Figure 32.1.

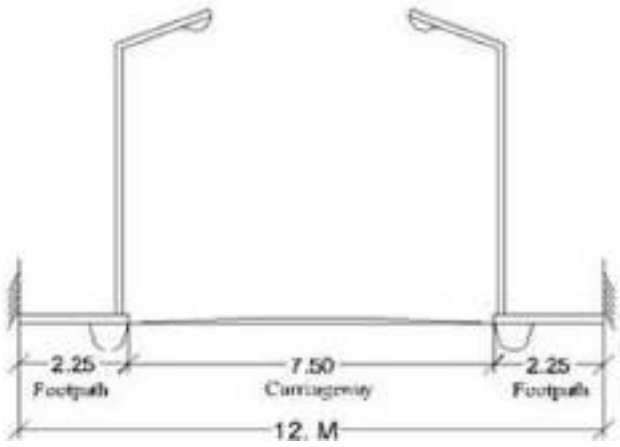


Figure 32.2 : Proposed cross section of Tertiary distributor of Haripad town

C. Third Order Roads

Tertiary roads provide vital connectivity between the town centre, growth nodes, and major transit points. These roads are proposed to be upgraded to tertiary road

standards with a 12 m RoW and a 7.5 m carriageway, considering space limitations and dense roadside development. Figure 32.2 illustrates the typical cross-section of a tertiary distributor road in Haripad.

D. Fourth Order Roads

Local roads play a vital role in providing last-mile connectivity between residential areas and higher-order roads. These roads are proposed to be upgraded to a minimum Right of Way (RoW) of 8 metres to ensure safe movement for pedestrians, non-motorised users, and motor vehicles. Figure *32.3* illustrates the typical cross-section of a local road in Haripad.

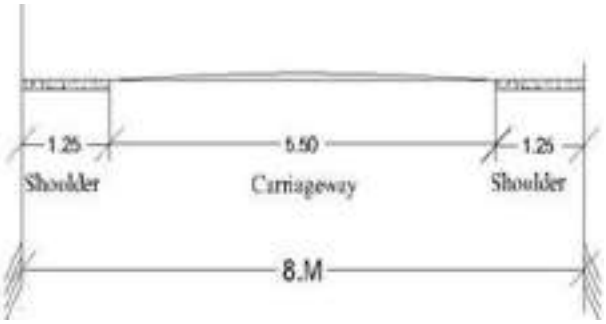


Figure 32.3 : Proposed cross section of local road of Haripad town

32.3.1.1 Development of an Inner Ring Road

The proposed Inner Ring Road is conceived as a strategic circumferential corridor encircling Haripad town's core urban and heritage precinct, aimed at diverting through-traffic away from the town centre and major pilgrimage corridors. By reducing vehicular pressure within the CBD and temple zones, the corridor will enhance the overall visitor experience, improve pedestrian safety, and support the development of a tourism-oriented urban core. The alignment largely follows existing roads with required geometric and capacity improvements, and is planned as a two-lane facility with a 7.0 m carriageway and 2.5 m shoulders on either side within a 12 m right-of-way, conforming to IRC standards for urban arterial roads. This intervention will ensure smoother circulation for regional traffic while preserving the cultural character and accessibility of key tourist destinations within the town. The alignment of the Inner Ring Road with commencement point as Danapady on the Alappuzha side of NH 66 is detailed as follows:

Starting at Danapady Junction- Moving southward through Danapady - Karthikappally Road – Deviating eastward to Karthikapally - R.K. Junction Road - Merging with NH 66 at R.K. Junction - Eastward extension crossing R.K. Junction to railway cross - Northward along Vettuveni Road through Paingolil Junction, intersecting Haripad – Pallippad Road till TB Junction – Continuing westward through TB Road - Joining Kolathu Junction – TPN Junction - Traversing Mannarasala Road (adjacent to Mannarasala Nagaraja Temple) till Block Junction – Traversing southward to re-join the Karthikappally – R.K. Junction Road at Danapady Junction.

32.3.1.2 Prospective radial roads to inner ring road:

While the previously mentioned roads define the primary corridors forming the boundary of the proposed inner ring road, a complementary network of radial roads has also been identified to further enhance traffic circulation within the town. These radial roads extend from the inner ring toward various parts of the Municipality, functioning as key connectors between the town centre and peripheral areas.

The identified radial roads are already existing routes; however, the proposal aims to strengthen their capacity and efficiency through selective widening and geometric improvements. This network will facilitate smoother vehicular movement, reduce congestion

within the core area, improve last-mile connectivity, and enhance overall accessibility across the town. Together, the ring and radial road system establishes a balanced circulation framework that optimizes internal mobility and supports future urban growth. The potential radial roads identified are given below:

- Vikas Junction – NH66 – Upto Thekkenada: Serves as a vital access corridor to major religious and commercial destinations in the southern sector of the town.
- Madhava Junction – Kacheri Junction – Kolathu Junction: Connects the town core with the northern periphery and integrates with the secondary distributor road network.
- Road from Mannarasala to Danapady Junction - West Nada Road to NH66: A priority corridor due to its religious significance and dense residential character, linking the prominent religious centres like Mannarasala Nagaraja Temple and Haripad Subrahmanya Swami Temple to the Inner Ring Road.
- TPN Junction – Town Hall Junction – Katchery Junction – Ezhikkakath Junction – Prathimukham Junction: Acts as a key radial connector facilitating the dispersal of traffic from the town centre to adjoining localities towards the north and east of the town.
- Road from Peethambil Sree Dharma Sastha Temple to NH66: A road segment that originates from the NH66, 125m west of Madhava Junction connecting to NH66 to the north of RK Junction.

The proposed road widening initiatives and the formation of an inner ring road encircling the town centre are expected to streamline traffic flow, particularly during peak hours, thereby reducing congestion, travel delays, and vehicular conflicts within the core area. By diverting through-traffic away from the town centre, the ring road improves accessibility to key commercial, cultural, and religious landmarks while enhancing the pedestrian environment and urban liveability - both critical factors for tourism development. Special

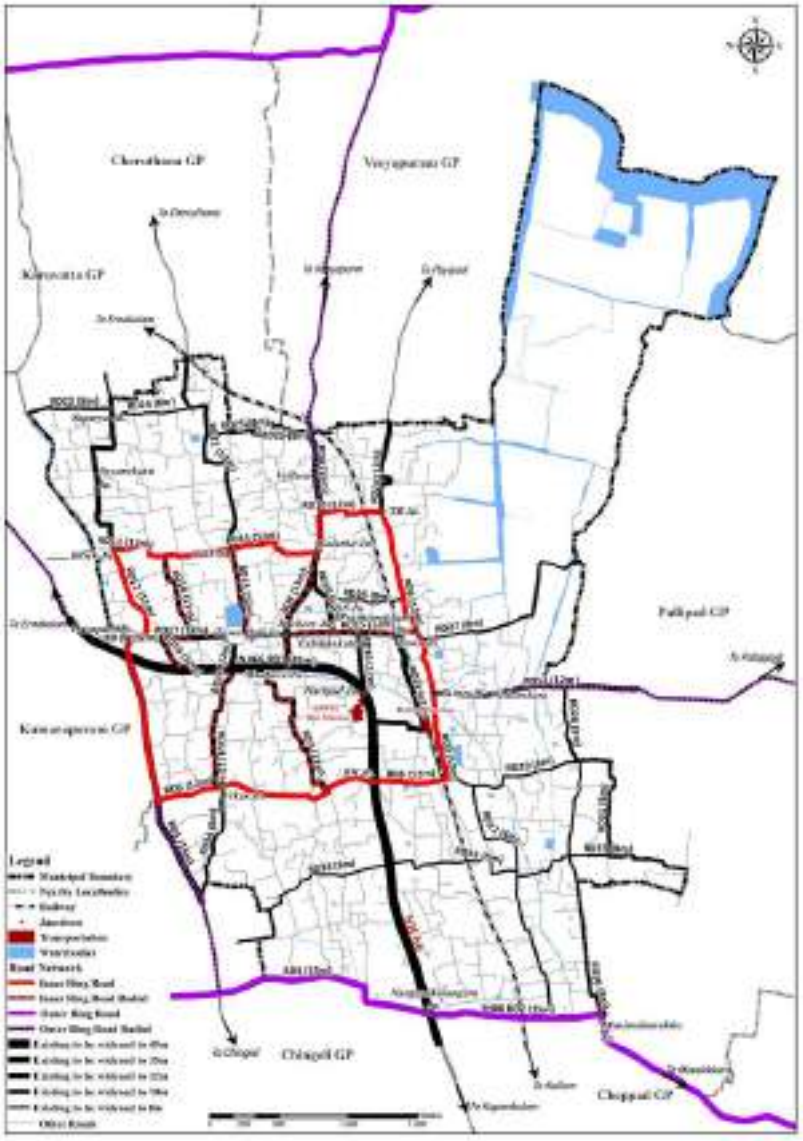


Figure 32.4 : Map showing Proposed outer and inner ring roads

emphasis on improving connectivity towards Nelpurakadavu - stretches of paddy fields identified as potential farm tourism destination - further expands Haripad's tourism portfolio. Enhanced access to such peripheral attractions encourages diversification into agro-tourism and experiential tourism, increasing visitor stay duration and local economic benefits.

Apart from these proposals, a potential outer ring road is proposed for Haripad, which aligns with the broader vision of integrating existing and upcoming infrastructure projects, particularly key stretches of the Coastal Highway Project such as the Thottappally–Thrikkunnappuzha and Thrikkunnappuzha–Thattarambalam corridors. These corridors function as important regional connectors, and their integration into the Outer Ring Road framework strengthens Haripad's role within the wider coastal mobility network.

Among the proposed outer ring corridors, the Thrikkunnappuzha–Nangyarkulangara–Thattarambalam (SH80 - Nangyarkulangara Junction – Manimala Junction) stretch passes along the southern boundary of the Municipality for approximately 2593.82 metres, forming a significant segment of the ORR within municipal limits. In addition to that, certain radial roads connecting to the proposed Outer Ring Road passes through the Municipality, including:

1. Haripad – Veeyapuram Road
2. Haripad – Pallippad – Chennithala Road
3. Haripad – Karthikapally – Kayamkulam Road

The proposed road network map of Haripad Town is shown in Figure 32.5 and the details of the proposed road widening are given in Table 32. 1.

Table 32. 1: List of Roads to be widened

Sl. No.	Name of the road	Proposed width (in m)	Code in Map
1.	NH 66	**45**	**RD 1**
2.	SH 80 (Nangiarkulangara Junction – Mavelikkara Road) up to Eastern boundary of the Municipality.	**15**	**RD 2**
3.	Nangiarkulangara Junction – Thrikkunnappuzha Road upto Western Boundary of the Municipality	**15**	**RD 3**
4.	Haripad Veeyapuram Road (Madhava Junction – Kolathu Junction – Veeyapuram Road upto Northern Boundary of the Municipality)	**15**	**RD 4**
5.	Danapady Junction - Karthikappally Road	**15**	**RD 5**
6.	RK Junction – Suresh Market Junction – Vikas Junction upto Western Boundary.	**12**	**RD 6**
7.	Road from Peethambil Sree Dharma Sastha Temple to NH66.	**12**	**RD 7**
8.	RK Junction to Vettuveni road - upto railway cross Junction.	**12**	**RD 8**
9.	Railway cross Junction- Prathimukham – TB Junction – Payippad road upto northern boundary.	**12**	**RD 9**
10.	TB Junction – Haripad Veeyapuram Road	**12**	**RD 10**
11.	Kolathu Junction – TPN Junction – Mannarasala – Block Junction	**12**	**RD 11**

12.	Danapady Junction – Block Junction – Ayyarukavu Junction – Saparya Junction upto Northern Boundary of the Municipality.	**12**	**RD 12**
13.	Paingolil – Kotheri – Nedunthara upto Eastern boundary	**12**	**RD 13**
14.	Vikas Junction – NH66 – Upto Thekkenada	**12**	**RD 14**
15.	TPN Junction – Town Hall Junction – Katchery Junction – Ezhikkakath Junction – Prathimukham Junction.	**12**	**RD 15**
16.	Ezhikkakath Junction – Harippad GH Road upto NH 66	**12**	**RD 16**
17.	Western Municipal boundary - SN Theatre to West Nada.	**12**	**RD 17**
18.	Road from Mannarasala to Danappady Junction - West Nada Road.	**12**	**RD 18**
19.	Road from Danappady Junction - West Nada Road to NH 66.	**12**	**RD 19**
20.	Kachery Junction – S&S Junction upto Haripad – Veeyapuram road	**12**	**RD 20**
21.	Road from NH 66 – Railway Station (RJ Road) – upto Govt. UPS Haripad.	**12**	**RD 21**
22.	Road from TPN Junction – Kottaykattu Junction – Kilikkakkulangara – Kuttatheth Junction upto Northern Boundary towards Cheruthana	**10**	**RD 22**
23.	Road from Saparya Junction through Northern boundary towards Danapady Thodu	**8**	**RD 23**
24.	Road from Kuttathethu Junction to Saparya Junction	**8**	**RD 24**
25.	Road from Kilikkakkulangara Ambadiyil Junction – Thrippakkudam Kaanikkavanchi to Harippad Veeyapuram Road	**8**	**RD 25**
26.	S & S Junction to Haripad Payippadu Road	**8**	**RD 26**
27.	Road from Excise Range Office to Choorellakkal towards Pallippad upto Municipal Boundary.	**8**	**RD 27**
28.	Kattilparambil to Nedunthara – Pallippad road	**8**	**RD 28**
29.	Road from railway cross to Kochuveettil – Kattilparambil – Parumukku towards Melpadom	**8**	**RD 29**
30.	Kattilparambil – Thayyilmukku – Katelil – Kotayil Junction upto Municipal Boundary	**8**	**RD 30**
31.	Katelil Kizhakku Junction – Sabari Junction to Parumukku towards Melpadom	**8**	**RD 31**
32.	Road starting from Railway cross - Kochuveettil road through Sri Mahadevar Samithi Temple upto Southern boundary towards SH 80	**8**	**RD 32**
33.	Road from Western Boundary - NH 66 – through Sree Narayana Library – Railway Cross- Katelil Junction – Katelil Kizhaku Junction – Kolachira Junction upto Eastern Boundary.	**8**	**RD 33**
34.	Road from Vikas Junction upto Danapady - Karthikappally Road	**8**	**RD 34**

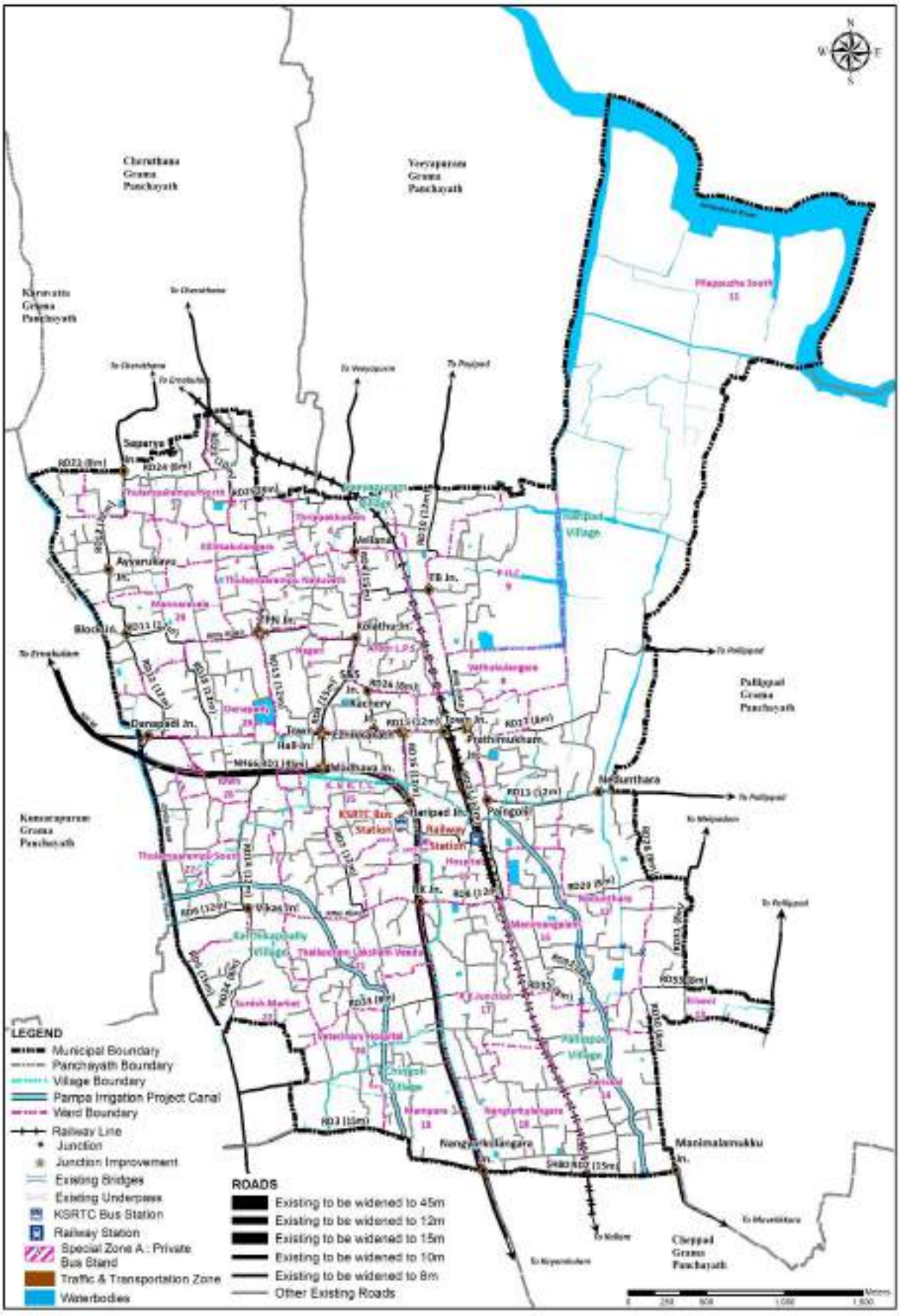


Figure 32.5 : Proposed Transportation Plan for Haripad

32.4 Proposed Traffic Management Schemes

Traffic regulatory measures are designed to manage road usage so that the volume-to-capacity ratio remains optimal. These may include one-way systems, turning restrictions, and entry/exit controls for heavy vehicles.

A. Implementation of one-way traffic at Kachery Road

A one-way system is proposed along the stretch from Kachery Junction to Town Hall–Veeyapuram Road, allowing vehicles from Kachery Junction heading towards Veeyapuram to use this route. This creates a triangular circulation between Town Hall Junction, Kachery Junction, and Veeyapuram Road, complementing the existing one-way on Town Hall–Taluk Hospital Road. Vehicles moving from Kachery Junction to Town Hall Junction may also use the Kachery Junction Road via Veeyapuram Road. Nagari Temple Road will remain a two-way facility, but vehicles exiting onto Kachery Junction Road will be restricted to left turns only, improving traffic flow and safety. The proposed scheme is illustrated in Figure 32.6.



Figure 32.6 : Proposed traffic regulation scheme at Kachery Junction

B. Redevelopment of RJ Road

As part of the proposals included in the Haripad Paithruka Veedhi, which is envisioned as the Cultural Corridor of Haripad, RJ Road, a 700 m stretch of mud road running along the railway line from Haripad Railway Station to Haripad Town becomes an important route. Upgrading this road will provide improved access to Haripad Town Junction and the town centre, which houses several town-level social infrastructure facilities such as the court and police station, along with two major schools. Development of RJ Road with a tarred carriageway, dedicated pedestrian facilities, and street lighting will create an effective alternate access to the railway station, thereby reducing traffic movement through the congested town centre. The road stretch is proposed to be designed in such a way so that it can benefit the

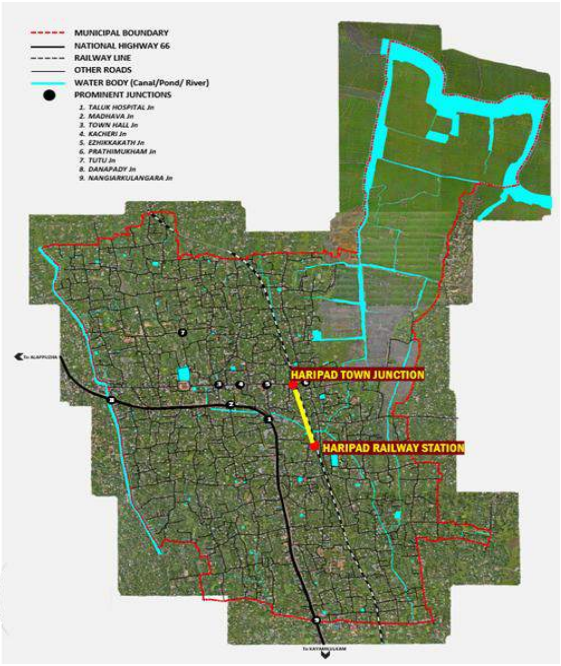


Figure 32.7 : Location of RJ Road

cycle traffic of the town triggered by the presence of the schools. The location of the RJ road and the conceptual view for the proposed development is shown in Figure 32.7 and Figure 32.8 respectively and the detailed project brief is described in chapter 36.



Figure 32.8 : Generated illustration of Proposed RJ Road Development

C. Development of Railway Over-bridges in Haripad town

In order to address the recurring traffic delays, congestion, and safety risks caused by level crossings in and around Haripad, the feasibility of grade-separated infrastructure - such as Railway Over Bridges (ROBs), flyovers, and underpasses - has been evaluated at four strategically important locations. Strengthening rail–road connectivity is particularly crucial for Haripad, given its prominence as a religious and cultural tourism destination that attracts a significant inflow of pilgrims and visitors throughout the year. Eliminating rail–road conflicts through these interventions will ensure uninterrupted traffic movement, reduce travel time for tourists and local commuters, and enhance the overall accessibility and reliability of the town's transport network.

Based on the Train–Vehicle Unit (TVU) analysis (Details of this has been discussed in Chapter 13 of this master Plan), the following locations have been prioritized for interventions:

i. Nangiarkulangara Junction (Manimala Road)
   - TVU: 2,26,496 – Highest among surveyed crossings

- Proposal: Construction of Railway over Bridge (ROB) to eliminate the level crossing.
- Additional Safety Enhancement: The approach roads on both sides of the level crossing shall be widened to two-lane carriageway with paved shoulders, ensuring improved road safety and capacity.

ii. Veeyapuram Road (Thrippakudam Level Crossing)

- TVU: 1,93,248 – Very high, warrants immediate ROB
- Proposal: Construction of a ROB on the Haripad–Veeyapuram road to ensure uninterrupted regional connectivity.

Funding and Implementation: The prioritized projects should be integrated into the State Annual Plan, with funding support explored through Indian Railways, MoRTH, or Central Road Fund (CRF) schemes. Successful implementation will require joint coordination between Southern Railway and State PWD/NHAI.

Given the high TVU values at the Nangiarkulangara and Veeyapuram level crossings, immediate construction of ROBs is strongly recommended. The RK Junction–Pallipad and Prathimukham crossings may be considered for future ROB or RUB development following detailed feasibility studies.

D. Improvements Proposed at Railway Underpass

The recurrent waterlogging at the Vathukulangara railway underpasses (RUB 1 and RUB 2) (Figure 32.9) during heavy rains necessitates an integrated mitigation system. The proposal includes sump wells with automatic submersible pumps at the lowest points for efficient drainage, complemented by IoT-based water level sensors to trigger automatic pump operation. To ensure uninterrupted functioning, float switches and backup power sources (diesel generators or batteries) will be incorporated, providing a resilient, smart water management solution for the underpasses.



Figure 32.9 : Vathukulangara railway underpasses

32.5 Junction Improvement

Intersection improvement schemes in Haripad are envisaged not only as traffic management interventions but also as strategic urban upgrades that support the town's emergence as a prominent pilgrimage and tourism destination. By streamlining traffic flow at key junctions through geometric corrections, installation of regulatory structures, improved traffic management measures, and signalization, these proposals aim to ensure safe, efficient, and comfortable movement within the town.

Many of the major intersections identified for improvement are located in close proximity to important pilgrim centres and culturally significant landmarks, which experience high footfall during festival seasons and peak pilgrimage periods. Congestion, pedestrian–vehicular conflicts, and unregulated parking at these nodes often affect visitor experience and local mobility. The proposed intersection improvements are therefore designed to manage peak-hour and seasonal traffic surges, enhance pedestrian safety, and create orderly access to temple precincts and surrounding commercial areas.

1. Townhall Junction

The redevelopment of Town Hall Junction is proposed under the Haripad Paithruka Veedhi, the cultural corridor of the town. Town Hall Junction is a four-arm intersection comprising Veeyapuram Road, Temple Road, the approach road to the National Highway at Madhava Junction, and the connecting road to Ezhikkakathu Junction, is proposed for geometric and safety improvements. Veeyapuram and Madhava Junction arms will be developed as divided carriageways (15 m ROW), while Temple and Ezhikkakathu roads will be widened to two-lane undivided carriageways with a ROW of 12m. The existing Lord Subrahmanya statue at the centre will be shifted to the centre of the junction. Pedestrian safety will be ensured through 1.8 m width and raised to 10cm (as per IRC 86:2018) footpaths on all arms, removal of temporary shops within bell-mouth areas, covered drains with concrete slabs, and railing barriers. Zebra crossings, lane markings, curb markings, route arrows, stop lines, and information signboards will further streamline movement and enhance safety. The junction improvements proposed for the Town Hall Junction is shown in the Figure 32.10.



Figure 32.10 : Improvement Proposals for Town Hall Junction

2. Ezhikkakath Junction

The redevelopment of Ezhikkakathu Junction is also a project under the Haripad Paithruka Veedhi initiative. Ezhikkakathu Junction, a three-arm intersection on the Haripad–Pallippadu Road, provides direct access to the National Highway via Taluk Hospital Junction. The proposed improvement includes introducing a small traffic channelizing island with green turfing (Figure 32.11). The Town Hall Road and Taluk Hospital Road arms will be widened to two-lane undivided carriageways (12m ROW), while an 8m wide widening is proposed for the Pallippadu Road (RD27). Existing roadside drains will be covered with concrete slabs, and

the plan also incorporates traffic lane markings and appropriate signage to improve safety and flow.



Figure 32.11 : Improvement Proposals for Ezhikkakathu Junction

3. Madhava Junction

The Haripad Paithruka Veedhi initiative visualizes Madhava Junction as an entry gate to the Haripad Temple town, which inevitably requires the redevelopment of the junction. The details of this project has been described in chapter 36. Priority Action Plan. Madhava Junction, a three-arm intersection in Haripad Town where NH66 meets the approach road from Town Hall Junction. The Town Hall–Madhava stretch will be developed as a divided carriageway with 15m ROW. Footpaths of at least 1.8 m width are planned on both sides (Figure 32.12). The plan also includes pedestrian crossings, traffic lane markings, and appropriate signage.

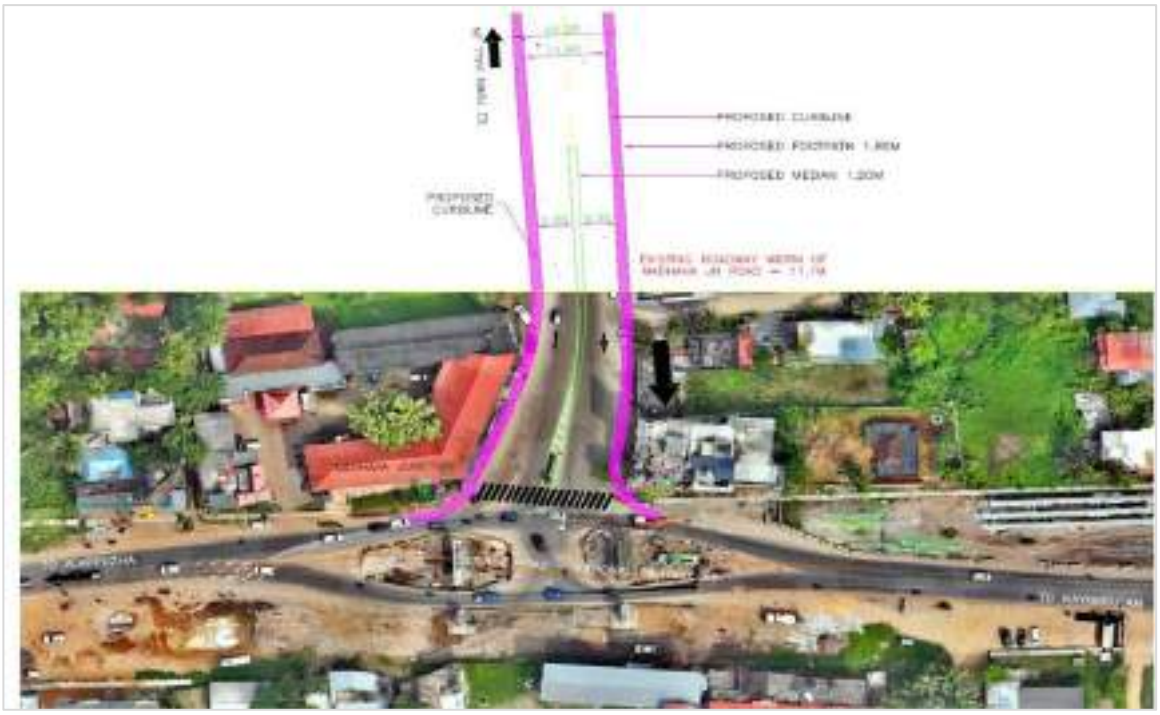


Figure 32.12 : Improvement Proposals for Madhava Junction

4. Prathimukham Junction

Prathimukham Junction is envisaged as a critical urban node in the future spatial structure of Haripad, positioned at the interface between the proposed Tourism Promotion Zone and the proposed Agro Tourism Promotion Zone, as detailed in Chapter 31 of this Master Plan. Strategically located along the stretch extending eastward from Ezhikkakathu Junction, it is expected to function as a key axle connecting these two vibrant and complementary activity zones identified under the Proposed Land Use Plan 2045.

Given its anticipated role in facilitating movement between the religious tourism circuit and emerging farm-based tourism destinations, the upgradation of Prathimukham Junction under the Haripad Paithruka Veedhi initiative assumes significant importance. The proposed interventions—including improved road signage, traffic islands, and comprehensive traffic management measures—are aimed at enhancing circulation efficiency, ensuring pedestrian safety, and supporting increased visitor flows. The redevelopment is also expected to catalyse local economic activity by strengthening access to nearby organic crop and millet outlets, thereby reinforcing the integration of tourism, agriculture, and local enterprise within Haripad's future growth frameworkThe redevelopment is also expected to support and promote the organic crop and millet outlets located in close proximity, thereby strengthening the local economy and tourism-related activities. The location of Prathimukham Junction is shown in Figure 32.13.



Figure 32.13 : Location of Prathimukham Junction



Figure 32.14 : Generated illustration of Prathimukham junction Redevelopment

5. TPN Junction

TPN Junction is one of the most critical mobility nodes in Haripad, functioning as a key convergence point for vehicular, pedestrian, and pilgrimage traffic within the town. Strategically located along the temple corridor connecting the Haripad Subrahmanya Swamy

Temple and the Mannarasala Nagaraja Temple, it plays a pivotal role in regulating movement and accessibility across this high-activity stretch. The Haripad Paithruka Veedhi project, through the development of Haripad Vinodha Veedhi, proposes the redevelopment of the 1.2 km road linking these two major temples. Strengthening and reorganizing TPN Junction is central to this initiative, as improved traffic circulation, pedestrian safety, and streetscape enhancement at this node will significantly enhance connectivity, safety, and the overall experience along the temple circuit. The location of TPN junction is shown in Figure 32.15. The conceptual redevelopment envisaged for the junction is shown in Figure 32.16.



Figure 32.15 : Location of TPN Junction



Figure 32.16 : Generated illustration of TPN Junction Redevelopment

32.6 Pedestrian Safety and Facilities

Pedestrian safety and the provision of well-designed crossing facilities constitute a fundamental component of sustainable urban transport planning in Haripad Municipality. As a town with significant tourism and pilgrim activity, ensuring safe, comfortable, and accessible pedestrian movement is particularly important. Large numbers of visitors, including elderly pilgrims and families, frequently move between temples, commercial areas, bus stops, and other activity nodes, increasing pedestrian–vehicular interaction along major corridors. In this context, the planning of dedicated and clearly defined pedestrian facilities at appropriate locations becomes essential to minimize conflicts and enhance overall mobility. The selection of suitable pedestrian control measures - whether at-grade crossings, signalized intersections, or grade-separated facilities - must be guided by empirical traffic data. Given below are some of the proposals that gives emphasis for pedestrian safety during the time of peak hour conflict.

Proposed Pedestrian Infrastructure Improvements: Based on the findings of the conflict analysis and the observed pedestrian movement patterns, the following pedestrian infrastructure improvements are proposed as part of the comprehensive traffic improvement plan:

1. **Haripad Hub - Town Centre Redevelopment**

The stretch from Town Junction to Town Hall Junction currently accommodates key social infrastructure such as the court complex, police station, village office, Government Model Boys HSS, Government UPS, Water Authority, Fire Station, and various commercial establishments. Presently functioning as a one-way road with on-street parking and limited pedestrian space, the stretch is proposed to be upgraded as a one-way corridor with enhanced pedestrian amenities and relocated parking to designate nearby parking areas.

This project aims to transform the 790 m stretch from Town Junction to Town Hall Junction into a pedestrian-oriented town centre (Figure 32.18) envisions a vibrant mixed-use zone with a strong focus on walkability and sustainable mobility. Key components include the provision of dedicated, wider footpaths (minimum 2.0 - 2.5 m width on both sides) with safety railings and wheelchair-accessible ramps, along with one-way vehicular traffic restrictions to minimize conflicts and enhance pedestrian safety. A dedicated bicycle lane, cycle stands, and facilities for rent-a-cycle pick-up and drop-off points are proposed to promote non-motorized transport. The streetscape will be enhanced through shaded pavilions with seating along the footpaths, increased tree plantation, and the installation of solar-powered street lights. Supporting public amenities such as waste receptacles and drinking water kiosks will be provided, while visual clutter will be reduced through the removal of advertisement hoardings, collectively contributing to a safe, inclusive, and people-centric town centre. This project has been discussed in detail in Chapter 36 of this Master Plan.

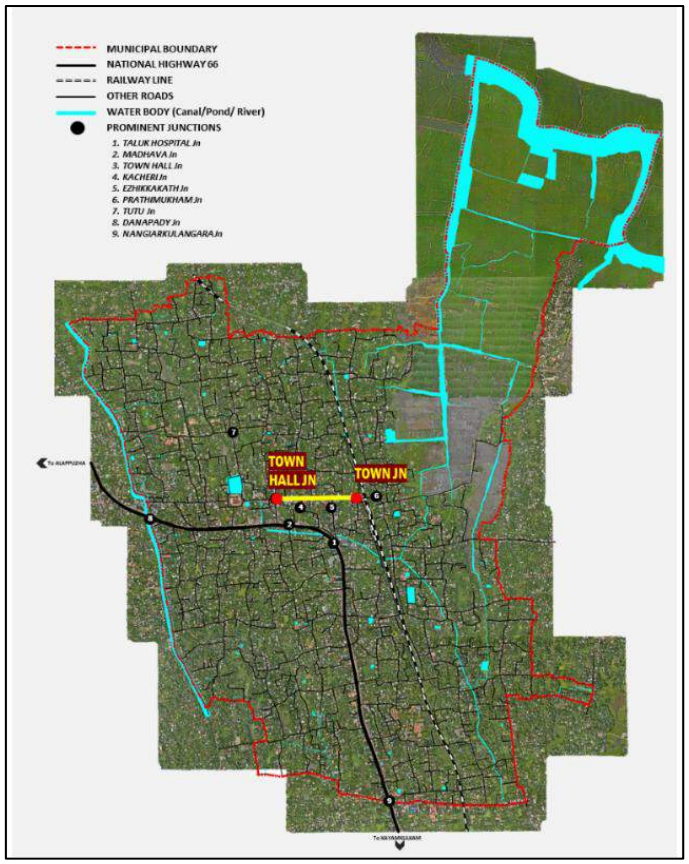


Figure 32.17 : Location of Haripad Hub - Town Centre



Figure 32.18 : Generated illustration of Haripad Hub - Town Centre

2. Haripad Temple Circuit Development

Adhering to the prominence of pilgrim tourism in Haripad town, a proposal has been formulated to develop a temple corridor around the Haripad Sree Subrahmanya Swamy Temple. The project includes road widening and the development of new roads in the temple surroundings to improve traffic circulation. It also seeks to address congestion caused by roadside encroachments by street vendors through the provision of designated relocation areas, thereby ensuring smoother traffic flow and improved pedestrian movement during peak pilgrimage periods. An illustration of the proposed temple circuit development is shown in Figure 32.19. This circuit involves road development projects like:

A) Haripad Kshethra Veedhi - Temple Road Redevelopment
B) Haripad Vinodha Veedhi - Haripad Temple to Mannarasala Temple Road Redevelopment



Figure 32.19 : An illustration of the proposed temple circuit development at Haripad

A) Haripad Kshethra Veedhi - Temple Road Redevelopment

Temple Road, presently congested with street vendors and temporary structures, possesses strong potential for transformation due to its historic significance and its visual axis aligned with the temple entrance. The 300 m stretch from Town Hall Junction to the entrance gateway of the Haripad Subrahmanya Swamy Temple is proposed to be developed as a model heritage street with a uniform architectural character that reinforces the temple as the focal point (Figure 32.20).



Figure 32.20 : Location of the Proposed Haripad Kshetra Veeedhi

The proposal includes implementation of a uniform façade code and regulated building guidelines, with height controls ensuring that all structures remain subordinate to the temple, thereby preserving its visual and spiritual prominence. Dedicated

pedestrian footpaths and bicycle tracks with parking stands are envisaged to promote safe and sustainable mobility. Street vendors will be relocated to designated zones within the temple premises to reduce congestion and improve streetscape order. Traditional-style lighting, seating, and other beautification measures, along with paid parking provisions on adjacent plots—especially during festivals and special occasions—are proposed to enhance functionality and overall visitor experience.

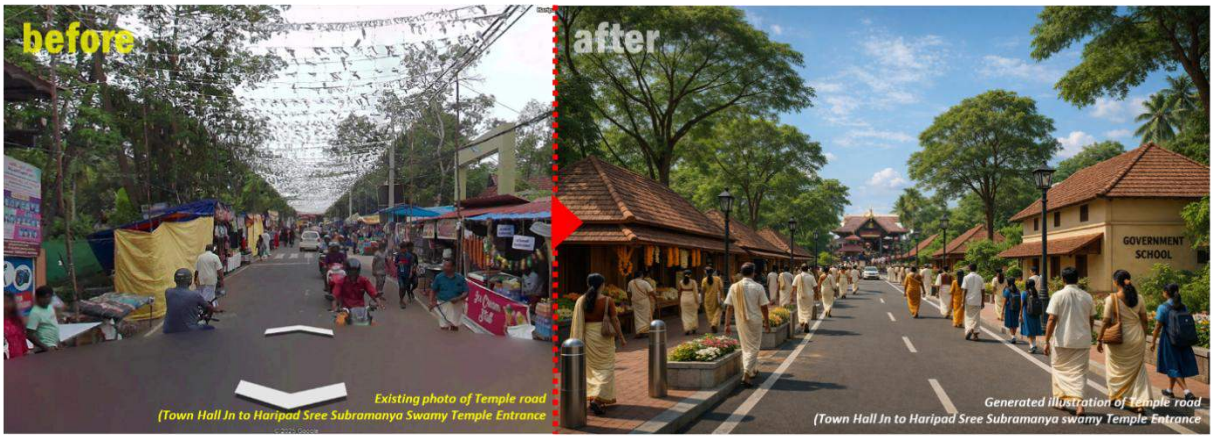


Figure 32.21 : Conceptual View of intended redevelopment as part of Haripad Kshethra Veedhi - Temple Road Redevelopment

B) Haripad Vinoda Veedhi - Haripad Temple to Mannarasala Temple Road Redevelopment

The Haripad Vinodha Veedhi – Haripad Temple to Mannarasala Temple Road Redevelopment is conceived as a culturally dynamic and pedestrian-oriented corridor connecting the Haripad Subramanya Swamy Temple to the Mannarasala Nagaraja Temple through TPN Junction (Figure 32.22). Extending approximately 1.2 km, the project envisions the creation of a safe, scenic, and well-structured pathway that enriches the pilgrim experience, enhances urban mobility, and revitalizes the character of this significant cultural axis. The proposed redevelopment incorporates widened and upgraded footpaths, thoughtfully designed street furniture, heritage-themed lighting, organized vending zones, junction enhancements, pond rejuvenation, and comprehensive pedestrian infrastructure. Positioned as Haripad's signature cultural tourism corridor, the initiative seeks to streamline movement patterns, strengthen public spaces, and celebrate the heritage value of the town's temple precincts. This project has been discussed in detail in Chapter 36 of this Master Plan.

32.7 Transport Terminals

The existing bus stopping pattern in Haripad town is largely informal and unregulated, with buses frequently halting near critical junctions such as Town Hall Junction and Ezhikkakathu Junction. This practice results in traffic congestion, operational delays, and increased safety risks for passengers and pedestrians. Considering Haripad's growing prominence as a religious and cultural tourism destination, the provision of properly planned and segregated bus shelters assumes greater significance. The proposed facilities aim to streamline boarding and alighting activities, improve traffic circulation, and enhance passenger safety and comfort. Strategically located near core areas such as Danapady and the Subramanya Swamy Temple precinct, these transport terminals will strengthen the efficiency and capacity of both public and private bus

services, while offering a more organized, welcoming, and tourist-friendly mobility environment within the town.

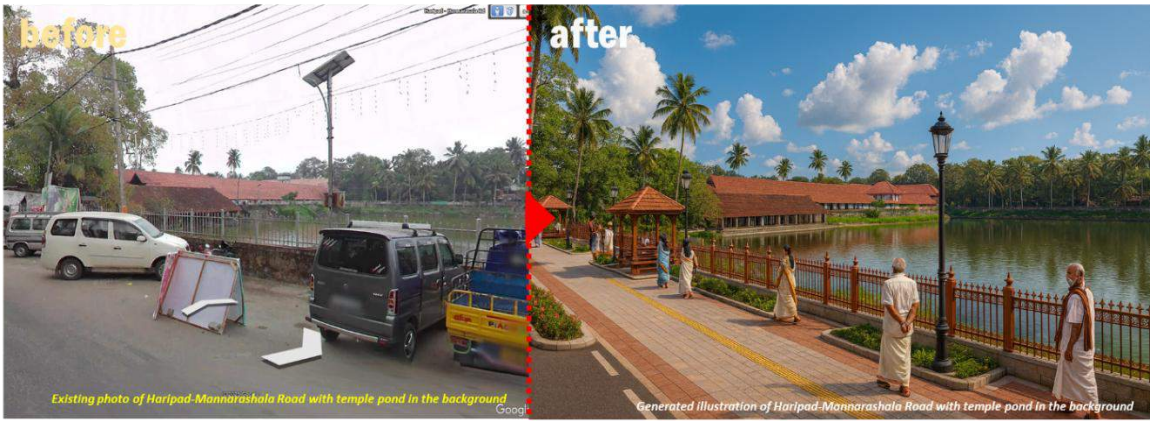


Figure 32.22 : Conceptual View of intended redevelopment as part of Haripad Vinoda Veedhi - Haripad Temple to Mannarasala Temple Road Redevelopment

32.7.1 Proposal for Urban Bus Shelters at Danapady, Subramanya Swamy Temple Road and near Ezhikakath Juction

The Urban Bus Shelters project at Danapady and Subramanya Swamy Temple Road is proposed under Haripad's comprehensive mobility improvement strategy, based on NATPAC's Traffic and Transportation Study for Haripad region. As two of the town's busiest and culturally significant corridors - serving commuters, students, workers, pilgrims, and temple visitors - the lack of proper bus shelters currently leads to congestion, inconvenience, and safety concerns. The project proposes the development of modern, safe, and universally accessible bus shelters equipped with essential passenger amenities and weather protection. By improving comfort, safety, and operational efficiency, the initiative will enhance the overall public transport experience and strengthen Haripad's connectivity to its key religious and tourism destinations. The details of this project have been discussed in detail in Chapter 36 of this Master Plan.

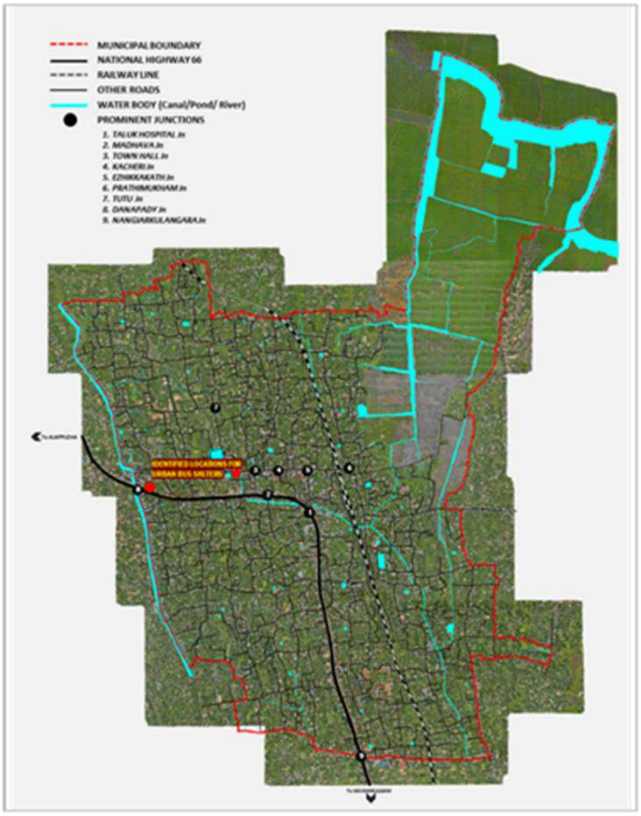


Figure 32.23: Location of Proposed bus shelters in Haripad

32.7.2 Upgradation of KSRTC Bus Terminal

The Haripad KSRTC Bus Terminal is proposed to be upgraded to enhance efficiency, safety, and passenger comfort. The proposed key improvements include demarcation between

workshop and depot, designated pedestrian walkway, upgradation of waiting shed etc. The details of this project have been discussed in detail in Chapter 36 of this Master Plan.

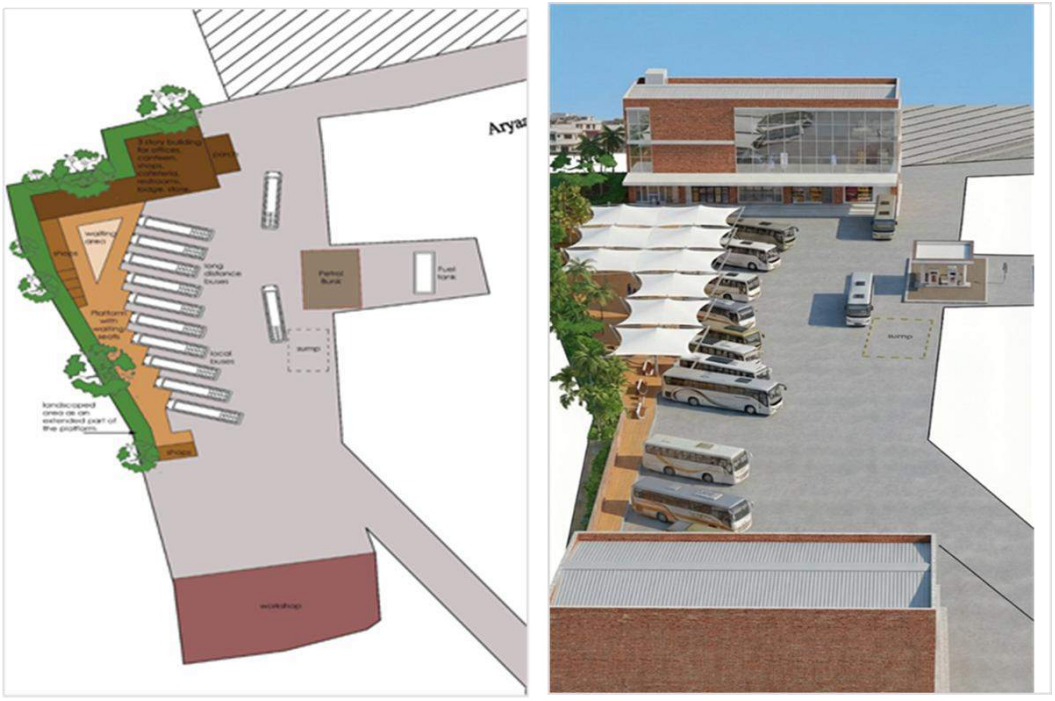


Figure 32.24 : Conceptual view of intended redevelopment as part of KSRTC Bus Stand Upgradation

32.8 Parking

Parking intervention sites have been identified based on peak accumulation, parking duration patterns, vehicle composition, and available right-of-way. All junctions are designated as no-parking zones, with appropriate traffic signboards to be installed to enforce the restriction.

32.8.1 Provision of new parking facilities

Projects to be proposed on identified vacant lands to address widespread on-street parking and congestion in Haripad using modern off-street parking facilities. Enforcement measures will curb illegal parking, while new facilities will ease pressure on road corridors. As existing temple parking areas have limited capacity, off-street lots near the Town Centre are



Figure 32.25 : Locations of new parking facilities for Haripad town

recommended for development. Some of the potential parking spaces are shown in Figure 32.26.



Figure 32.26 : Photos of locations of new parking facilities for Haripad town

32.9 Integration of bus transport services

To enhance connectivity between private bus operations and other public transport services, a new private bus stand is proposed near National Highway 66, 200 meters from the Railway Station access road. This terminal, suggested to be upgraded within the KSRTC compound, will provide better parking, pedestrian infrastructure, and passenger amenities, facilitating seamless multimodal transfers and improving transport efficiency in the area. The location of proposed private bus stand is shown in Figure 32.27.

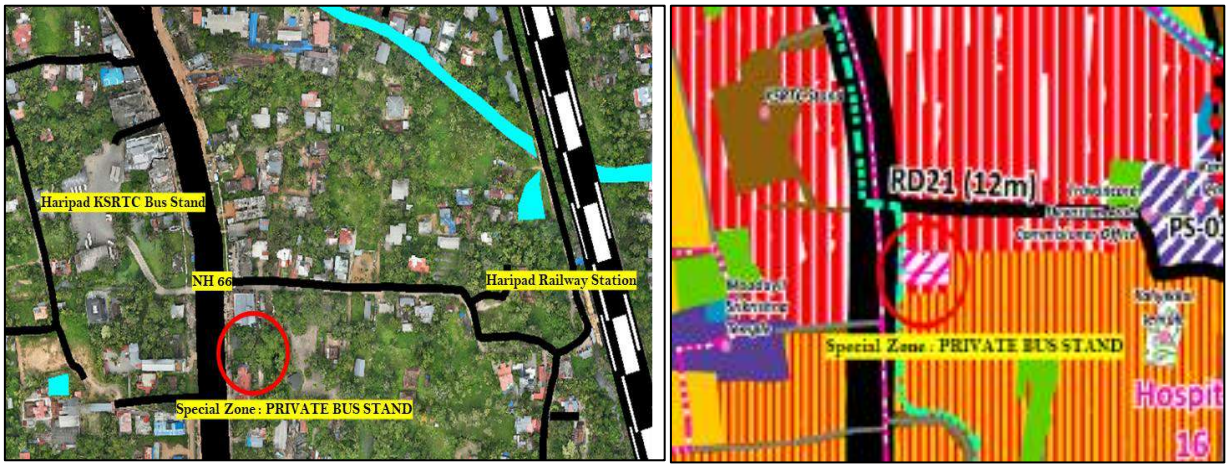


Figure 32.27: Location of Special Zone A – Private Bus Stand

32.10 Non - Motorised Transport Facilities

A dedicated Non-Motorized Transport (NMT) network is proposed for Haripad to promote safe, sustainable, and tourism-friendly mobility in accordance with IRC: 11–2015 guidelines. Recognizing the town's high share of walking and cycling trips - especially by students, daily commuters, and temple visitors - the proposal emphasizes the creation of continuous footpaths, safe pedestrian crossings, and dedicated cycle lanes across key corridors.

A 6 m road widening is proposed around the temple pond of the Haripad Subrahmanya Swami Temple, incorporating a jogging track and pedestrian-friendly improvements to enhance the spiritual and recreational character of the precinct. Dedicated bicycle tracks are also proposed along the RJ Road and along the stretch from Town Hall Junction to Town Junction to ensure safe student commuting. Further, bicycle lanes and cycle stands are planned between Town Hall Junction and the Haripad Subrahmanya Swami Temple to facilitate eco-friendly access to the temple corridor. As part of the broader destination enhancement strategy, similar provisions for cycle tracks are proposed at Mannarasala Temple to strengthen last-mile connectivity and promote sustainable tourism mobility within Haripad's temple network.

32.11 Other Transport Infrastructure to Promote Tourism

Haripad town, surrounded by numerous lakes and lagoons, possesses significant tourism potential. This natural advantage can be further enhanced through the development of efficient and accessible transport infrastructure connecting key tourist sites, thereby promoting sustainable tourism growth in the region.

National Waterway No. 3 (NW-3), passing along the outskirts of Haripad, offers a valuable opportunity to integrate water-based transport and tourism into the town's development vision. The waterway connects to a channel originating from Nelpurakkadavu near the PWD Guest House, which further links northward to the Achankovil River. This strategic hydrological connection presents potential for developing a heritage waterway trail that can showcase Haripad's cultural, ecological, and temple-related landscapes. By leveraging this inland water network, the town can diversify its tourism offerings through boat cruises, eco-trails, and pilgrim-linked water routes, thereby strengthening its identity as a culturally rich and environmentally responsive destination.



CHAPTER
33

DRAINAGE PLAN



The Drainage Plan, also referred to as the Drainage Network Plan and Redevelopment Project, provides a scientifically informed framework to address flooding, waterlogging, and stormwater management challenges in Haripad arising from its low-lying terrain, intense monsoons, and urban growth. A detailed technical study undertaken during the Master Plan preparation assessed existing drains, canals, natural watercourses, and paddy lands to identify capacity gaps and systemic deficiencies. Based on this assessment, the plan proposes targeted interventions such as strengthening and interlinking drains, restoring natural waterways, protecting paddy fields as retention areas, and integrating green infrastructure, making it critical for improving drainage efficiency, enhancing flood resilience, and supporting Haripad's climate-responsive urban development

- Introduction
- Preparation of Stormwater Drainage Plan
- Proposed Stormwater Drainage Plan
- Key features of the Drainage Plan
- Prioritization of Drainage Interventions
- Stormwater Management Measures

33. DRAINAGE PLAN

33.1 Introduction

A Drainage Plan, also referred to as the Drainage Network Plan and Redevelopment Project, is a comprehensive framework that guides the planning, design, and management of a town's stormwater and natural drainage systems to ensure the safe, efficient, and sustainable movement of water. For a town like Haripad—characterised by low-lying terrain, interconnected canals, paddy fields, and increasing urbanisation—a dedicated Drainage Network Plan and Redevelopment Project is essential to prevent waterlogging, mitigate flood risks, safeguard critical infrastructure, and maintain overall environmental health.

The need for such a plan becomes particularly critical in the context of changing rainfall patterns and rising development pressures. A detailed assessment of Haripad's existing drainage system—including natural waterways, thodus, canals, and urban drains—has been carried out and discussed in Chapter 14 of this Master Plan. The analysis revealed significant structural and systemic gaps, clearly establishing the necessity for a coordinated, town-wide intervention. Accordingly, this chapter presents a scientifically informed Drainage Network Plan and Redevelopment Project that builds on the earlier findings, addresses identified deficiencies, strengthens stormwater management capacity, and enhances Haripad's long-term flood resilience and climate responsiveness.

33.2 Preparation of Stormwater Drainage Plan

A reliable drainage plan requires accurate mapping of the existing network along with hydrometeorological data on rainfall, runoff, and storm frequency. Analysis of typical cross-sections of stormwater channels, and roadside drains of Haripad town has revealed deficiencies in carrying capacity, underscoring the need for system upgrades. Addressing the identified deficiencies through infrastructure improvements and better solid waste management is essential to enhance resilience and reduce flood risks in the town.

Following the CPHEEO guidelines, discharge is calculated using the rational method, with parameters such as return period, Intensity–Duration–Frequency (IDF) curves, runoff coefficients, and time of concentration. The system is designed for a two-year return period storm, balancing cost and space constraints. Rainfall data is analysed to develop IDF curves for 2–100 years, and probable maximum precipitation is estimated to strengthen design reliability. Considering the area's closely spaced inlets, economic feasibility, and acceptable flood risk, a time of concentration of 25 minutes has been adopted at the design stage.

Hydraulic modelling with Manning's formula is used to assess drain capacity and flow rates. In the proposed system, only constructed drains are used as primary / secondary drains, with flow velocities maintained between 0.60 m/s and 3.0 m/s to prevent stagnation or damage. Together, these measures create a robust, efficient, and adaptable drainage system that can manage current deficiencies while

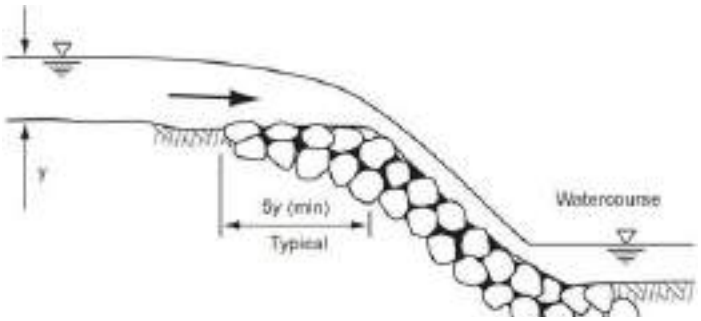


Figure 33.1 : Storm Water Channel Outfall

preparing Haripad for future urban growth and stormwater challenges. Outfall points should be chosen based on surface water levels (low, normal, high) and kept adequately high above the High Flood Level. Together, these criteria guide the assessment of existing drains and the design of new ones.

33.3 Proposed Stormwater Drainage Plan

A comprehensive stormwater drainage plan has been proposed for Haripad, covering a substantial urban area of approximately 16.34 sq. km, with the objective of improving drainage efficiency, reducing waterlogging, and enhancing flood resilience across the town. The plan includes the development of an extensive roadside drainage network with a total length of about 102,643.02 metres, designed using reinforced concrete box drains of varying sizes based on catchment characteristics, runoff intensity, and road hierarchy, ensuring effective collection and conveyance of stormwater.

In addition to roadside drains, the proposal includes the construction of approximately 6,601.11 metres of new nalas, along with the restoration and upgrading of existing nalas, to address missing links, improve hydraulic continuity, and enhance overall discharge capacity during peak rainfall events. These interventions are strategically aligned with natural drainage paths, low-lying areas, and flood-prone zones, ensuring uninterrupted flow towards outfalls and major water bodies. Together, the proposed measures form an integrated drainage network that strengthens Haripad's capacity to manage extreme rainfall, protects urban infrastructure, and supports long-term, climate-resilient urban development.

Details of the existing and proposed stormwater drainage design for Haripad are presented in Annexure, providing a comprehensive technical basis for planning and implementation. The annexure includes the following key drawings and reports:

Maps

- Map 1: Existing Nalas, Drainage Network, Roads, Water Bodies, Wetlands, and Canals (Annexure I)
- Map 2: Existing Nalas and Drainage Network – Adequacy Status (Annexure II)
- Map 3: Stormwater Management Plan Showing Existing and Proposed Drains and Nalas (Annexure III)

Technical Statements and Reports

- Table 1: Existing Major Stormwater Drain (Nala) – Design and Adequacy Check Statement (Annexure IV)
- Table 2: Proposed Stormwater Drain (Nala) Statement (Annexure V)
- Table 3: Roadside Drain Report (Annexure VI)

Together, these maps and technical statements offer a detailed and integrated understanding of the town's drainage system, supporting informed decision-making, phased implementation, and effective monitoring of the proposed Drainage Network Plan and Redevelopment Project for Haripad. Further Map 33.2 illustrates the Proposed Drainage Network of Haripad Town, which integrates existing nalas, proposed nalas, adequate capacity drains, and proposed drains as its key components.

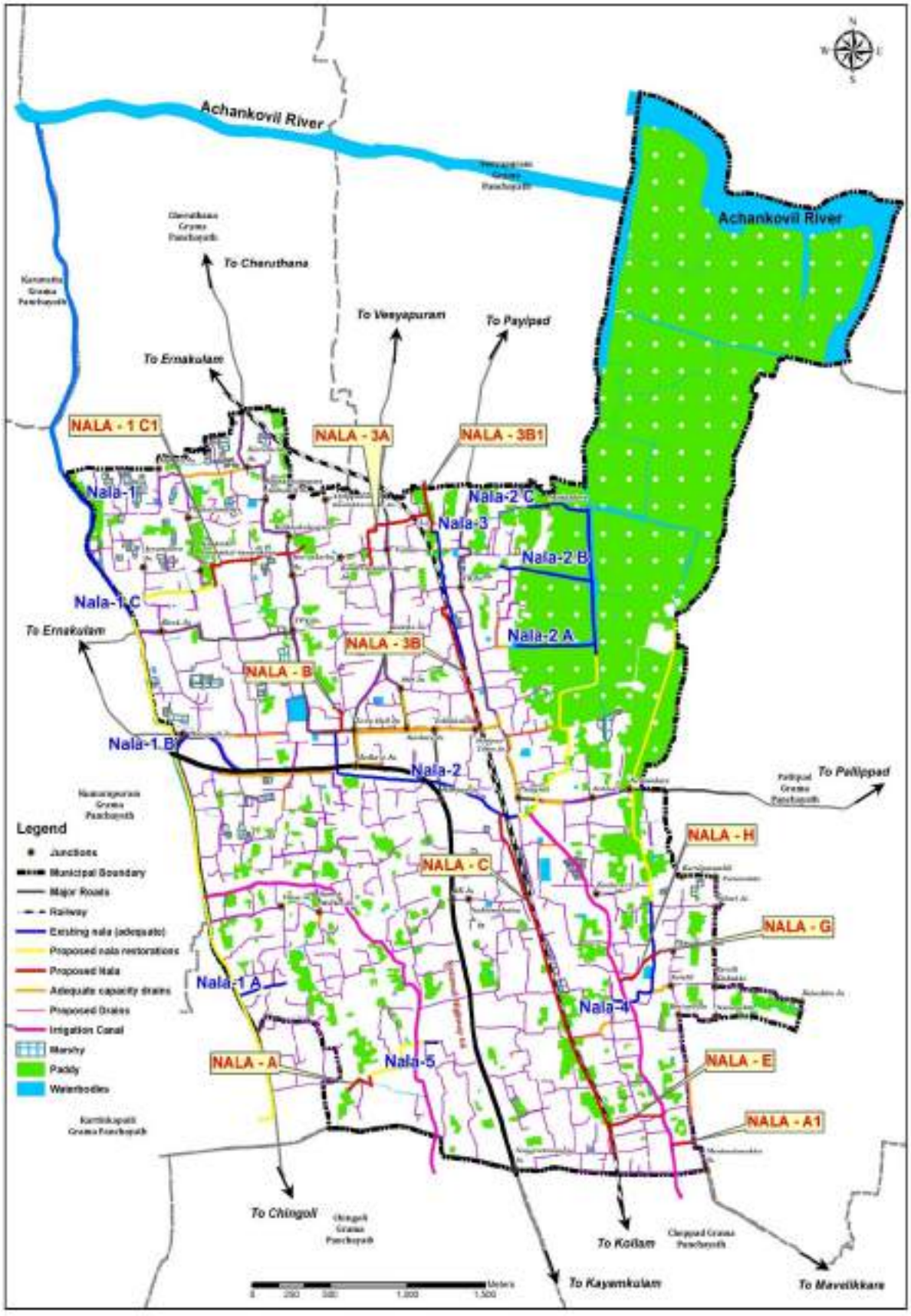


Figure 33.2 : Proposed Drainage Network for Haripad

33.4 Key features of the Drainage Plan

- **Restoration of Existing Nalas:** A substantial portion of the existing nalas in Haripad are proposed for restoration to enhance flow capacity, as many have become stagnant and non-functional due to weed growth, indiscriminate waste dumping, and bunds left in place after serving their purpose. Restoration through desilting, obstruction removal, weed clearance, and structural rehabilitation is essential to reinstate functionality and ensure effective integration with the broader drainage network.
- **Proposal for New Nalas:** New nalas are proposed in the drainage system for Haripad town to address critical gaps in the existing network and enhance its overall capacity to manage stormwater. While existing nalas, and drains provide the foundation, the new nalas expand coverage, connect isolated sections, and ensure smoother conveyance of runoff across the town. Integrated with restored and well-maintained channels, these additions improve flood mitigation, reduce waterlogging in vulnerable areas, and strengthen Haripad's resilience against heavy rainfall, making the system more comprehensive and reliable.
- **Existing Drains Having Adequate Capacity:** Most roads in Haripad are equipped with roadside drains; however, many have become non-functional due to broken connections caused by construction activities, weed growth, and indiscriminate waste dumping. At present, only a limited number of drains in the central core of the town possess adequate capacity. Consistent monitoring and cleaning of the drains will ensure efficient stormwater conveyance, thereby reduce flood risks and enhance the overall performance of the drainage system.
- **Proposed Roadside Drains:** Many of the existing roadside drains are proposed to be restored through cleaning and capacity enhancement, while new drains will be constructed where gaps exist. Together, these measures will expand coverage across major parts of the town, creating a more reliable and efficient stormwater management system by integrating both restored and newly built infrastructure.

33.5 Prioritisation of Drainage Interventions in Haripad

Figure 33.3 illustrates the existing drainage network of Haripad town along with areas prone to flooding and waterlogging under a 50-year return period flood scenario. The analysis indicates that zones of high inundation and persistent waterlogging are predominantly concentrated in the north-eastern paddy fields, particularly within Wards 8, 9, 10, and 11. In addition, flood-prone locations are dispersed across several wards, often in proximity to inadequately functioning nalas, major road corridors, and railway lines. This spatial pattern underscores limited drainage capacity, poor hydraulic connectivity, and insufficient conveyance within the town's drainage system.

The overlap of flood-affected areas with paddy fields and marshy lands further highlights the heightened vulnerability of Haripad's low-lying agricultural landscapes to seasonal inundation. To improve overall flood resilience, a focused and phased flood-mitigation strategy is therefore essential. As a first step, the existing nalas and roadside drains—many of which are currently non-functional—must be systematically revived and restored. Subsequently, identified gaps in the drainage network should be addressed through the construction of new nalas and roadside drains to establish missing hydraulic links. Implementation should follow a clear priority sequence, beginning with interventions in densely urbanised areas to reduce

immediate flood impacts, followed by measures in semi-urban zones, and finally extending to peripheral areas and paddylands.

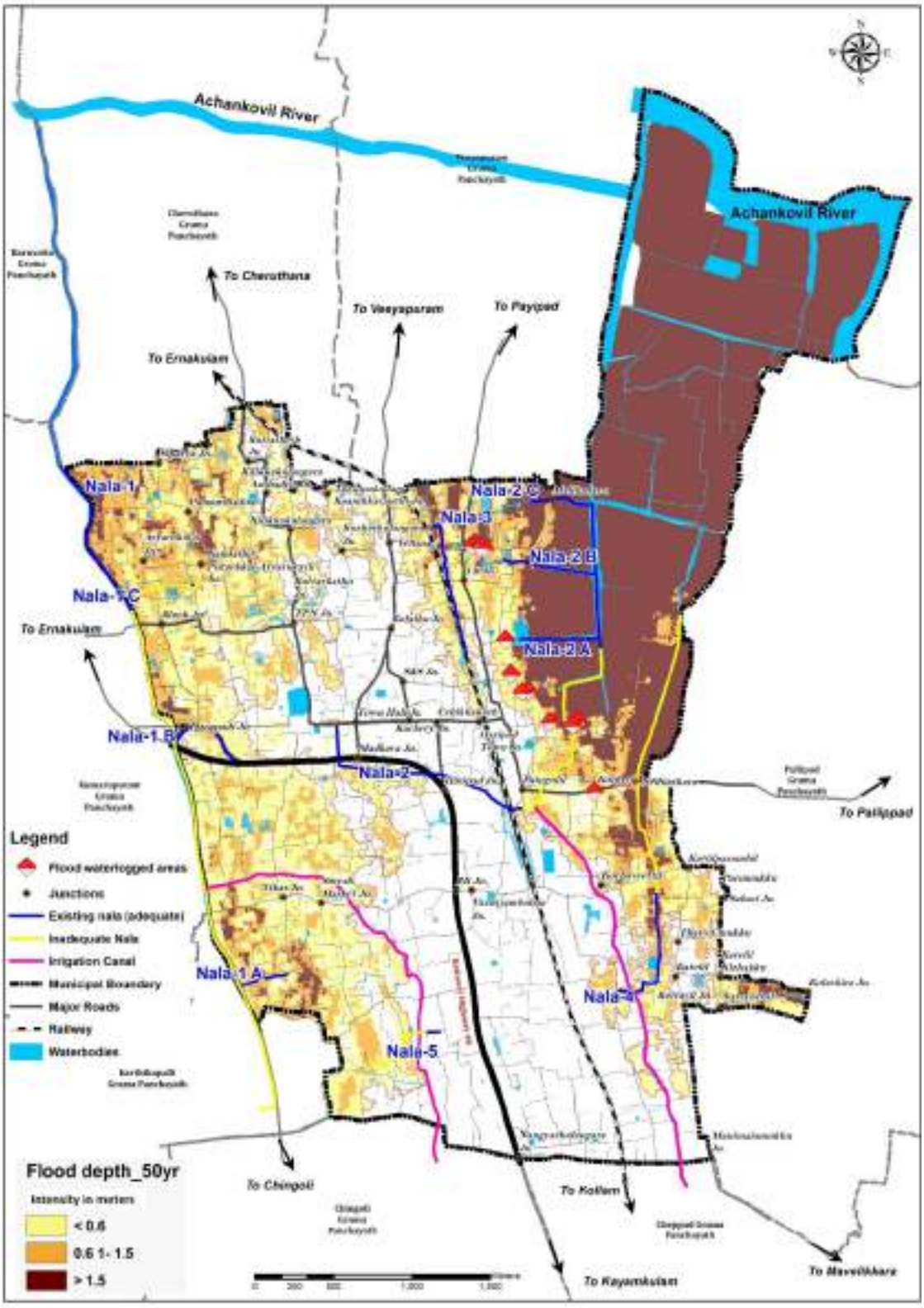


Figure 33.3 : Water logged areas in the town overlaid with & 50 Year Return Probability Map

33.5.1 Restoration of Existing nalas

The adequacy assessment of Haripad's stormwater drainage system indicates that the existing natural streams (nalas) in the upstream reaches are largely adequate, with flow-to-capacity ratios well below 100%. In contrast, the midstream and downstream sections exhibit significant hydraulic inadequacy, with flow-to-capacity ratios frequently exceeding 150–250%, clearly indicating severe capacity constraints. The details of the Major Stormwater Drain (Nala) Design and Adequacy Assessment for Haripad Town are presented in Annexure.

Based on this analysis, it is recommended that the identified inadequate stretches be upgraded on a priority basis using rectangular masonry drain sections, as specified in the annexure. In parallel, the upstream natural channels must be subjected to regular inspection and maintenance to prevent blockages caused by siltation, vegetation growth, and encroachments, which could otherwise reduce their effective carrying capacity over time. The timely removal of temporary bunds after their functional use is also critical to avoid flow obstructions, minimise localised flooding, and sustain overall flood resilience.

During the restoration of existing nalas, priority should be accorded to those channels that facilitate stormwater drainage from the central and densely urbanised areas of Haripad, before extending interventions to peripheral drainage channels. This phased approach will significantly reduce waterlogging and flood incidence in high-density urban zones. Accordingly, restoration and upgrading works are proposed to be implemented in the priority order outlined below

1) **Nala 1 (Danapady Thodu) & Nala 1C: Nala 1:** being an important channel with multiple subbranches, collects flows from roadside drains across the western part of the town and is critical for integrated drainage connectivity. Nala–1C functions as a feeder to the main Nala–1, and by diverting runoff from densely populated areas, it plays an important role in reducing localised waterlogging and flooding.
2) **Nala 2 (Pillathodu):** A major channel passing through the town centre, discharging stormwater into the Achankovil River and critical for relieving flooding in the most urbanised core.
3) **Nala 3**: Located near the north-eastern waterlogged areas, this nala is critical for mitigating flooding around Haripad Town Junction and TB Junction. As the entire stretch currently has adequate capacity with no observed bottlenecks or limitations, restoration should focus on cleaning, desilting, and removal of obstructions to reinstate its designed capacity and connectivity.
4) **Nala 4:** Situated near the eastern boundary, the nala channels stormwater from the southeastern town areas into the Achankovil River, enhancing overall drainage efficiency. However, approximately 49% of its total length is inadequate to carry the design flow. These stretches should be upgraded into a rectangular channel constructed with brick in mortar, as detailed in Annexure IV.
5) **Nala 5:** The smallest nala, located in the southwest portion of the town, drains stormwater from areas near NH into adjacent paddylands, thereby helping to mitigate flooding in peripheral areas. However, approximately 68% of its total length is inadequate to carry the design flow. To ensure efficient conveyance and reduce flooding in adjoining areas, this

irregular natural channel should be upgraded into a concrete rectangular section along its entire stretch. (Details are provided in Annexure IV.)

Nala 1 (Danapady Thodu) and Nala 2 (Pilla Thodu), being the two major streams serving stormwater drainage in the town, details of a representative stretch of these nalas are provided below:

A. Nala 1 (Danapady Thodu)

The drainage maps presented in Figures 33.4, 33.5, 33.6, and 33.7 provide a detailed hydraulic assessment of Nala–1 and its associated sub-drainage network. The analysis clearly indicates that only the upstream segment of Nala–1, extending from CB-149 to CB-438, is hydraulically adequate, with sufficient capacity to safely convey stormwater flows corresponding to design rainfall events. However, the downstream stretch from CB-438 up to the final outfall at O-214 is hydraulically inadequate, exhibiting limited conveyance capacity and an inability to handle peak stormwater discharges during periods of intense rainfall.

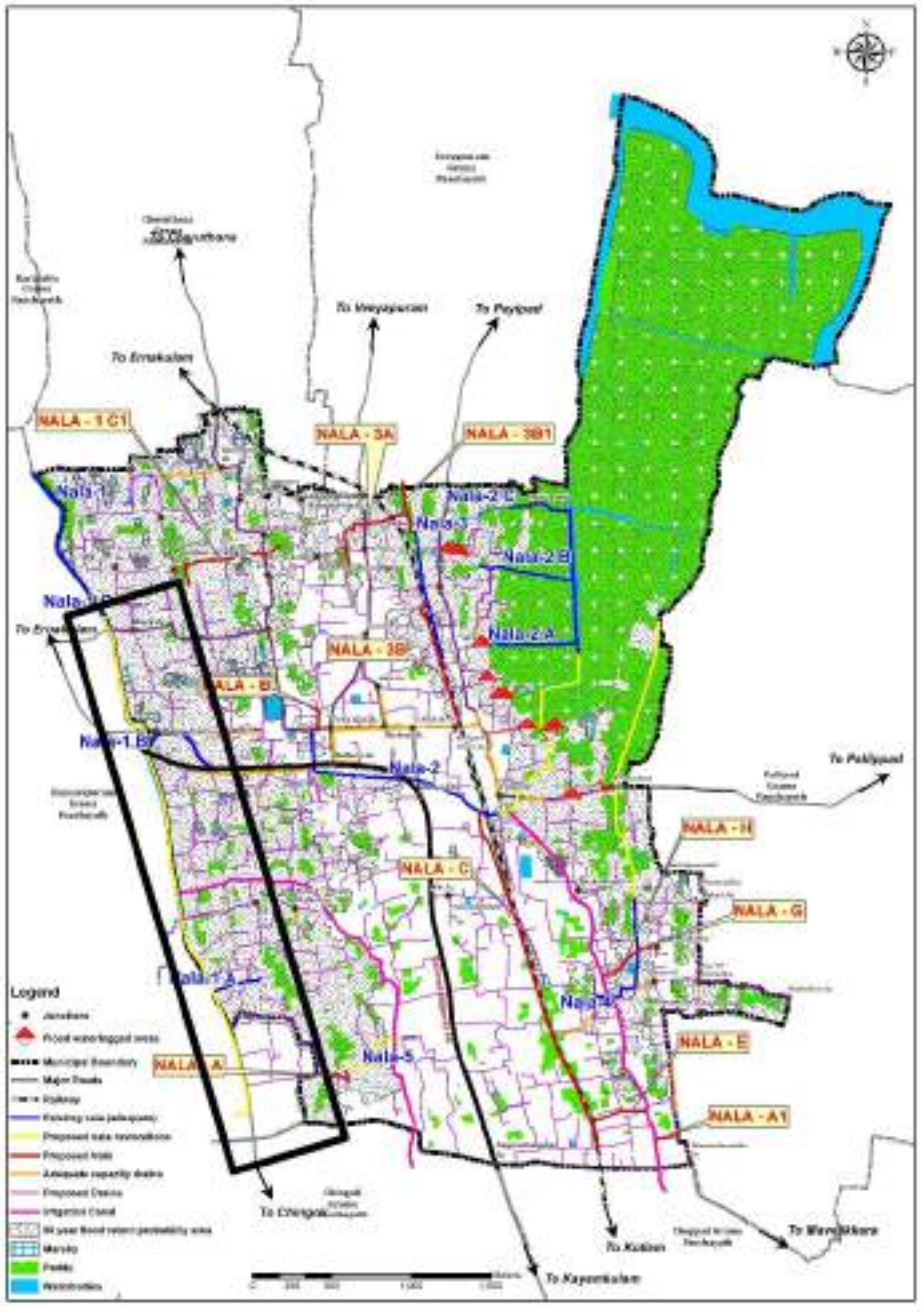


Figure 33.4 : Map showing Stretch of Nala 1 (Danpady Thodu) having inadequate

This downstream inadequacy is particularly critical because it receives combined inflows from multiple upstream and lateral sources. Several roadside drains, along with Nala–1A and Nala–1B, discharge into this deficient

segment, substantially increasing cumulative flow volumes. The convergence of these inflows overwhelms the existing channel capacity, leading to frequent surcharging, overtopping, and prolonged water stagnation during monsoon events. As a result, adjacent urban areas experience recurrent localised flooding, disruption to mobility, and heightened risks to public health and property, especially in densely built-up zones where natural drainage paths are constrained.

In contrast, Nala–1C connects to the hydraulically adequate portion of Nala–1, enabling efficient evacuation of stormwater. Catchments draining through Nala–1C therefore exhibit better drainage performance, faster runoff clearance, and comparatively lower flood incidence, even under heavy rainfall conditions. This differential performance within the same drainage system highlights a structural and hydraulic imbalance, where upstream adequacy is negated by downstream bottlenecks.

The findings underline that localized improvements alone are insufficient and that system-wide functionality depends on downstream capacity. Accordingly, the analysis establishes a clear and urgent requirement for capacity augmentation and structural upgrading of the downstream reach of Nala–1, including section enhancement and improved flow continuity up to the outfall. Addressing this critical bottleneck is essential to achieve uniform drainage efficiency across all contributing

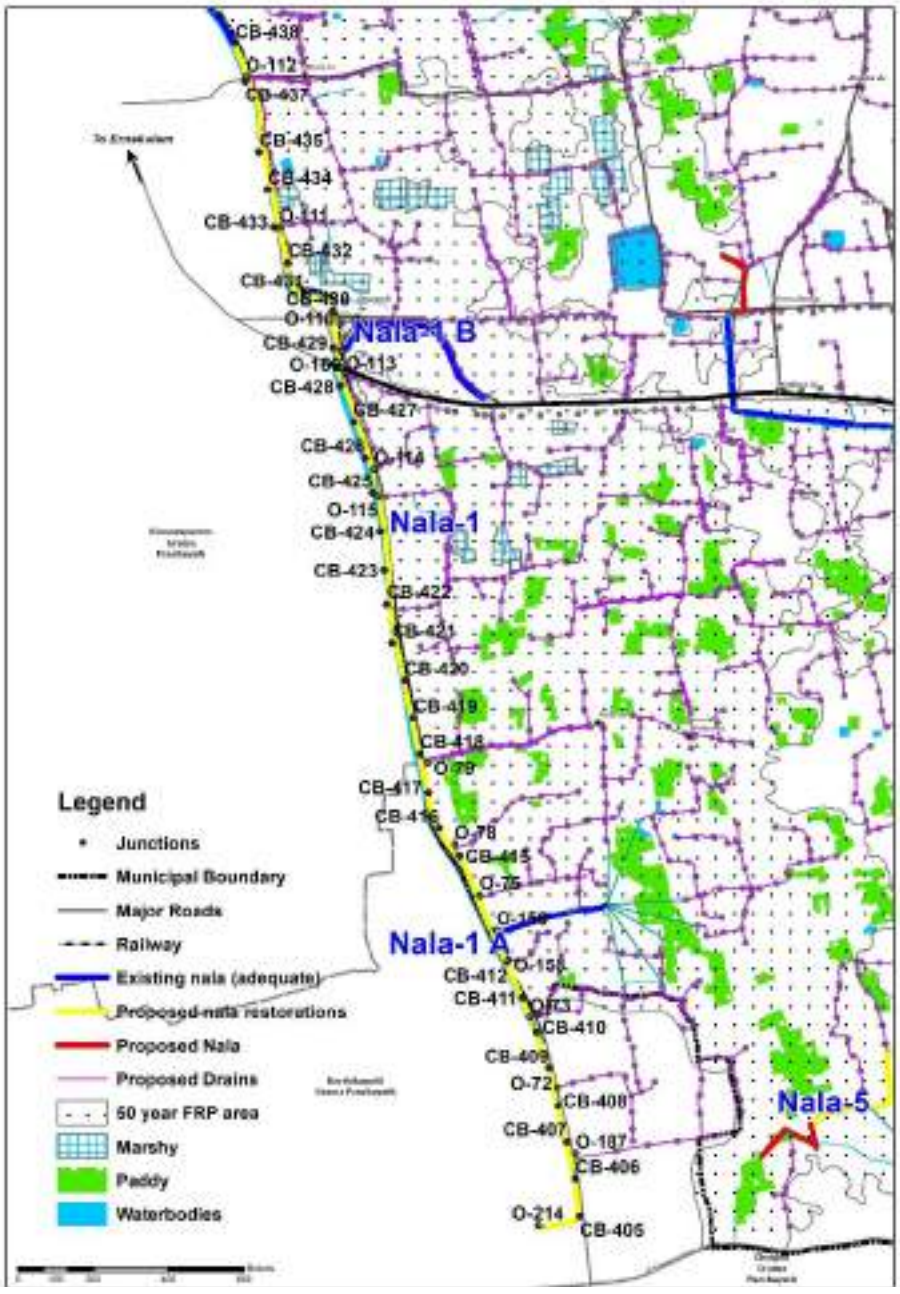


Figure 33.5 : Map showing details of the Inadequate Capacity along Nala–1 Stretch

catchments, reduce flood risk in vulnerable urban areas, and ensure the long-term resilience of Haripad's stormwater drainage network.

Table 33.1 presents the Stormwater Drain (Nala) Design and Adequacy Check Statement for a representative stretch of Nala–1 (Danapady Thodu), providing a detailed assessment of its hydraulic performance under design storm conditions. The analysis indicates that the stretch between catchment basins CB-449 and CB-438 is hydraulically adequate, with sufficient capacity to safely convey peak stormwater flows. Although this portion of the nala is currently impacted by solid waste accumulation, weed growth, and vegetation, the assessment confirms that once desilted and properly maintained, the existing natural channel geometry is adequate and does not require any structural design modification. This underscores the importance of routine maintenance, desilting, and encroachment removal to restore and retain the nala's original conveyance capacity.

In contrast, the stretch downstream of CB-438 has been identified as hydraulically inadequate, even under the conservative assumption of a clean and obstruction-free channel. The flow-to-capacity ratios in this segment exceed acceptable limits, indicating that the existing natural stream section is structurally insufficient to handle design discharge volumes during high-intensity rainfall events. Consequently, this stretch acts as a critical bottleneck within the drainage network, contributing to surcharging, overflow, and downstream waterlogging during monsoon periods.

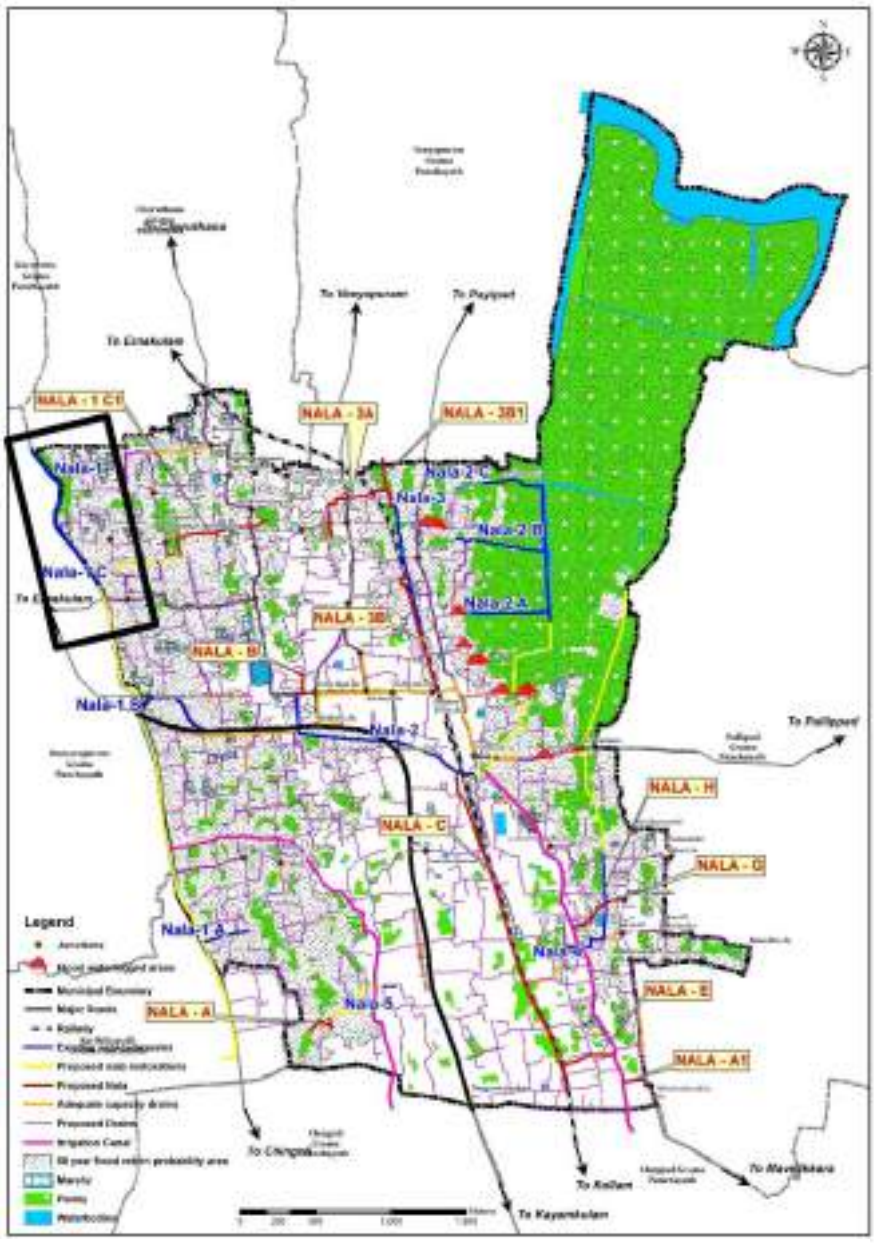


Figure 33.6 : Stretch of Nala 1 (Danpady Thodu) having adequate capacity

To address this deficiency, targeted design interventions

are proposed. These include converting the irregular natural stream section into a hydraulically efficient rectangular channel, constructed using brick masonry in mortar, to ensure structural stability, ease of maintenance, and predictable hydraulic performance. Further, the channel dimensions are proposed to be enlarged in accordance with calculated design discharges, with the objective of reducing the flow-to-capacity ratio to below 100%, thereby achieving full hydraulic adequacy and compliance with design standards.



Figure 33.7 : Map showing details of the Adequate Capacity along Nala–1 Stretch

All inadequate stretches identified along Nala–1 are proposed to be upgraded to rectangular channels of appropriate dimensions, as specified in Annexure IV. These interventions, when implemented alongside regular maintenance measures, will significantly enhance the conveyance capacity, reduce flood risk in downstream urban areas, and improve the overall efficiency and resilience of Haripad's stormwater drainage system. While Table 33.1 presents the Stormwater Drain (Nala) Design and Adequacy Check Statement for a representative stretch of Nala–1 (Danapady Thodu), providing a detailed assessment of its hydraulic performance under design storm conditions, the details of the same is shown in Annexure IV of this Master Plan.

Table 33.1 : Stormwater Drain Design and Adequacy Check Statement for Nala 1 (Sample stretch)

Haripad Major Storm water Drain (Nala) Design and Adequacy Check Statement

						Existing Nala									Adequate Design Nala									
Label	Start Node	Stop Node	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	System Drainage Area (m²)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	Flow (m³/s)	Flow / Capacity (Design) (%)	Section Type	Material	Adequacy Check	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	Flow (m³/s)	Flow / Capacity (Design) (%)	Span (m)	Rise (m)	Section Type	Material	Adequacy Check
Nala-1	CB-449	CB-448	1.27	1.26	72.45	1,03,012.20	0.03	0.17	3.3	0.61	15.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.17	3.3	0.61	15.7			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-448	CB-447	1.26	1.25	99.93	1,30,881.90	0.03	0.16	4.2	0.78	18.5	Irregular Channel	Natural stream, clean	Adequate	0.03	0.16	4.2	0.78	18.5			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-447	CB-446	1.25	1.24	99.97	1,50,445.00	0.03	0.17	3.53	0.89	25.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.17	3.53	0.89	25.3			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-446	CB-445	1.24	1.23	100.34	1,70,344.30	0.03	0.19	10.95	1.01	9.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.19	10.95	1.01	9.3			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-445	CB-444	1.23	1.22	100	3,34,041.90	0.03	0.26	3.12	2.34	74.9	Irregular Channel	Natural stream, clean	Adequate	0.03	0.26	3.12	2.34	74.9			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-444	CB-443	1.22	1.21	100.22	3,86,433.80	0.03	0.26	3.07	2.35	76.5	Irregular Channel	Natural stream, clean	Adequate	0.03	0.26	3.07	2.35	76.5			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-443	CB-442	1.21	1.2	100.1	4,77,599.80	0.03	0.28	8.94	2.83	31.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.28	8.94	2.83	31.7			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-442	CB-441	1.2	1.19	100.45	4,83,635.60	0.03	0.21	3.53	2.93	81.5	Irregular Channel	Natural stream, clean	Adequate	0.03	0.21	3.53	2.93	81.5			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-441	CB-440	1.19	1.18	99.94	5,23,212.70	0.03	0.24	3.53	3.14	87.4	Irregular Channel	Natural stream, clean	Adequate	0.03	0.24	3.53	3.14	87.4			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-440	CB-439	1.18	1.17	99.76	5,42,460.80	0.03	0.31	4.46	3.22	72.2	Irregular Channel	Natural stream, clean	Adequate	0.03	0.31	4.46	3.22	72.2			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-439	CB-438	1.17	1.16	99.33	14,53,641.70	0.03	0.31	11.23	8.62	76.8	Irregular Channel	Natural stream, clean	Adequate	0.03	0.31	11.23	8.62	76.8			Irregular Channel	Natural stream, clean	Adequate
Nala-1	CB-438	CB-437	1.16	1.15	100.24	14,92,638.20	0.03	0.45	4.7	8.85	188.4	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.45	9.38	8.85	94.4	10	1.5	Rectangular Channel	Brick in mortar	Adequate
Nala-1	CB-437	CB-436	1.15	1.14	99.8	16,48,386.10	0.03	0.35	8.24	9.78	118.6	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.35	9.91	9.78	98.6	10.5	1.5	Rectangular Channel	Brick in mortar	Adequate
Nala-1	CB-436	CB-435	1.14	1.13	100.41	16,55,580.70	0.03	0.5	4.61	9.82	210.4	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.5	9.88	9.82	99.4	10.5	1.5	Rectangular Channel	Brick in mortar	Adequate

B. Nala 2 (Pilla Thodu)

The drainage maps presented in Figures 33.8, 33.9, 33.10, and 33.11 illustrate the hydraulic performance of Nala–2, clearly identifying stretches with adequate and inadequate conveyance capacity under design storm conditions. The analysis indicates that the upstream segment from catchment basin CB-357 to CB-106, as well as the downstream segment from CB-92 to the designated outfall, are hydraulically adequate and capable of safely conveying peak stormwater flows when maintained in a clean condition.

In contrast, the intermediate stretch between CB-106 and CB-92 has been identified as hydraulically inadequate, with insufficient cross-sectional capacity to handle cumulative stormwater discharge during high-intensity rainfall events. This stretch therefore

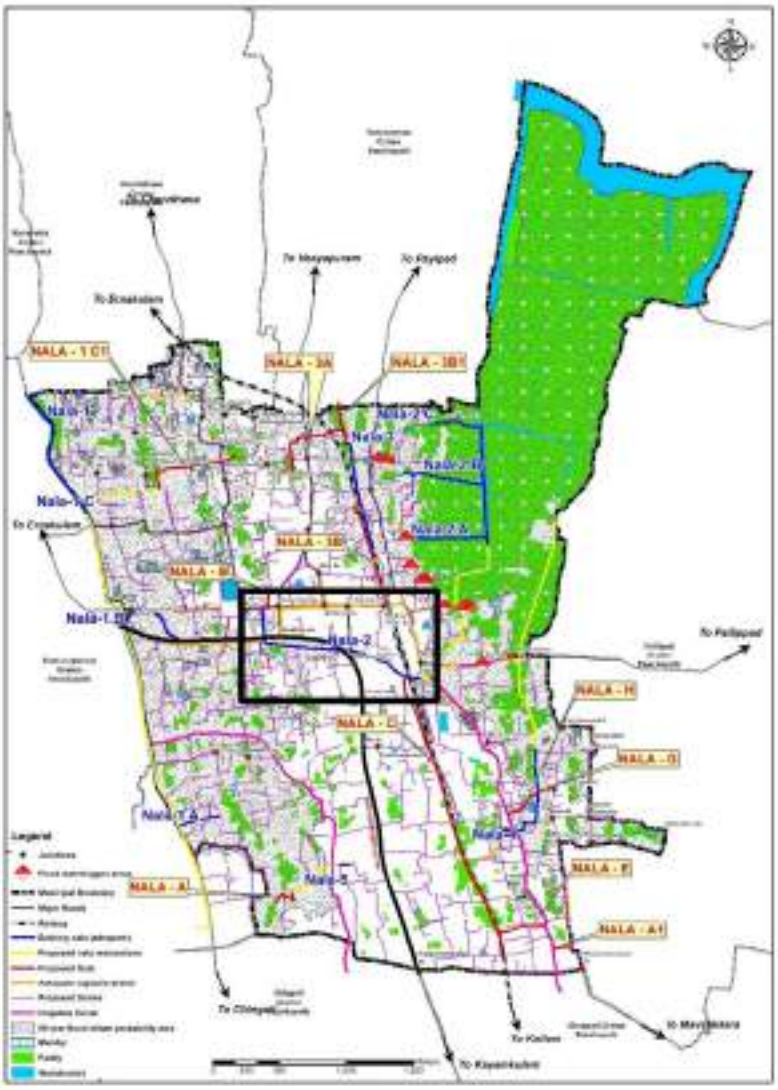


Figure 33.8 : Map showing Stretch of Nala 2 (Pilla Thodu) having Adequate capacity

represents a critical constraint within the Nala–2 drainage system and poses a heightened risk of surcharging, localised overflow, and waterlogging in adjoining areas during monsoon periods.

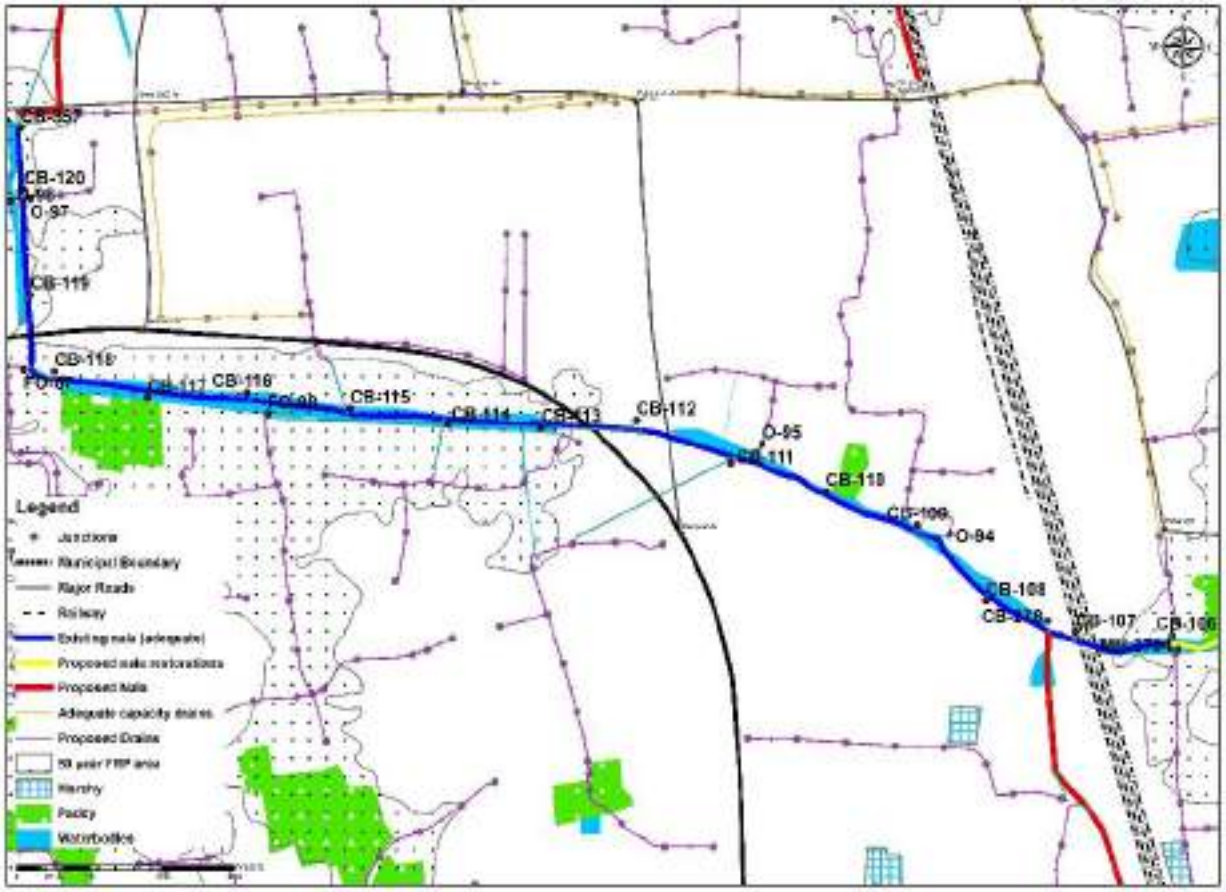


Figure 33.9 : Map showing details of the Adequate Capacity along Nala–2 Stretch

The discharge pattern further underscores this imbalance. Two newly proposed nalas—Nala-B and Nala-C—along with multiple roadside drains, are designed to discharge into the hydraulically adequate segments of Nala–2, thereby ensuring effective conveyance without overloading the system. In contrast, the hydraulically inadequate stretch between CB-106 and CB-92 receives inflow only from roadside drains, yet remains capacity-deficient even under this comparatively lower inflow scenario. This highlights that the inadequacy is primarily due to structural and geometric limitations of the nala section rather than excessive upstream inflow alone.

Given its strategic position within the drainage network, the CB-106 to CB-92 stretch of Nala–2 warrants priority intervention. Capacity augmentation through channel widening, sectional modification, or conversion to a defined masonry or concrete section, along with systematic desilting and maintenance, will be essential to ensure uniform hydraulic performance across the entire nala. Addressing this bottleneck will improve overall drainage efficiency, reduce flood risk in downstream urban areas, and enhance the resilience of Haripad's stormwater management system.

As per the Stormwater Drain (Nala) Design and Adequacy Check Statement for Nala–2 (Table 33.2), the irregular natural stream sections are hydraulically adequate under clean conditions in the identified adequate stretches. This indicates that the nala can safely convey design storm flows if regular cleaning, desilting, and removal of vegetation and encroachments are ensured. Such preventive maintenance is therefore essential to sustain drainage efficiency and reduce flood risk.



Figure 33.10 : Map showing Stretch of Nala 2 (Pilla Thodu) having Inadequate capacity

However, the inadequate stretch of Nala–2, similar to Nala–1, requires structural upgrading. It is proposed to convert these deficient reaches into rectangular channels of suitable dimensions to achieve hydraulic adequacy, as detailed in of Annexure IV. While Table 33.2 presents adequacy results for a representative stretch, the complete stretch-wise design and capacity details for Nala–2 are provided in Annexure IV of this Master Plan, which shall guide implementation.

Table 33.2 : Stormwater Drain Design and Adequacy Check Statement for Nala 2- Pillathodu (Sample stretch)

Label	Start Node	Stop Node	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	System Drainage Area (m²)	Manning' s n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	Flow (m³/s)	Flow / Capacity (Design) (%)	Section Type	Material	Adequacy Check	Manning' s n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Peak Flow (m³/s)	Flow / Capacity (Design) (%)	Span (m)	Rise (m)	Section Type	Material	Adequacy Check
Nala-2	CSN-007	CSN-020	-3.42	-3.6	94.87	1,95,220.00	0.03	0.33	7.54	0.07	0.94	Irregular Channel	Material in nala, slope	Adequate	0.03	0.29	7.54	0.07	0.94			Irregular Channel	Material in nala, slope	Adequate
Nala-2	CSN-020	CSN-040	-3.6	-3.85	100.00	2,12,220.00	0.03	0.32	10.03	0.03	0.33	Irregular Channel	Material in nala, slope	Adequate	0.03	0.25	10.03	0.03	0.33			Irregular Channel	Material in nala, slope	Adequate
Nala-2	CSN-040	CSN-070	-3.85	-4.1	125.00	3,47,220.00	0.03	0.37	13.29	0.05	0.42	Irregular Channel	Material in nala, slope	Adequate	0.03	0.27	13.29	0.05	0.42			Irregular Channel	Material in nala, slope	Adequate
Nala-2	CSN-070	CSN-090	-4.1	-4.35	87.50	2,26,220.00	0.03	0.33	24.61	0.12	0.49	Irregular Channel	Material in nala, slope	Adequate	0.03	0.29	24.61	0.12	0.49			Irregular Channel	Material in nala, slope	Adequate
Nala-2	CSN-090	CSN-100	-4.35	-4.5	150.00	3,34,220.00	0.03	0.43	16.31	0.21	1.29	Irregular Channel	Material in nala, slope	Adequate	0.03	0.35	16.31	0.21	1.29			Irregular Channel	Material in nala, slope	Adequate
Nala-2	CSN-100	CSN-120	-4.5	-4.7	140.00	3,52,220.00	0.03	0.66	19.47	0.45	2.31	Irregular Channel	Material in nala, slope	Inadequate	0.03	0.54	19.49	0.45	2.31	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-120	CSN-140	-4.7	-4.85	135.00	3,52,220.00	0.03	0.69	20.79	0.49	2.36	Irregular Channel	Material in nala, slope	Inadequate	0.03	0.58	20.8	0.49	2.36	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-140	CSN-160	-4.85	-5.1	150.00	2,72,220.00	0.03	0.78	6.63	0.55	8.29	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.03	6.64	0.55	8.29	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-160	CSN-180	-5.1	-5.45	175.00	2,80,000.00	0.03	0.82	16.89	0.64	3.79	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.08	16.89	0.64	3.79	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-180	CSN-200	-5.45	-5.8	175.00	2,85,000.00	0.03	0.83	17.09	0.65	3.81	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.09	17.09	0.65	3.81	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-200	CSN-220	-5.8	-6.15	175.00	2,90,000.00	0.03	0.84	17.29	0.66	3.83	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.1	17.29	0.66	3.83	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-220	CSN-240	-6.15	-6.5	175.00	2,95,000.00	0.03	0.85	17.49	0.67	3.85	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.11	17.49	0.67	3.85	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-240	CSN-260	-6.5	-6.85	175.00	3,00,000.00	0.03	0.86	17.69	0.68	3.87	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.12	17.69	0.68	3.87	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-260	CSN-280	-6.85	-7.2	175.00	3,05,000.00	0.03	0.87	17.89	0.69	3.89	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.13	17.89	0.69	3.89	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-280	CSN-300	-7.2	-7.55	175.00	3,10,000.00	0.03	0.88	18.09	0.70	3.91	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.14	18.09	0.70	3.91	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-300	CSN-320	-7.55	-7.9	175.00	3,15,000.00	0.03	0.89	18.29	0.71	3.93	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.15	18.29	0.71	3.93	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate
Nala-2	CSN-320	CSN-340	-7.9	-8.25	175.00	3,20,000.00	0.03	0.90	18.49	0.72	3.95	Irregular Channel	Material in nala, slope	Inadequate	0.03	1.16	18.49	0.72	3.95	1.5	0.9	Rectangular Channel	Brick work in cement mortar	Adequate

Similarly, other existing nalas should be cleaned, desilted, and structurally modified as recommended in the Existing Major Nala Design and Adequacy Check Statement Annexure IV, wherever necessary. When combined with other interventions, these measures will significantly enhance the overall efficiency of the stormwater drainage system

33.5.2 Restoration of Existing roadside drains

The restoration of roadside drains should be undertaken in alignment with the nala restoration sequence to ensure integrated stormwater management. Priority must be given to drains that collect runoff from the town centre and discharge into Nala 2, as this channel is critical for relieving flooding in the most urbanised core. Subsequent attention should be given to drains connected to Nala 1&1C, Nala 3, Nala 5, and finally Nala 4, following the order of importance. Implementing this phased strategy will ensure reliable drainage in heavily urbanised locations, thereby maximising flood mitigation benefits and strengthening the resilience of the town's drainage infrastructure.

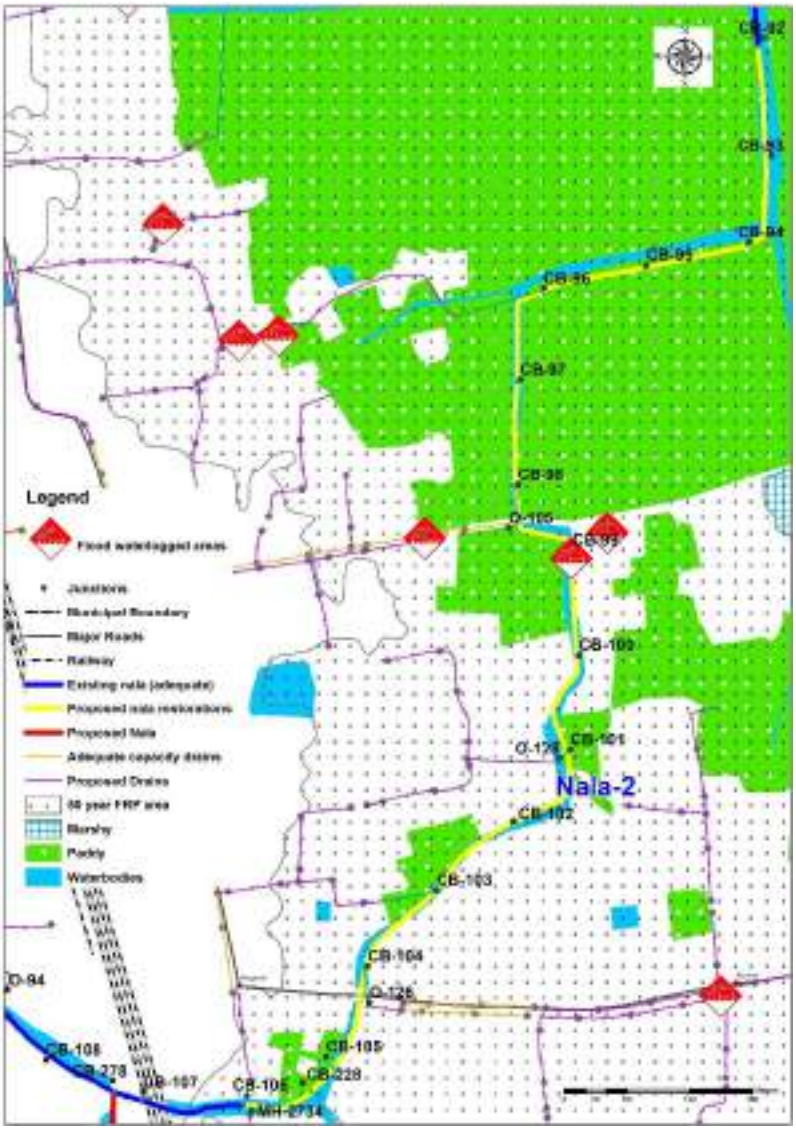


Figure 33.11 : Map showing details of the Inadequate Capacity along Nala–2

33.5.3 Construction of New Nalas

As part of the Stormwater drainage plan, eleven new nalas (streams/channels) of varying dimensions have been proposed to augment the existing network and enhance the overall resilience of the town's stormwater drainage system. The proposal includes multiple nalas (Nala-1 C1, Nala-B, Nala-3 A, Nala-3 B etc.), each designed with specific hydraulic and structural parameters to efficiently collect and convey runoff. Each nala section is tailored with unique lengths, slopes, and dimensions to suit local topography. Flow capacity and velocity are calculated using Manning's equation to ensure optimal performance during peak rainfall. Flow-to-capacity ratios are assessed to confirm that each segment can handle expected stormwater volumes without overflow. Details of the Proposed Stormwater Drain (Nala) Statement is provided in Annexure V.

Most nalas are proposed to have a rectangular cross-section and to be constructed using concrete, or in some cases brick masonry, to ensure durability and high flow capacity. They are designed to efficiently handle substantial runoff volumes. The proposal aims to mitigate urban flooding by effectively managing stormwater runoff.

Effective implementation of the proposal requires prioritising the construction of new nalas along with the revival and restoration of existing ones. Priority should be given to areas with the highest flood risk, greater population density, and critical infrastructure. To strengthen resilience and improve the drainage efficiency of Haripad town, proposed nala segments to be implemented are listed below considering their priority.

1) **Nala–3B** is proposed to originate from low-lying areas near Haripad Town Junction in the central part of the municipality and flow eastward until it joins Nala–3, which subsequently drains into the Achankovil River. About 845.26 meters long, it is designed to carry rainwater from both new and existing roadside drains and cross the railway line before merging with Nala–3. This nala will play an important role in diverting excess runoff into Nala–3, thereby reducing flood risks in the central part of the town.

2) **Nala 1C1 :** Nala 1C1 is proposed to originate from the catchment basin in a paddy land located near the northern part of the town and flow westward, traversing several wetlands/ paddy fields. It then will join the existing Nala 1C and continue to its outlet near the municipal boundary. With a length of 824.48 meters, this nala will collect rainwater from roadside drains and nearby houses, and carry it into the larger Nala 1 system. It will improve drainage in the western part of the town and help prevent flooding in the urbanised areas.

3) **Nala 3A :** Nala 3A, proposed to begin near the northern portion of the town, will flow northward before turning east to join the main stream Nala–3. With a total length of 749.51meters, it is designed to collect runoff from residential areas and roadside drains along its alignment and cross the railway line before discharging into Nala–3. It will help in reducing waterlogging in the northern part of the town and improving the conveyance of stormwater towards downstream catchments.

4) **Nala 3B1:** Nala 3B1 is proposed to start from Nala 3B and flow north until it joins a stream in the neighboring Panchayat at the northern boundary. About 317.7 meters long, it is designed to pass through paddy fields and collect rainwater from roadside drains along the way, thereby helping to reduce localised waterlogging in the northern part of the town above TB Junction.

5) **Nala A** : Nala A will be originating from Nala 5 and extending to its outfall at a wetland (paddy field) located in the southwestern portion of the town, with a total length of 486.53 meters. Nala–5 will convey stormwater collected by roadside drains near the National Highway in the southern part of the municipality and ultimately discharge into the paddy field through the newly proposed Nala–A. The paddy field functions as a natural retention basin during periods of heavy rainfall, thereby reducing flooding and waterlogging in the southwestern region of the town.

6) **Nala B** : Proposed to originate from the catchment basin near a paddy field in the central portion of the town, Nala 3A will extend to its outfall near the catchment basin of Nala 2 (Pilla Thodu), with a total length of 225.09 meters. Nala 2, one of the major drainage channels in Haripad Town, collects stormwater from the outfalls of Nala B along with several other drains, conveys runoff from densely built residential and commercial areas to the Achankovil River. Nala B, in conjunction with Nala 2, will reduce localised flooding and enhance the overall conveyance of stormwater towards the Achankovil River.

7) **Nala C** – Nala C is proposed to originate from the catchment basin of a paddy field located near the railway line at the southern boundary of the municipality and flow northward, running parallel to the railway line, before ultimately joining Pilla Thodu near the northern part of the railway station. Measuring 2257.48 meters in length, it is designed to collect stormwater from roadside drains along its course, traverse several wetlands, and channel the flow efficiently into the Achankovil River. This nala will play a particularly significant role in mitigating waterlogging in the southeastern part of the town, especially in the area between the National Highway and the railway line.

8) **Nala H -** Nala–H will originate from the southern part of the town near the PIP canal and flow eastward to merge with Nala–4. Spanning 289.45 meters, this nala will provide a dedicated outlet for stormwater from the low-lying areas in the southeastern part of the town, thereby reducing flooding risks and improving overall drainage efficiency.

9) **Nala G-** Nala–G is proposed to originate from low lying areas at Thayyil Mukku near the eastern boundary of the municipality, collect stormwater from drains on the eastern side of the town, and extend to join Nala–4. With a total length of 122.36 meters, it will function as a vital drainage path, directing excess runoff into Nala–4 and thereby minimising waterlogging in the nearby settlements

10) **Nala E -** Nala–E is proposed to link isolated streams in the southeastern part of the town with the main drainage network. Extending 346.51 meters, it will provide a new outlet for stormwater into marshy areas that serve as natural retention basins, thereby reducing flood risk in adjoining residential pockets. The outfall from Nala–E is proposed to connect to the catchment basin of Nala–4, which ultimately drains into the Achankovil River.

11) **Nala A1 -** Nala–A1 is the shortest nala proposed in the drainage plan. With a length of about 136.77 meters, it is proposed to originate from a catchment basin at the eastern boundary in the southern part of the town and flow westward to the outfall near the PIP irrigation canal. From there, stormwater will be discharged into Nala–4 at the northern section, ensuring proper drainage and reducing waterlogging in the surrounding areas

Details of a representative stretch of Nala 3B and Nala 1C1 are provided below.

A. Nala 3B

Figure 33.13 and Figure 33.14 illustrate different segments of Nala 3B, highlighting sections with varying capacities and design parameters. As illustrated in the maps (Figure 33.12, Figure 33.15, 33.17, 33.18), the proposed drainage network integrates existing and new infrastructure, comprising existing and proposed nala alignments (shown in blue and red respectively), existing drains with inadequate capacity (yellow), proposed new drains (purple), along with designated outfall locations, manholes, and catch basins (CBs). The proposed alignments traverse varied land uses, including marshy areas, paddy fields, and existing waterbodies, and have been planned to work in harmony with the natural drainage characteristics of the town.

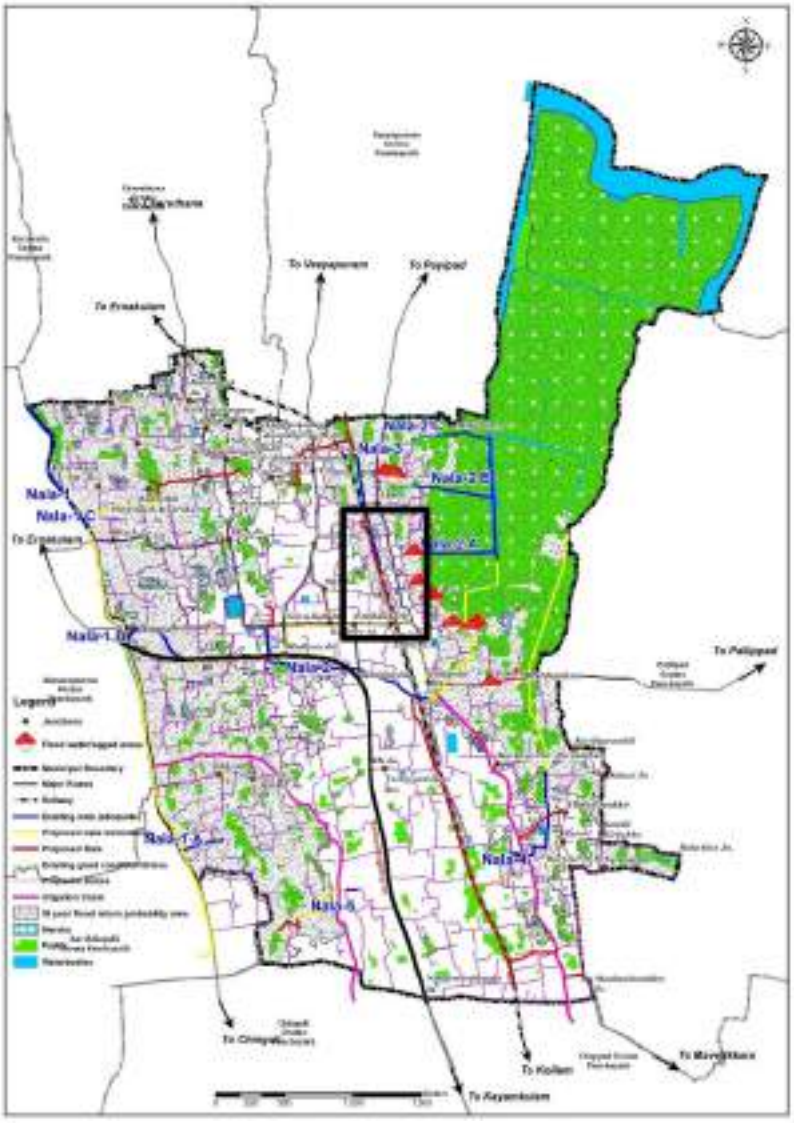


Figure 33.12 : Map showing Proposed Nala 3B

Table 33.3 : Details of Design Parameters of Nala 3B)

ID	Label	Start Node	Stop Node	Invert (Start) (m)	Invert (Stop) (m)	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	System Drainage Area (m^2)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow (m^3/s)	Flow / Capacity (Design) (%)	Span (m)	Rise (m)	Section Type	Material
9740	Nala-3 B	CB-347	CB-348	2.81	2.8	4.17	3.73	116.22	2.41	50416.8	0.013	0.44	0.68	0.3	0.3	44.1	1.5	1.0	Rectangular Channel	Concrete
9741	Nala-3 B	CB-348	CB-349	2.79	1.9	3.73	3.20	135.25	1.78	54867	0.013	1.55	4.31	0.3	0.3	7.5	1.5	1.0	Rectangular Channel	Concrete
9742	Nala-3 B	CB-349	CB-350	1.85	1.8	3.20	2.79	83.42	3.11	2,89,462.00	0.013	1.42	1.79	1.7	1.7	95.9	1.5	1.0	Rectangular Channel	Concrete
9750	Nala-3 B	CB-350	CB-351	1.75	1.7	2.79	3.08	134.39	3.42	2,91,802.00	0.013	1.19	1.77	1.7	1.7	97.7	1.8	1.0	Rectangular Channel	Concrete
9751	Nala-3 B	CB-351	CB-352	1.65	1.6	3.08	2.50	138.72	3.47	2,99,718.70	0.013	1.18	1.78	1.8	1.8	99.8	1.8	1.0	Rectangular Channel	Concrete
9752	Nala-3 B	CB-352	CB-353	1.55	1.5	2.50	2.58	89.59	3.35	3,35,913.10	0.013	1.09	2.22	2.0	2.0	89.9	1.8	1.0	Rectangular Channel	Concrete
9753	Nala-3 B	CB-353	CB-354	1.45	1.4	2.58	2.89	52.40	3.29	3,45,865.90	0.013	1.12	2.42	2.1	2.1	84.6	1.8	1.0	Rectangular Channel	Concrete
9754	Nala-3 B	CB-354	CB-355	1.38	1.3	2.89	2.70	35.69	3.39	3,48,514.70	0.013	1.13	2.22	2.1	2.1	93.1	1.8	1.0	Rectangular Channel	Concrete
9760	Nala-3 B	CB-355	CB-356	1.34	1.3	2.70	2.90	25.11	3.28	3,76,663.20	0.013	1.22	2.65	2.2	2.2	84.4	1.8	1.0	Rectangular Channel	Concrete
9761	Nala-3 B	CB-356	CB-169	1.30	1.3	2.90	2.92	34.47	3.59	4,67,031.80	0.013	1.38	2.89	2.8	2.8	95.8	1.8	1.1	Rectangular Channel	Concrete

Nala–3B, proposed to originate near Haripad Town Junction, is aligned parallel to the railway corridor and begins at the designated outfall point O-135, which receives discharge from both existing and proposed drains. From CB-347 to CB-356, the nala conveys stormwater downstream, crosses the railway line beyond CB-355, and subsequently merges with Nala–3 at CB-169 before ultimately discharging into the Achankovil River. Strategically aligned through waterlogging-prone areas in Wards 8, 9, and 10, Nala–3B plays a critical role in addressing localised flooding, enhancing conveyance capacity, and strengthening stormwater resilience in some of Haripad's most vulnerable urban zones.

Table 33.3 presents the hydraulic and structural characteristics of the proposed Nala 3B. This channel is subdivided into multiple segments, each defined by its start and stop

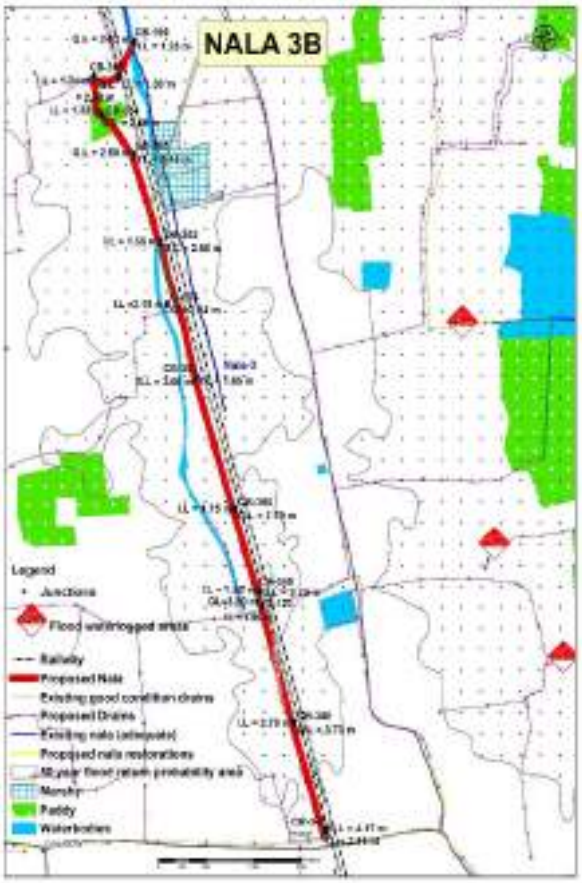


Figure 33.13: Map showing details of Proposed Nala 3B

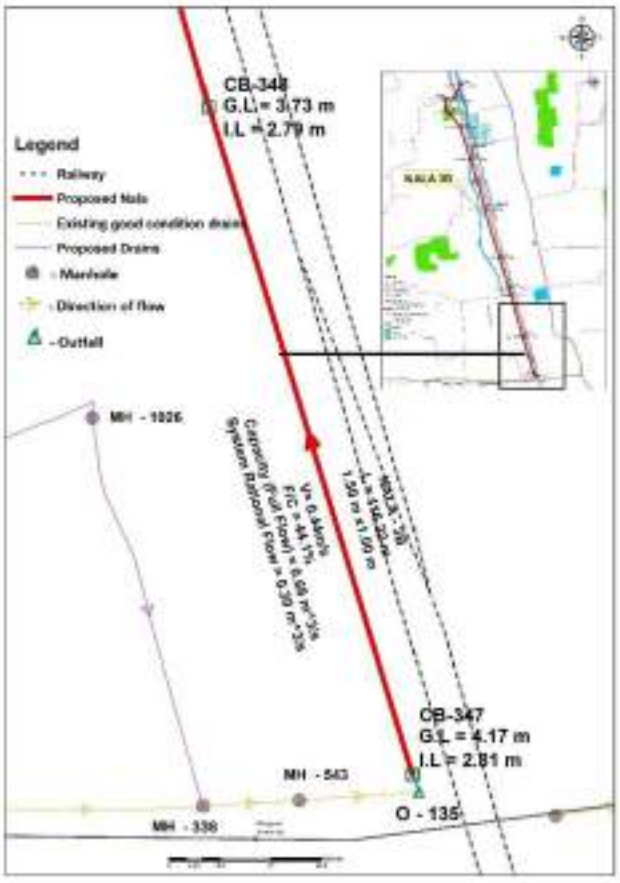


Figure 33.14 : Map showing details of Design Parameters and Outfall locations for Nala 3B

nodes, invert and ground elevations, flow velocity, full-flow capacity, material type, and cross-sectional geometry. The invert levels (I.L.) and ground levels (G.L.) exhibit a consistent downstream gradient, effectively supporting gravity-driven flow. The implementation of Nala-3B is expected to significantly reduce waterlogging and flood risks in critical locations, including the railway underpass at Haripad Town Junction, as well as the surrounding areas of Nelpurakadavu and Aranazhika Temple. While Table 33.3 below showcases the details of a representative stretch, the details of all proposed nala stretches can be seen in Annexure IV of this Master Plan.

B. Nala 1C1

Nala 1C1 originates from catchment basin CB 385, located within a paddy land near Kilikkakulangara Jn. in the northern part of the municipality. The channel flows westward through marshy areas and paddyl fields before merging with the existing Nala 1C at CB 51. These marshy areas and paddy fields enhance infiltration and act as natural retention basins during peak rainfall events.

Figure 33.15 and Figure 33.16 illustrate details of proposed Nala 1C1, highlighting various segments and network components. The proposed drainage network comprises existing and proposed nala alignments (blue and red lines respectively), existing nalas with inadequate capacity (yellow lines), proposed new drains (purple lines), outfall locations, manholes, and catch basins (CB). Nala 1C1 lies within the 50-year return period flood zone, making it a priority intervention for safeguarding vulnerable urban areas. With a total length of 824.48 meters, the channel collects runoff from roadside drains and nearby residential areas before discharging into Nala 1 at outfall O-161. By directing this flow into the larger Nala 1 system, Nala 1C1 enhances drainage efficiency and reduces localised flooding risks, particularly in built-up zones in the north-western sector of the town.

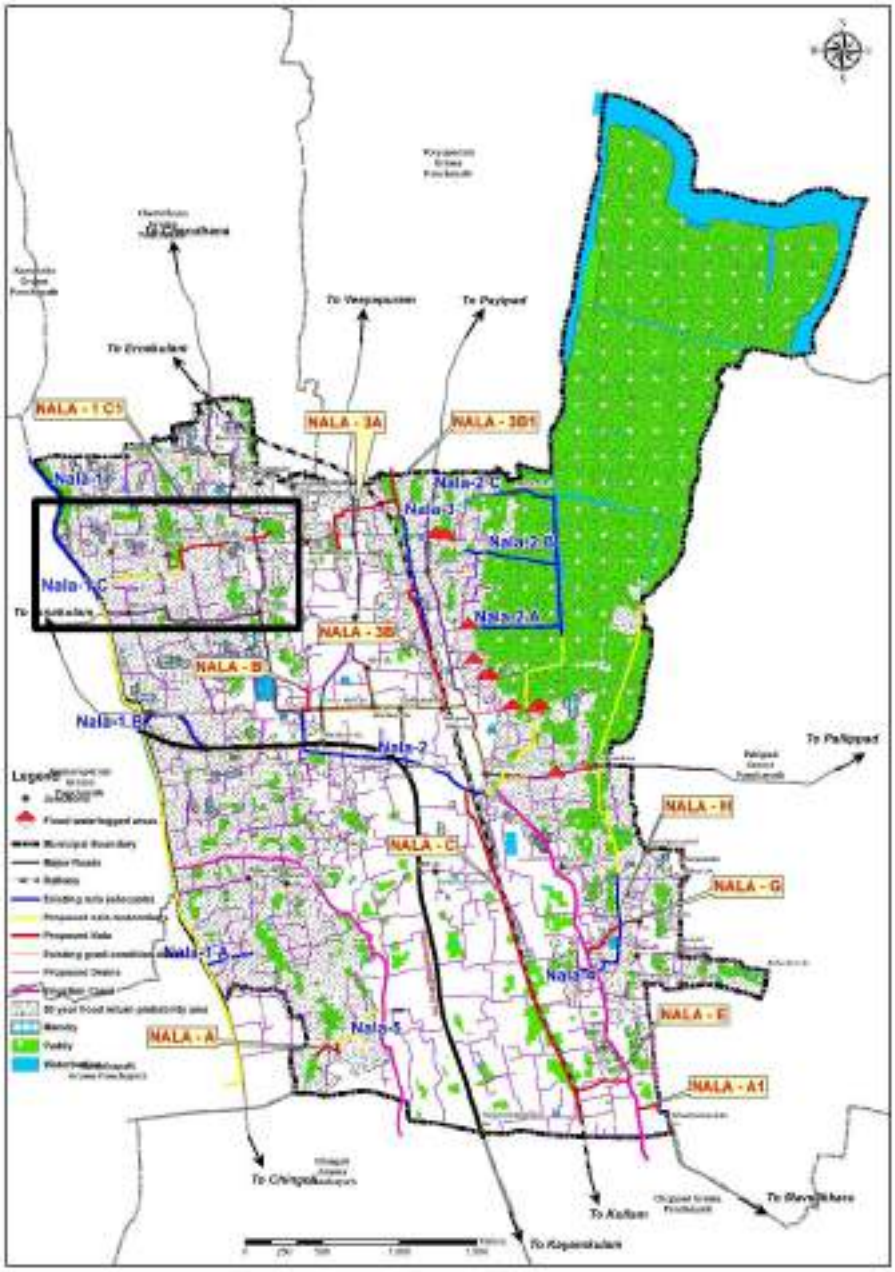


Figure 33.15 : Map showing details of Proposed Nala 1C1

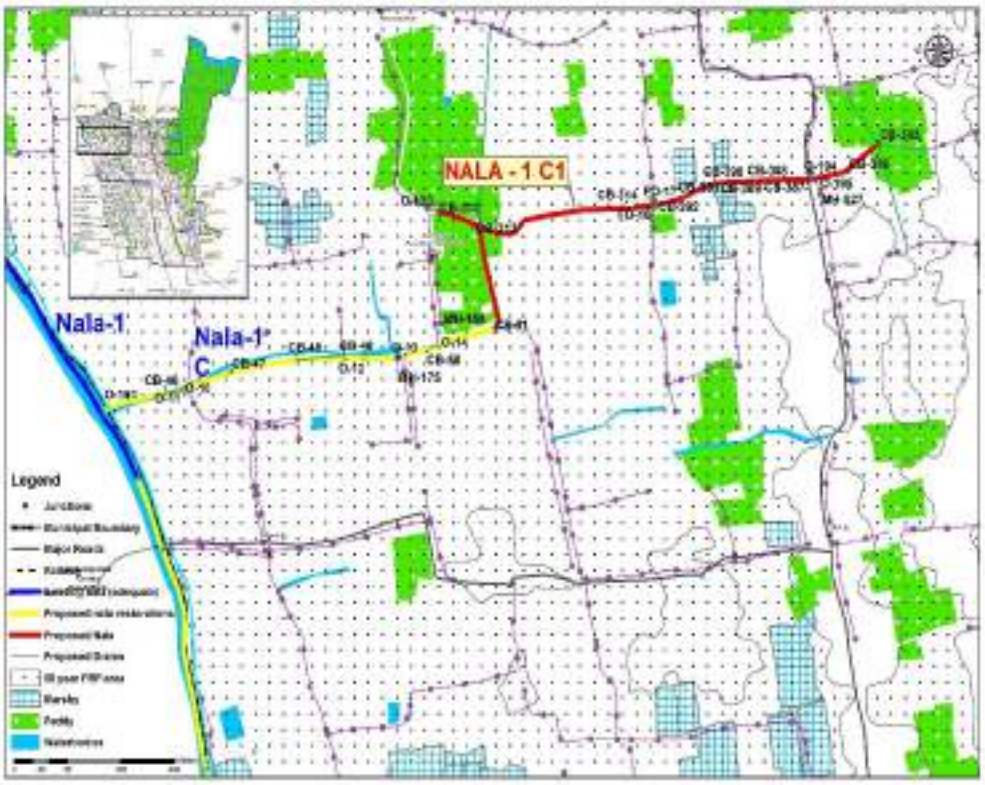


Figure 33.16 : Map showing details of various segments of Nala 1C1 (Part)

Table 33.4 summarises the hydraulic and structural characteristics of Nala 1C1. The nala is divided into multiple segments, each characterised by start and end nodes, invert and ground elevations, flow velocity, full-flow capacity, material type, and cross-sectional geometry. The steady downstream gradient of the invert and ground levels ensures efficient gravity-driven flow. While Table 33.4 gives the detail of a representative stretch, the details of other stretches can be seen in Annexure IV of this Master Plan.

Table 33.4 : Details of Design Parameters of Nala 1C1

ID	Label	Start Node	Stop Node	Invert (Start) (m)	Invert (Stop) (m)	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	System Drainage Area (m²)	Manning' s n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow (m³/s)	Flow / Capacity (Design) (%)	Span (m)	Rise (m)	Section Type	Material
9936	Nala-1 C1	CB-385	CB-386	1.55	1.5	2.5	2.84	61.38	1.8	1,66,512.50	0.013	1.06	0.99	0.99	0.99	99.9	1.1	1.0	Rectangular Channel	Concrete
9937	Nala-1 C1	CB-386	CB-387	1.5	1.45	2.84	3.17	52.09	2.74	1,73,237.50	0.013	0.99	1.07	1.03	1.03	95.7	1.1	1.0	Rectangular Channel	Concrete
9938	Nala-1 C1	CB-387	CB-388	1.45	1.4	3.17	3.56	43.57	3.1	2,79,400.00	0.013	1.14	1.48	1.66	1.66	98.8	1.5	1.0	Rectangular Channel	Concrete
9939	Nala-1 C1	CB-388	CB-389	1.4	1.38	3.56	3.81	55.15	3.9	2,33,962.50	0.013	0.79	1.7	1.68	1.68	99.2	2.1	1.1	Rectangular Channel	Concrete
9940	Nala-1 C1	CB-389	CB-390	1.38	1.37	3.81	3.5	45.4	4.35	2,92,634.40	0.013	0.75	1.76	1.74	1.74	98.4	2.5	1.2	Rectangular Channel	Concrete
9941	Nala-1 C1	CB-390	CB-391	1.37	1.26	3.5	2.63	41.68	4.13	3,01,358.40	0.013	0.78	1.84	1.79	1.79	97	2.5	1.2	Rectangular Channel	Concrete
9942	Nala-1 C1	CB-391	CB-392	1.26	1.25	2.63	2.5	48.72	4.49	3,07,824.30	0.013	0.74	1.9	1.83	1.83	96	2.5	1.3	Rectangular Channel	Concrete
9943	Nala-1 C1	CB-392	CB-314	1.25	1.33	2.5	2.5	34.23	4.18	4,14,509.40	0.013	1.17	3.24	1.46	2.46	76	2.5	1.3	Rectangular Channel	Concrete
9935	Nala-1 C1	CB-314	CB-313	1.33	1.28	2.5	2.38	136.34	4.97	4,14,509.40	0.013	0.81	2.47	1.46	2.46	99.6	2.6	1.4	Rectangular Channel	Concrete
9936	Nala-1 C1	CB-312	CB-313	1.5	1.28	2.5	2.38	64.35	1.78	17,494.20	0.013	1.07	0.02	0.22	0.22	7.4	1.5	1.0	Rectangular Channel	Concrete
9937	Nala-1 C1	CB-313	CB-31	1.28	1.26	2.38	2.44	140.07	9.35	9,17,800.00	0.013	0.87	3.48	3.31	3.31	90	4	1.5	Rectangular Channel	Concrete

33.5.4 Proposed Road Side Drains

Detailed segment-wise information on the roadside drainage network is provided in Annexure V, offering a comprehensive technical basis for planning, design, and implementation. Each row in the table corresponds to an individual drainage segment, identified by a unique ID and label, and captures its physical, hydraulic, and structural characteristics. The data include ground level and invert elevations, segment length, wetted perimeter, hydraulic radius, flow velocity, and discharge capacity, enabling a clear assessment of drainage performance under design storm conditions.

In addition, the table presents key design and adequacy indicators such as the flow-to-capacity ratio and the contributing drainage area, which help identify stretches that are under-performing or at risk of surcharge during heavy rainfall. Structural details including section type (open/covered), construction material, span, rise, and cross-sectional geometry are also documented to guide standardisation, upgrading, and maintenance decisions. Collectively, this dataset serves as a critical reference for engineering evaluation, prioritisation of improvements, routine maintenance planning, and future system upgrades within Haripad's roadside drainage network.

Table 33.5: Details of existing drains having good capacity and proposed drains (Sample Segment)

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth /Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
3477	Prop (Polyline)-1341	MH-1026	MH-338	3.5	4.11	2.77	2.74	67.5	1.4	0.011	0.58	0.35	0.13	36.7	99.9	6,772.50	Box	Concrete	0.91	0.61
5437	EX (Polyline)-1338(2)	MH-338	MH-543	4.11	3.87	2.74	2.73	15.97	3.18	0.019	0.63	0.89	0.77	86.9	68.4	49,255.60	Box	Concrete	1.83	0.91

Table 33.5 presents a sample of the hydraulic and structural characteristics of both existing drains having good capacity and proposed drains. The table provides a comprehensive technical profile of each drainage segment, capturing essential parameters such as invert and ground elevations, scaled segment length, flow velocity, full-flow discharge capacity, section type and dimensions, and material specifications. By documenting both existing hydraulically adequate drains and proposed new drains within a single analytical framework, the assessment enables a system-wide understanding of conveyance performance. This integrated approach ensures continuity in the drainage network, avoids redundant interventions, and maximises the efficiency of stormwater movement across urban catchments—thereby reducing the likelihood of localised waterlogging and flood incidence.

Spatial analysis of inundation patterns indicates that the north-eastern portion of Haripad experiences the highest concentration of waterlogged areas, making it the most critical zone for immediate intervention. Strengthening and extending roadside drains in these wards will enable faster evacuation of stormwater from upstream urbanised areas and prevent backflow and ponding near strategic infrastructure, including the railway line, major road corridors, and key junctions. Improvements in this sector will also have a cascading benefit by lowering hydraulic pressure on downstream drains and nalas, thereby enhancing overall system resilience.

Based on this prioritisation, an initial 12.92 km of roadside drainage network has been identified for construction and restoration in the north-eastern part of the town. Using average cross-sectional dimensions and standard engineering thumb rules, the indicative capital cost is estimated at approximately ₹12.92 crore. This estimate is preliminary and intended for planning and budgeting purposes only. A Detailed Project Report (DPR) will be essential prior to implementation to undertake detailed topographic and utility surveys, confirm hydraulic design parameters, finalise drain cross-sections and materials, address site-specific constraints, and update cost estimates with greater accuracy.

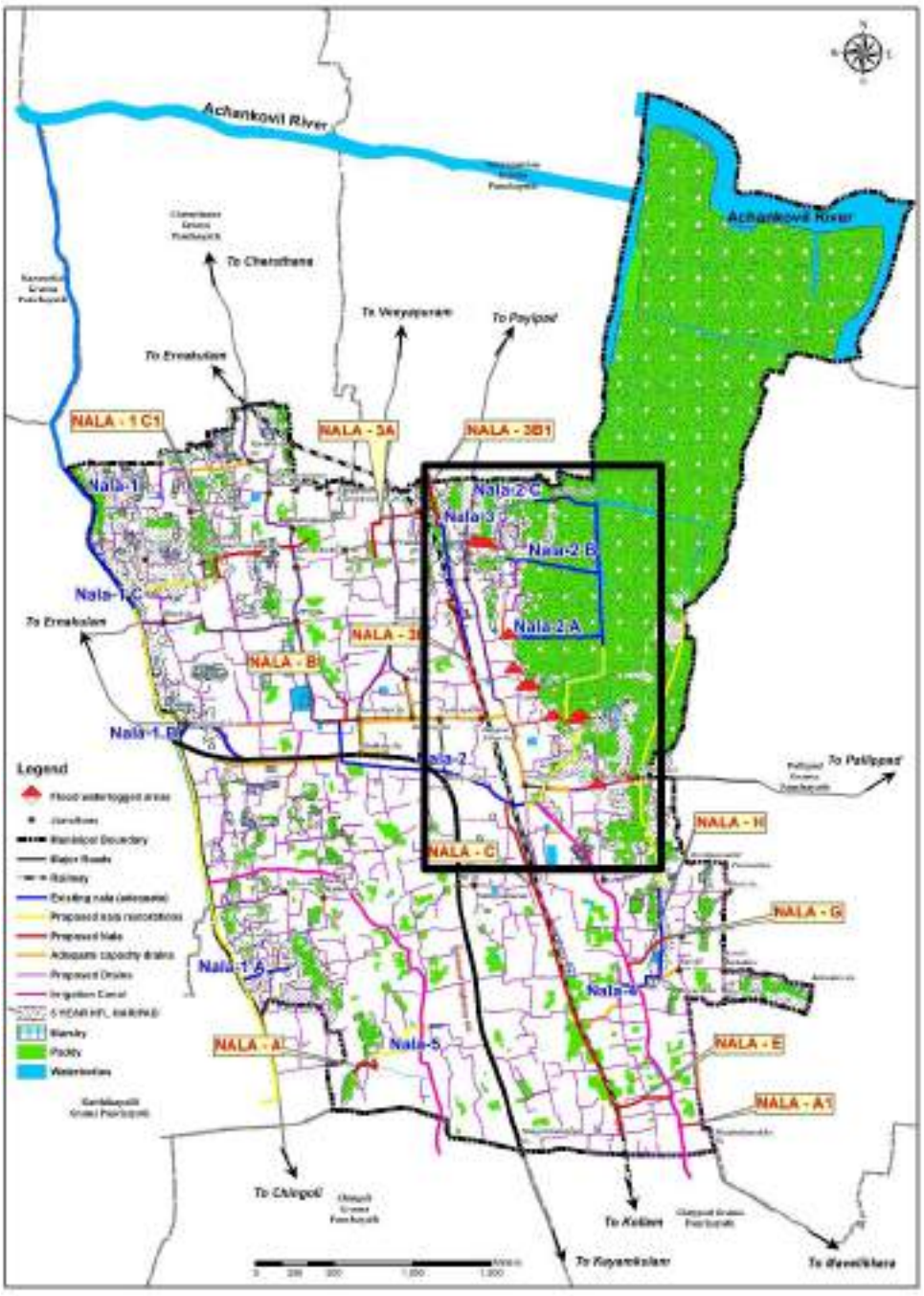


Figure 33.17 : Map showing Priority Intervention areas for Roadside Drains

Accordingly, the phased construction and rehabilitation of approximately 12.92 km of priority roadside drains has been identified as the most critical first-phase intervention under the Drainage Network Plan and Redevelopment Project. This action is central to achieving effective flood mitigation, safeguarding vital infrastructure, and enhancing Haripad's long-term urban resilience and climate adaptability

The integration of newly proposed nalas with restored existing nalas, in conjunction with an expanded network of roadside drains, will establish a robust and interconnected stormwater conveyance system for Haripad. This integrated drainage framework is designed to ensure uninterrupted flow paths, eliminate missing links, and enhance the overall hydraulic performance of the town's drainage network, thereby significantly reducing the incidence of waterlogging and urban flooding.

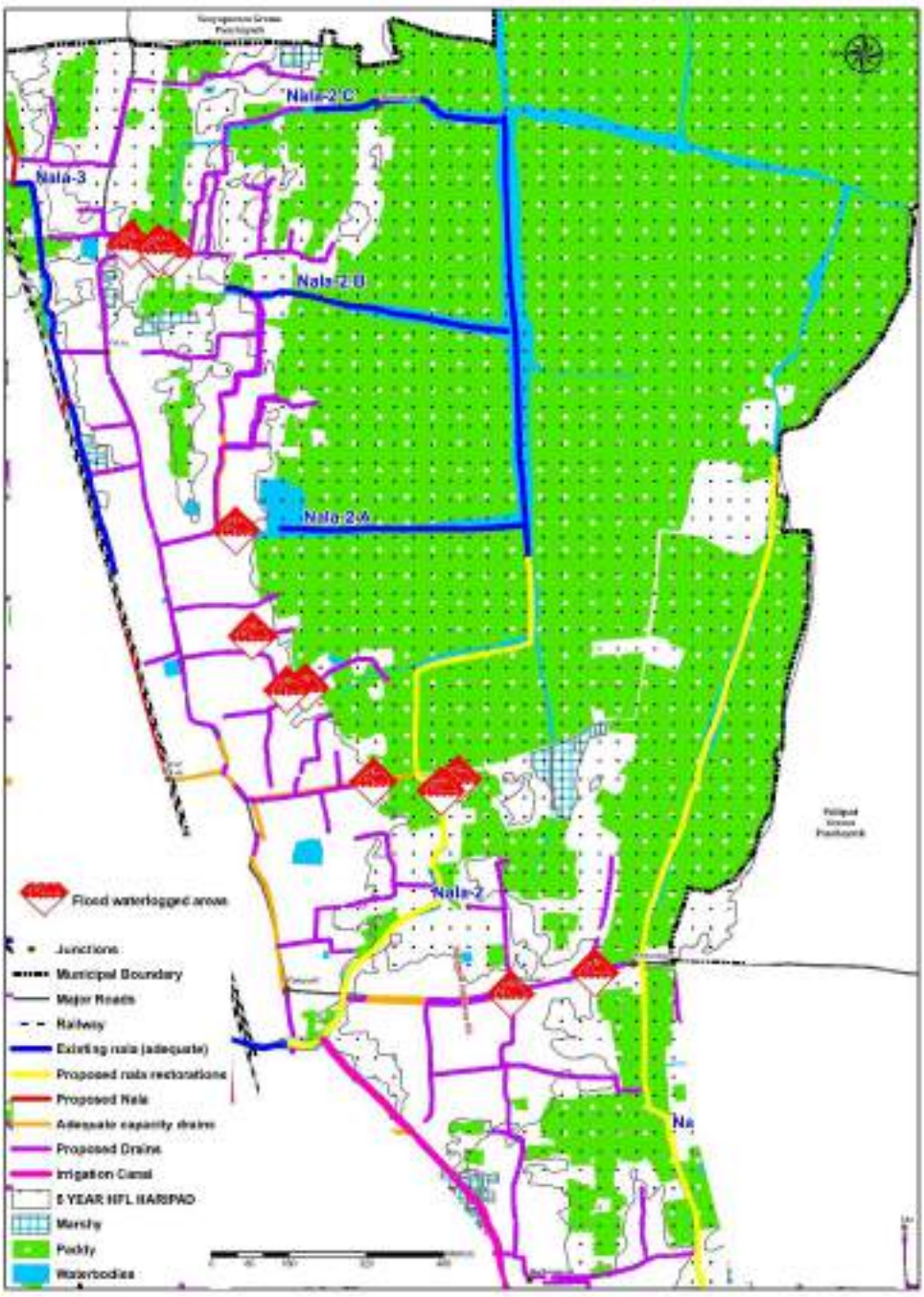


Figure 33.18 : Map showing location of Proposed Roadside Drains identified for Prioirty Intervention

Building on this strengthened conveyance system, the next critical step is the implementation of complementary stormwater management measures that address runoff generation at the source. Such measures are essential to regulate excess rainwater before it enters the drainage network, particularly in dense built-up areas where impervious surfaces intensify runoff volumes. Source-level interventions will help moderate peak flows, reduce pressure on nalas and roadside drains, and minimise the risk of overflow during high-intensity rainfall events.

Together, the combined approach of network-level drainage improvements and decentralized stormwater management measures will enhance Haripad's ability to manage extreme rainfall

events more effectively. This integrated strategy will not only reduce waterlogging in urban areas but also strengthen the town's long-term resilience to climate variability and changing rainfall patterns, ensuring a more sustainable, reliable, and climate-responsive urban water management system.

33.6 Stormwater Management Measures

33.6.1 Conservation of Paddy lands and Rejuvenation of Water Bodies

Haripad town has many waterbodies and paddylands that play an important role in controlling excess rainwater. These areas act as natural storage spaces, holding floodwater and reducing its impact across the town. Over the years, however, several waterbodies have lost their function and are no longer properly connected to their catchments. Restoring these systems can significantly reduce flooding, as they serve as natural storage and recharge basins. In some locations, nalas originate from waterbodies or paddylands, while in others they discharge water into them, thereby improving floodwater conveyance. Protecting and conserving paddylands will also enhance groundwater recharge, filter pollutants, and provide long-term flood protection. As a step towards this, the following projects have been identified as part of the Master Plan, the details of which are discussed in its respective chapters:

- Mangrove Fringe along canals and agricultural fields: This is a climate-resilience initiative aimed at protecting Haripad's flood-prone agricultural areas along the Achankovil stretch from saline intrusion and seasonal flooding. By establishing scientifically planned mangrove buffers along vulnerable canals, riverbanks, and field edges using native species such as Rhizophora, Avicennia, and Acanthus, the project will stabilise soils, reduce erosion, and act as a natural barrier against salinity. This nature-based intervention will enhance biodiversity, restore multi-crop farming potential, safeguard farmlands and settlements, and strengthen Haripad's long-term agricultural sustainability and climate adaptation capacity. The details of this are discussed in Chapter 34 of this Master Plan.
- Padashekaram Revitalization & Smart Irrigation Network: The project focuses on strengthening Haripad's traditional agricultural systems by improving irrigation efficiency, drainage performance, and climate resilience across major and minor padashekarams. The initiative combines bund strengthening, canal rehabilitation, desilting, and improved farm access with smart, sensor-based irrigation and regulator systems to ensure timely water management and effective drainage. By reducing flooding, saline intrusion, and crop loss while enabling multi-cropping, the project enhances agricultural productivity and livelihood security. Integrating traditional water management practices with modern automation, the initiative positions Haripad as a model for climate-adaptive and drainage-efficient agriculture in Kerala's coastal region. The details of this project are discussed in Chapter 36 of this Master Plan.

33.6.2 Provision of Green Infrastructure

Green infrastructure like rain gardens, bioswales, and permeable pavements manage stormwater close to where it falls. By slowing down, storing, and allowing water to soak into the ground, they help to reduce the amount of runoff entering nalas and drains all at once. This helps prevent waterlogging in built-up areas, lowers the risk of overflow in drainage channels, and protects nearby waterbodies and paddy fields from being overloaded. As a step towards

increasing green infrastructure, the following projects have been identified as part of the Master Plan, the details of which are discussed in its respective chapters.

- **Wetland Park in Ward 11**: The proposed Wetland Park is a strategic, nature-based climate resilience intervention designed to mitigate Haripad's recurring flood and waterlogging challenges. Located within low-lying, hydrologically sensitive areas, the project aims to restore and enhance the natural flood retention and absorption capacity of existing wetlands while integrating them into the town's open-space network. By combining ecological restoration with carefully managed public access, the Wetland Park will function as a flood buffer, biodiversity habitat, and environmental awareness space, supporting disaster risk reduction, climate adaptation, and improved urban liveability. The details of the same has been discussed in Chapter 36- Section 36.4.26 of this Master Plan.
- **Detention and Retention Basins:** A Detention/Retention Basin is proposed as a special zone in Haripad to serve as a key structural measure for flood mitigation and stormwater management. Designed to temporarily detain excess runoff during heavy rainfall and release it in a controlled manner, the basin will reduce peak flows and downstream flooding. As a retention feature, it will also function as a permanent waterbody supporting stormwater storage, groundwater recharge, and natural water-quality improvement. This intervention will play a vital role in enhancing flood resilience, safeguarding low-lying areas, and promoting sustainable urban water management in Haripad. The details of these are discussed in Chapter 31 of this Master Plan.
- **Decentralized Wastewater Reuse Gardens:** The Decentralized Wastewater Reuse Gardens project is a sustainable water management and green infrastructure initiative under the Haripad Master Plan, aimed at safely reusing treated wastewater for gardening, landscaping, and floriculture. In the absence of a centralized sewerage system and given Haripad's dispersed settlements and agricultural plots, decentralized treatment offers a practical and efficient solution. The project proposes small, localized treatment and reuse systems linked to residential clusters, public buildings, and institutions, enabling treated greywater to irrigate parks, road medians, floriculture plots, and community green spaces. This approach reduces freshwater demand, lowers pollution loads on canals and drains, and simplifies operation and maintenance. By supporting organic farming, floriculture, and circular resource use, the initiative enhances environmental quality, strengthens climate resilience, and advances Haripad's transition towards a resource-efficient and sustainable urban future. The details of this projects are discussed in detail in Chapter 34 of this Master Plan.
- **Pachathuruthu – Miyawaki Urban Forest Initiative:** The Pachathuruthu – Miyawaki Forest project is a green infrastructure initiative proposed to enhance urban green cover and ecological resilience in Haripad through the creation of dense, native-species mini forests using the Miyawaki method. Implemented on vacant municipal lands and underutilised public spaces, the approach enables rapid development of self-sustaining forests within limited urban footprints. By introducing diverse indigenous

tree and shrub species, the project will improve microclimate, biodiversity, air quality, and reduce urban heat and surface runoff—addressing Haripad's vulnerability to waterlogging and climate risks. Envisioned as a community-led effort involving residents, schools, and local institutions, Pachathuruthu forests will also function as neighbourhood green pockets and informal learning spaces. Overall, the initiative supports Haripad's goal of becoming a greener, healthier, and climate-resilient town through low-cost, high-impact ecological interventions. The details of this are discussed in Chapter 34 of this Master Plan.

- **Haripad Flood Resilience Program -** Community Awareness & Capacity Building Initiative: This is a community-focused initiative aimed at improving flood preparedness while supporting effective drainage and stormwater management in the town. Given Haripad's vulnerability to monsoon flooding, waterlogging, and drainage congestion—especially in low-lying wards and along the Achankovil stretch—the program emphasizes public awareness, community capacity building, and better coordination during extreme rainfall events. User-friendly print and digital resources will guide residents on flood do's and don'ts, evacuation routes, relief shelters, emergency contacts, and safe practices for keeping drains, nalas, and access routes functional during floods. Complementary training programmes for ward-level officials, volunteers, youth groups, and institutions will strengthen local response, emergency coordination, and drainage-related preparedness. Overall, the initiative aims to build informed communities, improve on-ground flood response, and support the effective functioning of Haripad's drainage system during extreme weather events. The details of this are discussed in Chapter 34 and 35 of this Master Plan.
- **Pilla Thodu - Canal Front Redevelopment**: This project addresses the ecological restoration and neighbourhood-level improvement of a 450-metre stretch of Pilla Thodu between RJ Road and Taluk Hospital Junction in Haripad. Once a functional urban drainage channel, this stretch has deteriorated due to pollution, solid waste dumping, weed growth, siltation, and poor maintenance, resulting in stagnant water, public health concerns, and environmental degradation. The project proposes comprehensive canal rejuvenation through desilting, debris and weed removal, strengthening of the canal bed and sidewalls, and measures to restore continuous water flow and drainage efficiency. Alongside hydraulic restoration, canal edges will be redeveloped in a context-sensitive manner—creating pedestrian walkways, seating, shaded pavilions, landscaping, and basic amenities where space permits, while prioritising structural strengthening, erosion control, sanitation improvement, and safety railings in constrained residential sections. Limited land acquisition will be undertaken only where essential. Overall, the project aims to transform this neglected canal into a clean, safe, and resilient urban edge, improving drainage performance, public health, neighbourhood liveability, and long-term environmental resilience in Haripad. The details of this project are discussed in Chapter 34 of this Master Plan.

Together, the conservation of waterbodies and paddy lands and the provision of green infrastructure provide a balanced approach to stormwater management. When combined with existing drainage improvements, these measures offer a cost-effective and sustainable way to manage stormwater, reduce waterlogging in built-up areas, and strengthen Haripad's resilience against future rainfall and climate challenges. However, its effectiveness depends on the regular maintenance and upkeep of all drains and channels.

33.6.3 No Encroachments on Roadside Drains

Roadside drains should be treated as vital public assets, and no encroachment should be permitted. Any encroachment must be immediately removed and the authorities responsible for stormwater management should ensure that all drains remain encroachment-free. Special drives to identify and remove encroachments from roadside drains should be undertaken regularly to maintain the effectiveness of the drainage system.

33.6.4 No Solid Waste in Roadside Drains

Roadside drains must be kept free from solid waste and silt. No road silt, debris, or solid waste should be allowed to enter or be dumped into the drains. Preventing such dumping is essential to maintain the capacity of the drainage system, avoid blockages, and ensure effective stormwater management across Haripad.

33.6.5 No Construction Inside Roadside Drains

To ensure proper functioning, roadside drains must remain free from any form of construction. In Haripad, the installation of electric posts within roadside drains has reduced their carrying capacity. Such practices should be strictly prohibited. Where the cross-section of a roadside drain has already been compromised, immediate measures must be taken to restore its original carrying capacity.

33.6.6 Maintenance of Stormwater Drainage

A. Inspection and Maintenance of Surface Drainage System

(a) Inspection and Examination: All stormwater management facilities shall be inspected by a qualified engineer minimum twice a year.

(b) Frequency of cleaning of drain: Though, it is impractical to assign cleaning frequencies for each element, all should be maintained before blockage; the storm water drainage system must be inspected and cleaned pre-monsoon, during monsoon, and post-monsoon.

(c) Maintenance procedure: The principal activities in maintenance are:

i. Desilting
ii. Clearing of weeds
iii. Cleaning of obstruction, debris, and blockage
iv. Repairing of lining immediately at the commencement of damage or deterioration

B. Inspection and Maintenance of Storm Water Conduits

Inspection and Examination of Storm Water Conduits: Drainage appurtenances are inspected either directly through visual checks of open channels and pumping stations, or indirectly, which is more common for closed storm conduits and often uses cameras. The choice of method depends on cost, available funds, type of appurtenance, and potential defects.

33.7 Conclusion

The Drainage Plan, also referred to as the Drainage Network Plan and Redevelopment Project, establishes a comprehensive and risk-informed roadmap for strengthening Haripad's stormwater and flood management systems. Grounded in detailed field surveys, hydraulic adequacy assessments, and scientific analysis, the plan systematically addresses existing deficiencies in nalas, roadside drains, and natural waterways while proposing targeted capacity augmentation, network interlinking, and restoration measures. By integrating engineered drainage solutions with nature-based interventions such as wetlands, retention areas, and green infrastructure, the plan moves beyond conventional flood control to a resilient, adaptive urban water management framework. Its phased and prioritised implementation—focusing first on flood-prone and highly urbanised areas—will significantly reduce waterlogging, protect critical infrastructure, and enhance public safety. Overall, the Drainage Plan provides a robust foundation for Haripad's sustainable growth, ensuring long-term flood resilience, improved urban utility performance, and climate-responsive development aligned with the town's future needs.

CHAPTER
34

SECTOR WISE PROPOSALS



The Sector-Wise Proposals chapter outlines focused development interventions across the priority sectors of Haripad, designed to operationalize the town's spatial vision, development concept and policy framework. It presents spatial-level projects and sector-specific recommendations that address the functional needs and growth potential of Haripad, ensuring coordinated and future-ready urban development.

The proposals were formulated through a structured, multi-step process integrating the analytical insights from Parts I and II of this Master Plan, public participation inputs, technical assessments and alignment with relevant state and local policies. Together, these proposals serve as a strategic mechanism that translates Haripad's broader planning objectives into implementable actions on the ground.

All sectoral interventions, except those related to the Traffic and Transportation system, are detailed in this chapter. Recommendations for the Traffic and Transportation sector have been presented separately in the preceding chapter.

Agriculture | Fisheries | Animal Husbandry | Industry | Tourism | Trade & Commerce | Service Industry | Water Supply | Drainage | Solid Waste Disposal | Energy | Education | Health | Housing | Recreation | Other Civic Amenities | Environment | Heritage | Special Concern areas | Governance

34. SECTOR WISE PROPOSALS



34.1 AGRICULTURE AND ALLIED SECTORS

A defining feature that distinguishes Haripad from other urban centers is its strong agrarian base. Preserving and strengthening this character is vital for sustaining livelihoods and ensuring local economic resilience. The proposals for agriculture and allied sectors therefore focus on revitalizing agricultural practices, modernizing animal husbandry and inland fisheries infrastructure, promoting women's participation and youth engagement, enhancing productivity through technological innovations, and rehabilitating underutilized public assets such as ponds and farmlands. In addition, emphasis is placed on developing organized marketing systems through cooperative models and value-added enterprises, thereby improving food security, generating employment, and fostering sustainable rural–urban integration.

The strategy also recognises the importance of climate-resilient farming practices, efficient irrigation management, and strengthening farmer collectives to address challenges such as flooding, salinity, and fluctuating market conditions. By integrating production, processing, storage, and marketing within a coordinated framework, the plan seeks to position Haripad as a model for sustainable, locally anchored agricultural development within Kerala's evolving urban landscape.

34.1.1 AGRICULTURE



Agriculture in Haripad Municipality shall be revitalized and sustained through a comprehensive and integrated approach that balances productivity enhancement with ecological conservation. The strategy emphasizes the protection of paddy fields, wetlands, and traditional padasekharams as critical components of the town's agrarian landscape and natural flood management system. Modernization of farming practices through mechanization support, scientific crop planning, soil health management, and the adoption of climate-resilient crop varieties will be prioritized to address changing rainfall patterns, saline intrusion, and water scarcity. Strengthening irrigation networks, bunds, regulators, and flood protection infrastructure will improve drainage efficiency and water management across agricultural zones. The plan also focuses on reinforcing farmer cooperatives, improving storage, value addition, and market linkages, and promoting farm tourism and allied activities to diversify income streams. Special emphasis will be placed on enhancing women's participation through Kudumbashree initiatives and encouraging youth engagement in agri-entrepreneurship and sustainable farming practices. Collectively, these interventions aim to improve productivity, ensure food security, enhance farmer livelihoods, and preserve the ecological balance and agricultural heritage of Haripad. Some of the proposals aimed at developing the agriculture sector are specified as:

1. **Preserve and utilize agricultural land effectively**
   - Enforce zoning regulations to prevent conversion of paddy fields and wetlands.
   - Promote land pooling and collective farming through Padasekhara Samithis.
   - Rehabilitate unused or abandoned farmlands for cultivation.
   - Planting mangroves to prevent salt water intrusion and flood
2. **Enhance irrigation and water management systems**
   - Construct shutters to control saltwater intrusion.

- Renovate and desilt canals/streams (Pillathodu, Danapadi Thodu, Nelpurakkadavu) for smooth water flow.
- Restore and utilize Pampa Irrigation Project (PIP) canals for irrigation and groundwater recharge.
- Implement micro-irrigation and rainwater harvesting in dry cultivation areas.

3. **Promote climate-resilient and diversified farming**
   - Encourage cultivation of flood-resistant paddy varieties and drought-tolerant crops (millets, legumes).
   - Promote intercropping with vegetables, tubers, flowers and pulses.
   - Implement soil conservation measures to reduce erosion and degradation.
4. **Strengthen market infrastructure and farmer cooperatives**
   - Expand existing Eco-shops and weekly markets to cover more products.
   - Develop farmer-producer companies and cooperatives for collective marketing.
   - Establish value chain infrastructure including storage, grading, processing, and packaging facilities.
5. **Encourage value addition, women's participation, and youth engagement**
   - Promote small-scale food processing units (rice-based products, coconut oil, banana chips, flowers, tuber flour).
   - Provide training and credit and entrepreneurship support to women SHGs and youth groups.
   - Organize capacity-building workshops on agro-based business and market-linked farming.
6. **Rehabilitate and protect wetlands and canals**
   - Implement strict monitoring and control of encroachment and pollution in wetlands.
   - Introduce eco-restoration of degraded ponds and canals.
   - Use wetlands for fish–paddy integrated farming systems.
7. **Introduce modern technologies and urban farming**
   - Promote mechanization (harvesters, tillers) and digital tools for precision farming.
   - Introduce urban farming initiatives (terrace farming, hydroponics, vertical farming).
   - Promote urban and peri-urban farming models such as terrace farming, hydroponics, and vertical farming for residential areas.




Figure 34.1 : Floriculture, Organic Vegetable Farming

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the agriculture sector to systematically advance Haripad's long-term vision, strengthen farm-based livelihoods, and realise the town's aspirations for sustainable, resilient, and inclusive agricultural development.

34.1.1.1 Haripad Agri Samriddhi Kendra - AgriTech, FPO & Cold Chain Resource Centre



Haripad AgriSamriddhi Kendra - AgriTech, FPO & Cold Chain Resource Centre is envisioned as a comprehensive, town-level support ecosystem to anchor Haripad's ambition of becoming a frontrunner in organic vegetable farming, floriculture, animal husbandry, and agro-based value addition in Kerala. While the Master Plan promotes decentralized organic farming, MSMEs, cottage industries, and floriculture clusters across the town, their long-term success depends on a strong institutional and logistical backbone. This project aims to create that backbone.

Table 34.1 : Project Details of Proposed Haripad Agri Samriddhi Kendra - AgriTech, FPO & Cold Chain Resource Centre

Project Details of Proposed Haripad Agri Samriddhi Kendra - AgriTech, FPO & Cold Chain Resource Centre		
Key Plan	Land Ownership	Government
	Ward Number	26
	Project Area	Approx 0.65 Acres
	Survey Number	228(p)
	Project Location	
		

The proposed facility will function as a centralised knowledge, logistics, and enterprise hub supporting farmers, self-help groups, Kudumbashree units, youth entrepreneurs, Farmer Producer Organisations (FPOs), and agro-based MSMEs. The centre will consolidate multiple critical functions- capacity building, training, aggregation, quality control, storage, processing, packaging, and market linkage- within a single integrated campus. The project proposes to strengthen and expand the existing FPO infrastructure at Danapady, transforming it into a professionally managed Farmer Producer Company (FPC) with enhanced governance, higher participation of youth and women, and improved access to markets. Regular training and handholding support will be provided on organic farming practices, floriculture techniques, animal husbandry, pest and disease management, quality certification, post-harvest handling, and compliance with food safety standards.

A key component of the facility will be a Central Collection and Cold Chain Facility, including a mini-warehouse, cold storage units, grading and sorting areas, and a common packaging facility. This will help farmers reduce post-harvest losses, stabilise prices, and ensure consistent supply to urban markets, institutions, tourism establishments, and agro-produce outlets proposed across Haripad. Integrated logistics support will enable efficient aggregation and distribution of produce within and outside the town.



Figure 34.2 : Conceptual visualization of Proposed Haripad AgriSamriddhi Kendra, Haripad

The project will also house an AgriTech Incubation and Training Centre, promoting innovation, entrepreneurship, and technology adoption in agriculture and allied sectors. Start-ups and MSMEs working on value-added products, organic inputs, bio-fertilisers, animal feed, food processing, and agri-tourism services will be supported through mentoring, shared infrastructure, market access, and linkages to government schemes and subsidies. A dedicated Agri Helpdesk will operate within the facility, serving as a one-point contact for farmers and entrepreneurs for technical guidance, scheme information, research inputs, soil and crop advisory services, and coordination with line departments such as Agriculture, Animal Husbandry, Horticulture Mission, NABARD, and Kerala Startup Mission.

The Haripad AgriSamriddhi Kendra - AgriTech, FPO & Cold Chain Resource Centre is envisioned as the institutional heart of the town's green economy- strengthening livelihoods, enabling value addition, promoting inclusive participation of women and youth, reducing wastage, and ensuring that Haripad's organic farming and floriculture vision translates into a resilient, market-linked, and future-ready agricultural ecosystem

34.1.1.2 Agro Produce Outlets



The Agro Produce Outlets project is proposed as a town-level initiative to strengthen Haripad's vision of emerging as a frontrunner in organic vegetable farming and horticulture. Haripad has numerous small and fragmented agricultural plots spread across the municipality, many of which are well-suited for organic cultivation and value-added agro products. While production potential is high, farmers- especially those with small landholdings- often face challenges in aggregation, branding, and direct market access. This project seeks to

bridge that gap by creating a decentralized retail network that directly connects local producers with consumers.

Under this initiative, small-scale, kiosk-based agro produce outlets will be established at prominent locations across the town, particularly in areas with high public and tourist footfall. These outlets will sell fresh organic vegetables, fruits, horticultural produce, and simple value-added products sourced from local farmers. Where required, produce can be aggregated, minimally processed, and packaged to ensure quality and shelf life. The outlets are envisioned to operate on a franchise or collective model, managed by individuals, Kudumbashree units, youth groups, self-help groups, or residents' welfare associations.

Institutional support and capacity-building will be extended through agencies such as the Department of Agriculture, State Horticulture Mission Kerala, Kerala State Youth Welfare Board, Kudumbashree Mission, and other relevant departments. This will include assistance in branding, quality control, pricing, business management, and regulatory compliance. The Agro Produce Outlets project aims to enhance local food self-sufficiency, improve farmer incomes, encourage organic farming practices, and create sustainable livelihood opportunities- particularly for women and youth- while offering residents and visitors easy access to fresh, locally grown produce.



Figure 34.3: Conceptual visualization of a Agro Produce Outlets in Haripad town

34.1.1.3 Padasekharam Revitalization & Smart Irrigation Network



The Padasekharam Revitalization & Smart Irrigation Network project aims to strengthen Haripad's traditional agricultural ecosystem by improving the condition, accessibility, and irrigation efficiency of the town's major and minor padasekharams. Developed in close consultation with the Department of Agriculture, the project responds directly to long-standing challenges faced by local farming communities- particularly the need for better access roads for farm machinery, timely water management, and protection from saline intrusion.

The project proposes a smart, sensor-based shutter control system for bunds and regulators, allowing precise and efficient water flow management across different padasekharams. This

includes the modernization of shutters at Thottappally Spillway to prevent saline water from entering agricultural channels during critical periods. Similar timely interventions are planned for key bunds at Danapady and Pulinkuzhi, where automated or semi-automated operation can significantly improve irrigation reliability.

In addition, the project identifies and addresses site-specific repair needs across multiple padasekharams- such as bund strengthening, canal clearing, drain repairs, and improvement of internal farm access routes to support mechanized farming. Together, these measures will help revive multi-cropping potential, reduce crop loss due to flooding and salinity, and improve long-term agricultural productivity.

Overall, the initiative combines traditional water management knowledge with modern technology, helping create a resilient, farmer-friendly irrigation network that can sustain Haripad's agricultural sector for years to come. Various Padasekharams and the intended repairs/ intervention in them are listed below:

Table 34.2 : Padasekharams and the intended repairs/ intervention

Padasekharams and the intended repairs/ intervention			
Sl. No	**Name of Padasekharam**	**Local Body**	**Proposed works**
1	Padinjare Parambikkeri	Haripad Municipality	Motor Shed, protection wall, thodu clearing
2	Kizhakke Parambikkeri B Block Padasekharam	Haripad Municipality	Ramps
3	Vazhuthanam Padinjaru Thekku Padasekharam	Haripad Municipality	Protection wall, ramps, deepending of thodu
4	Kareeli Padasekharam	Pallipad GP	Protection wall, Ramp
5	Koikalethu Padasekharam	Pallipad GP	Protection wall
6	Kureethara Padasekharam	Pallipad GP	Motorshed
7	Muttathu Vadakku Padasekharam	Pallipad GP	Motorshed
8	Chendenkeri Padasekharam	Pallipad GP	Box Culvert
9	Chalunkal Padasekharam	Cheruthana GP	Ramps
10	Ezhankeri East Padasekharam	Karuvatta GP	Pothumada, Ramp
11	Cheruthuruthu Padasekharam	Cheruthana GP	Protection wall, Ramp
12	Pullamvazhichal Padasekharam	Karuvatta GP	Desilting of thodu
13	Padinjare Pocha Padasekharam	Cheruthana GP	Pothumada, Side protection of muttu
14	Pandy Vadakku Padasekharam	Cheruthana GP	Motor shed
15	Vellokkery Padasekharam	Karuvatta GP	Pothumada

The project has been discussed in detail in Section 36.4.14 of Chapter 36 of this Master Plan.

34.1.1.4 Bio-Fertilizer & Vermicompost Micro Units



The Bio-Fertilizer & Vermicompost Micro Units project is proposed as a key support initiative to strengthen Haripad's vision of becoming a leading hub for organic vegetable farming, horticulture, and sustainable agriculture. With numerous small and scattered agricultural plots across the town, along with growing animal husbandry activities, Haripad generates a steady stream of agricultural residues, animal waste, and biodegradable household waste. At present, much of this organic waste remains underutilised or improperly managed, despite its strong potential for conversion into valuable organic inputs.

This project proposes the establishment of small-scale, decentralised bio-fertilizer and vermicompost units at suitable locations across the municipality. These micro units will process farm residues, animal waste, and segregated biodegradable household waste into high-quality organic manure without the need for heavy machinery or complex infrastructure. The produced bio-fertilizers and vermicompost can be directly utilised by local farmers, thereby reducing dependence on chemical fertilisers, lowering input costs, and improving soil health and long-term agricultural productivity.

In addition to decentralised units, the project also envisions a few centralised town-level processing units where biodegradable waste collected from households and markets can be scientifically treated. This approach supports a circular economy by converting waste into a resource, reducing landfill burden, and improving overall waste management efficiency. The initiative can be implemented through farmer collectives, Kudumbashree units, self-help groups, youth groups, and individual entrepreneurs, with technical and institutional support from the Agriculture Department, Animal Husbandry Department, Suchitwa Mission, and State Horticulture Mission Kerala. Overall, the Bio-Fertilizer & Vermicompost Micro Units project aims to integrate agriculture, waste management, and livelihoods into a sustainable local ecosystem- enhancing farm resilience, generating green employment opportunities, promoting organic practices, and strengthening Haripad's position as a model town for eco-friendly and resource-efficient development

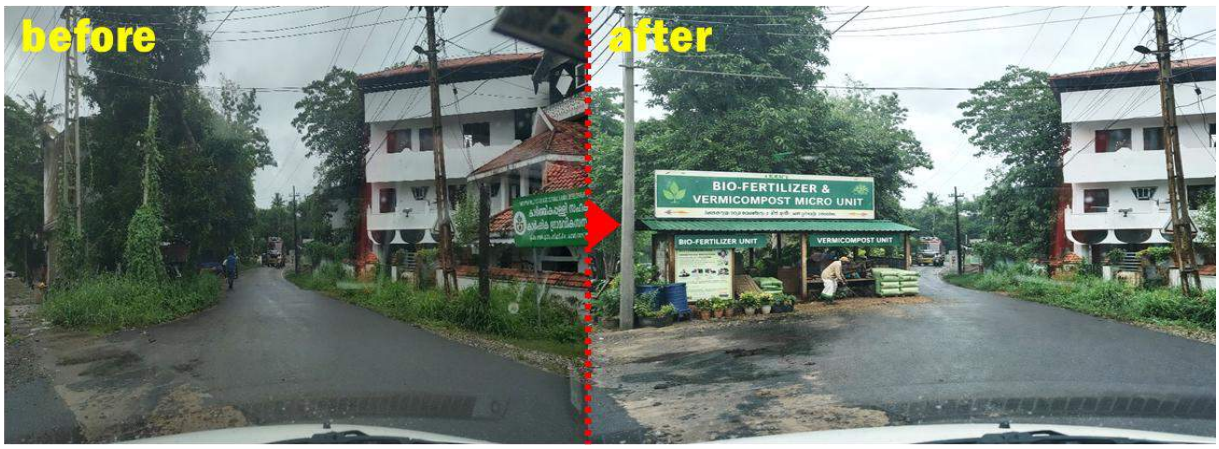


Figure 34.4 : Concpetual view of a proposed Bio-Fertilizer & Vermicompost Micro Unit near the Karthikappally Co-Operative Agricultural And Rural Development Bank, Thulamparampu North

34.1.1.5 Farm to School Nutrition Link Program



The Farm to School Nutrition Link Program is proposed as an education–nutrition–agriculture integration initiative aimed at nurturing healthy food habits and sustainable farming awareness among children in Haripad, with a primary focus on lower primary and upper primary school students. As Haripad aspires to emerge as a leading town for organic farming and sustainable agriculture in Kerala, it is essential to instil these values at an early age, when learning has the strongest and most lasting impact.

The program proposes to introduce concepts of nutrition, organic farming practices, local food systems, and basic cultivation methods as structured co-curricular activities within schools. Students will be exposed to age-appropriate theoretical lessons as well as hands-on experiences such as school kitchen gardens, visits to nearby organic farms, interaction with local farmers, and simple activities related to sowing, composting, and harvesting. Linking locally grown organic produce to school meals, wherever feasible, will further strengthen children's understanding of healthy eating and local food economies.

By connecting schools with local farmers and agricultural institutions, the program will promote awareness of nutritious diets, environmentally responsible farming, and respect for agriculture as a livelihood. In the long term, the initiative is expected to influence healthier lifestyle choices, encourage community participation in organic farming, and support Haripad's broader vision of becoming a sustainable, agriculture-led town.

34.1.1.6 Haripad Vidya Vanam & School Agro-Forestry Initiative



The Haripad Vidya Vanam & School Agro-Forestry Initiative is envisioned as a school-centred environmental education and green infrastructure project aimed at nurturing ecological awareness, sustainable farming values, and climate responsibility among young citizens of Haripad. Anchored in the Kerala Forest Department's Vidyavanam scheme, the project proposes the creation of miniature forests and agro-forestry learning spaces within school campuses across the town.

Schools with land parcels of five cents or more will be encouraged to develop miniature forests using indigenous species, following high-density, multi-layered planting techniques inspired by the Miyawaki method. These green pockets will function as living classrooms, enabling students to experience forest ecosystems first-hand while learning about biodiversity, soil health, water cycles, climate change, and sustainable land practices. The initiative will be

implemented with active student participation through Forestry Clubs, reinforcing long-term stewardship and ownership.

Given Haripad's aspirations to strengthen its agricultural base and promote sustainable livelihoods, the project also integrates basic agro-forestry and nature-based learning, linking environmental education with responsible farming practices. The use of native species, organic soil enrichment, prohibition of exotic plants, and low-maintenance design principles ensures ecological compatibility and long-term sustainability.

In a rapidly urbanising context where open spaces are shrinking and heat-island effects are intensifying, this initiative responds to the urgent need for increasing green cover, improving micro-climate conditions, and fostering environmental resilience. By embedding forests within educational institutions, the project not only contributes to climate mitigation and biodiversity conservation but also helps shape environmentally conscious future generations.

Overall, the Haripad Vidhya Vanam & School Agro-Forestry Initiative aligns with the town's broader vision of sustainable development, ecological balance, and community-led growth. It strengthens Haripad's identity as a town rooted in nature, culture, and knowledge, while investing in long-term environmental and social well-being.



Figure 34.5 : Concptual view of a proposed Vidya Vanam implement implemented at Govt. Girls Higher Secondary School, Haripad



Figure 34.6 : Concptual view of a proposed Vidya Vanam implement implemented at Govt. Model Boys Higher Secondary School, Haripad

34.1.1.7 Haripad Haritha Samriddhi Clusters Project



The Haripad Haritha Samriddhi Clusters project (Collective Organic Farming, Floriculture & Herbal Garden Initiative) envisions a town-wide transformation of underutilised and fragmented agricultural lands into productive, sustainable, and income-generating landscapes through collective organic farming, floriculture, and herbal cultivation. The agricultural character of Haripad is distinct- while the northern and north-eastern parts of the town comprise large, contiguous paddy fields organised under padasekharams, the southern and central parts contain numerous small, scattered agricultural plots, many of which remain fallow for most of the year due to constraints in irrigation, labour availability, and economic viability of paddy cultivation.

Rather than viewing this fragmented land pattern as a limitation, the project leverages it as an opportunity to promote high-value, low-footprint agricultural practices such as organic vegetables, flowers, medicinal plants, and herbs. These forms of cultivation are well suited to small land parcels, require comparatively less water, and can be managed efficiently through group-based models. The initiative encourages farming to be undertaken not only by individual landowners, but also by collectives such as Residents' Welfare Associations, Kudumbashree units, youth groups, and self-help groups, thereby fostering community participation and shared ownership.

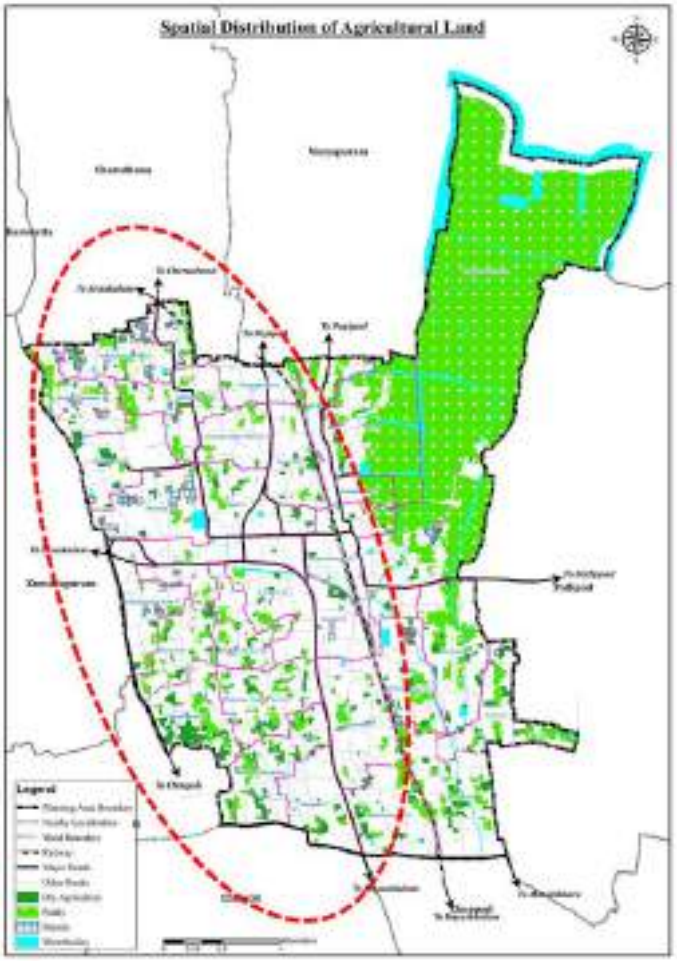


Figure 34.7 : Map showing location of distributed agricultural lands clusters in Haripad town

The project proposes the development of cluster-based farming models, where geographically proximate plots are linked through common planning, training, branding, and market access. Floriculture and herbal gardens will be promoted alongside organic vegetable farming to diversify income sources and reduce risk. These clusters can be supported through the NAWO–DHAN (New

Agricultural Wealth Opportunities - Driving Horticulture and Agribusiness Networking) programme of the Government of India, as well as state-level agriculture and horticulture missions.



Figure 34.8 : Usage of vacant agricultural plots for Organic vegetable farming and floriculture

Beyond improving agricultural productivity and local food security, the project is envisioned as a catalyst for women and youth empowerment, enabling supplementary income generation, skill development, and entrepreneurship at the neighbourhood level. The collective farming clusters will also strengthen Haripad's identity as a green, health-oriented, and agriculture-led town, aligning with its broader aspirations in organic farming and farm-based tourism.

In the long term, the Haritha Samriddhi Clusters can evolve into experiential agro-tourism landscapes, where visitors can engage with organic farms, floriculture plots, herbal gardens, and seasonal activities such as planting, harvesting, and workshops. This integration of agriculture, livelihoods, and tourism will not only enhance the economic resilience of farmers but also reinforce Haripad's cultural connection to land, nature, and sustainable living.

Overall, the project seeks to convert idle agricultural land into vibrant productive assets-keeping Haripad green, economically resilient, socially inclusive, and culturally rooted, while contributing meaningfully to the town's self-sufficiency and climate-responsive development vision

34.1.2 FISHERIES



The fisheries sector in Haripad Municipality shall be strengthened through sustainable inland fish farming, rehabilitation of natural water bodies, adoption of modern technologies, and development of efficient marketing and support systems. The focus will be on improving productivity, ensuring livelihood security, reducing vulnerability to hazards, and promoting inclusive participation, particularly of women and youth, thereby enhancing the sector's contribution to the town's economy, food security, and resilience. The proposals for the improvement of fisheries sector are:

1. **Revitalization of inland fisheries and aquaculture**
   - Rehabilitate and desilt public ponds, canals, and streams for productive fish farming.
   - Identify and utilize unused/abandoned water bodies for aquaculture.

- Promote community-based aquaculture under JMK and cooperative models.
- Promotion of freshwater pearl farming and its allied capacity building

2. **Productivity enhancement through technology**
   - Introduce innovative practices such as Biofloc, pen culture, cage culture, and integrated aquaculture.
   - Provide training and technical support through FFDA and Fisheries Department.
3. **Disaster risk reduction and resilience**
   - Develop contingency plans and insurance schemes for fish farmers against floods and water contamination.
   - Implement biodiversity protection measures in rivers and canals.
   - Strengthen embankments and improve water circulation in aquaculture ponds.
4. **Strengthening marketing infrastructure**
   - Establish local fish collection, processing, and cold storage centres.
   - Promote cooperative fish marketing networks to reduce middlemen exploitation.
   - Live fish vending units to enhance marketing faciliies.
   - Develop digital/online platforms for fish sale and distribution at local and regional levels.
5. **Inclusive participation and capacity building**
   - Encourage women's participation in fish farming, processing, and value-added enterprises.
   - Launch youth-focused programs in modern aquaculture and entrepreneurship.
   - Conduct regular training, capacity building, and exposure visits for fish farmers.
6. **Institutional strengthening & convergence of schemes**
   - Integrate state and central schemes (JMK, PMMSY, FFDA) for coordinated implementation.
   - Subsidies & assistance for padutha pond construction under PMMSY
   - Ensure timely supply of quality fish seed and subsidized feed.
   - Establish a fisheries resource centre in Haripad for technical support and coordination.



Figure 34.9 :Padutha Pond

7. **Environmental sustainability & waste management**
   - Introduce proper waste management systems to prevent pollution in water bodies.
   - Undertake water quality monitoring and disease surveillance.
   - Promote eco-friendly aquaculture practices that conserve aquatic biodiversity.

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the Fisheries sector to strengthen Haripad's aquatic resource base, enhance local fish production, and support sustainable livelihoods. These initiatives aim to promote scientific and climate-resilient aquaculture practices, improve participation of youth and women, and reduce the town's dependence on external fish supplies. By leveraging Haripad's extensive network of ponds, canals, and water bodies, the proposed projects seek to build a

resilient, self-sufficient, and environmentally responsible fisheries ecosystem that contributes to food security, economic diversification, and inclusive growth.

34.1.2.1 Haripad Blue Harvest Initiative - Community Aquaculture Development Programme



Haripad Municipality is endowed with a rich network of freshwater resources, including private ponds, temple ponds, municipal ponds, irrigation channels, and water bodies associated with agricultural fields. These assets offer immense untapped potential for the development of freshwater aquaculture, positioning Haripad to significantly strengthen its fisheries sector and move towards local self-sufficiency in fish production. At present, a substantial portion of the town's fish consumption is met through supplies from external fishing centres, despite the availability of suitable water bodies within the municipal limits.



Figure 34.10 : Inspiration for community aquaculture - A fish farm that was fashioned out of an abandoned pond in Thalavoor, Kollam district

The Haripad Blue Harvest Initiative proposes to systematically promote freshwater aquaculture as a livelihood-based, community-oriented economic activity. The project aims to identify suitable water bodies- subject to ownership consent, environmental clearance, and technical feasibility- for scientifically managed aquaculture practices. Emphasis will be placed on participatory models involving youth groups, women self-help groups, Kudumbashree units, and individual entrepreneurs, thereby expanding livelihood opportunities and strengthening local economic resilience. With technical guidance and financial support from the Fisheries Department, participants will be provided training in pond preparation, species selection, feeding practices, water quality management, disease control, and sustainable harvesting techniques. The project will also encourage low-input, eco-friendly aquaculture methods to ensure long-term environmental sustainability and water quality protection. Where feasible, linkages will be created with local markets, agro-produce outlets, and value-added processing units to improve income realization and reduce post-harvest losses.

In addition to boosting fish production, the project is expected to activate underutilized water bodies, generate employment, enhance nutrition security, and promote entrepreneurship at the

local level. By integrating aquaculture with Haripad's broader vision for agriculture, organic farming, and community-based economic development, the initiative will contribute meaningfully to a diversified and resilient local economy. Overall, the Haripad Blue Harvest Initiative envisions freshwater aquaculture not merely as a production activity, but as a socially inclusive, environmentally responsible, and economically viable sector that aligns with Haripad's long-term development aspirations.

34.1.2.2 Biofloc Aquaculture Initiative



The Biofloc Aquaculture Project is proposed as an innovative, sustainable fisheries initiative for Haripad, aligned with the town's vision of strengthening local food security, livelihoods, and climate-resilient economic activities. Given Haripad's limited availability of large land parcels and increasing pressure on natural water resources, conventional aquaculture practices face constraints. In this context, the biofloc aquaculture system offers a highly suitable solution for urban and semi-urban settings like Haripad.

Biofloc Technology (BFT) is a closed-loop aquaculture system that uses beneficial microorganisms to convert fish waste and uneaten feed into protein-rich bioflocs, which serve as a natural feed source for fish and shrimp. This significantly reduces water exchange, feed costs, and environmental pollution, while enabling high-density fish culture in relatively small tanks or lined ponds. The system minimizes disease risks, optimizes nutrient use, and requires considerably less water compared to traditional aquaculture methods- making it ideal for Haripad's spatial and ecological context.



Figure 34.11 : Biofloc tanks for fish farming

The project proposes the establishment of biofloc units under the Pradhan Mantri Matsya Sampada Yojana (PMMSY), with implementation in identified safe zones that have access to good-quality water and are not prone to flooding. These units can be developed as small-scale, modular facilities using cement tanks or lined ponds, suitable for household-level, group-based, or cluster-based operations. Special emphasis will be placed on encouraging participation from youth, women, Kudumbashree groups, and self-help collectives, thereby enhancing entrepreneurship and employment opportunities.

Alongside infrastructure development, the project will include training and capacity-building programs, technical guidance, monitoring support, and access to subsidies and institutional finance through the Fisheries Department. Integration with local markets and value chains will help ensure economic viability and steady income generation.

The Biofloc Aquaculture Project will position Haripad as a forward-looking town that adopts modern, resource-efficient aquaculture practices. It supports sustainable fish production, reduces dependency on external supply centers, strengthens local livelihoods, and contributes meaningfully to the town's long-term resilience and food security goals.

34.1.2.3 Freshwater Pearl Farming



Freshwater pearl farming is a high-value, eco-friendly aquaculture activity that involves the scientific cultivation of pearls inside freshwater mussels by implanting a small nucleus or irritant, which stimulates the formation of pearls over time. Unlike marine pearl extraction, which is legally restricted and environmentally sensitive, freshwater pearl farming is permitted, sustainable, and well-suited to inland water bodies such as ponds, canals, and tanks.

In the context of Haripad, freshwater pearl farming presents a highly feasible and innovative livelihood opportunity. The town is characterised by an abundance of freshwater resources, including private ponds, temple ponds, canals, and irrigation channels, along with a strong tradition of agriculture and aquaculture. These conditions provide an ideal ecological setting for freshwater mussel culture. Moreover, Haripad's vision of strengthening agri-based and allied sectors, increasing youth and women participation, and promoting value-added rural enterprises aligns strongly with the objectives of pearl farming.

The project proposes the establishment of Freshwater Pearl Farming units using proven technologies developed by institutions such as ICAR–CIFA (Central Institute of Freshwater Aquaculture). Locally available freshwater mussel species such as Lamellidens marginalis, Corbicula, and Parreysia corrugata can be cultured in controlled ponds or tanks. The farming process involves training local farmers and entrepreneurs in grafting techniques, water quality management, and mussel care, supported by technical guidance from fisheries and aquaculture



Figure 34.12 : Freshwater peral farming done using buckets in constructed tanks

departments. Pearls- round, half-round, rice, keshi, and designer pearls- can be produced depending on the implantation method and market demand. From an economic perspective, freshwater pearl farming is a long-term but highly profitable venture. A single farming cycle typically takes 15–18 months, with success rates of 70–80% under proper management. Value addition through designer pearls, jewellery making, and by-products such as shell powder further enhances profitability. Importantly, once the basic infrastructure is established, recurring costs reduce significantly in subsequent cycles, improving returns. The activity also creates secondary employment in pearl processing, design, packaging, and marketing.

For Haripad, the project can be implemented at a cluster or cooperative level, involving farmers, youth groups, Kudumbashree units, and self-help groups. Pearl farming can be integrated with existing aquaculture initiatives and supported under government schemes and subsidies, including fisheries development programs. In addition to strengthening local incomes, the project contributes to diversification of the rural economy, reduced dependence on external fish and aquaculture products, and the promotion of Haripad as a hub for innovative, sustainable agro-aqua enterprises.

Overall, Freshwater Pearl Farming is envisioned as a technically sound, environmentally responsible, and economically viable project for Haripad- one that leverages local water resources, builds entrepreneurial capacity, and adds a unique high-value dimension to the town's agriculture and fisheries sector.

34.1.3 ANIMAL HUSBANDRY



The animal husbandry sector in Haripad is to be improved as a complementary pillar to agriculture by modernizing veterinary resilient and profitable livestock farming, promoting fodder and feed security, enhancing milk and meat production through scientific methods, supporting women and youth entrepreneurship, and building climate and disaster resilience. The goal is to transform animal husbandry into a sustainable livelihood sector that contributes to local food security, employment generation, and economic growth. The proposals aimed at improving this sector are:

1. **Revitalize livestock population and productivity**
   - Introduce high-yield, disease-resistant breeds of cows, goats, and poultry.
   - Provide subsidies and schemes (e.g., Kidari Valarthal) for purchasing livestock.
   - Establish breeding and artificial insemination centers to ensure genetic quality and productivity.
2. **Strengthen veterinary infrastructure and services**
   - Upgrade Haripad Veterinary Polyclinic with modern facilities, equipment, and adequate staff.
   - Construct a dedicated building with laboratories for diagnostics and vaccination services.
   - Expand mobile veterinary clinics to cover all wards.
   - Establish a livestock waste management and disposal facility.
3. **Ensure fodder and feed security**

- Promote cultivation of fodder crops in unused and agricultural lands.
- Set up small-scale fodder processing units (silage, hay, pellets).
- Provide subsidies for organic feed production.

4. **Enhance milk and meat production and marketing**
   - Strengthen existing dairy cooperatives and increase milk collection points.
   - Develop cold storage and processing units for milk, meat, and poultry products.
   - Promote value-added enterprises: cheese, curd, ghee, packaged meat products.
   - Establish a scientific town level slaughter house with proper waste management
5. **Promote women's participation and youth engagement**
   - Provide credit, training, and entrepreneurship support for women SHGs in dairy and poultry.
   - Implement skill development programs for youth in dairy management, poultry farming, and processing industries.
6. **Develop climate and disaster resilience**
   - Prepare livestock disaster management plans with emergency shelters and fodder reserves
   - Maintain a livestock insurance scheme to compensate for disaster-related losses.
   - Train farmers in flood-resilient shed construction and post-disasters disease management.
7. **Integrate animal husbandry with agriculture and allied sectors**
   - Promote mixed farming systems integrating crop, livestock, and poultry.
   - Use animal waste for biogas and organic manure production.
   - Link livestock sector with fisheries and agriculture for circular economy opportunities.
   - Encourage community-based cooperative models connecting agriculture, animal husbandry, and small-scale industries.



Figure 34.13 : Cattle farms in Kerala

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the Animal Husbandry sector to strengthen livestock-based livelihoods, improve productivity and animal health, and support Haripad's integrated agricultural vision. These initiatives aim to enhance supporting infrastructure, promote sustainable and locally suited practices, encourage youth and women's participation, and reinforce the linkages between agriculture, dairy, and allied activities, thereby contributing to a resilient, inclusive, and economically viable rural–urban ecosystem in Haripad.

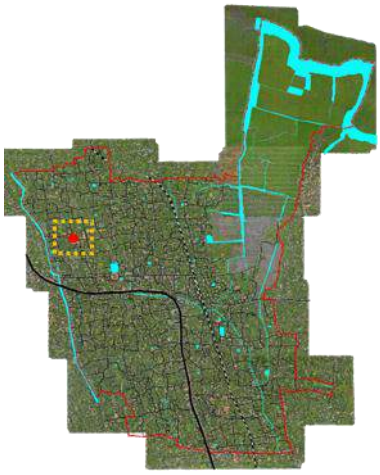
34.1.3.1 Government Veterinary Polyclinic Enhancement - Haripad



The Government Veterinary Polyclinic Enhancement project is proposed as a key intervention to strengthen the Animal Husbandry sector in Haripad Municipality, which is closely linked to the town's agricultural economy and rural livelihoods. As Haripad aspires to emerge as a forerunner in agriculture and allied activities, improving veterinary healthcare infrastructure is essential to support farmers, dairy producers, poultry rearers, and small livestock owners across the municipal area.

The project proposes upgradation and expansion of the existing Government Veterinary Polyclinic to improve its capacity, accessibility, and service delivery. Planned interventions include the addition of consultation and treatment rooms, improved diagnostic and medical equipment, dedicated spaces for vaccination and minor procedures, information and help desks for farmers, waiting areas, and better storage facilities for medicines and vaccines. Provisions for improved water supply, sanitation, power backup, and barrier-free access will also be incorporated to enhance overall functionality.

Table 34.3 : Project Details of Government Veterinary Polyclinic Enhancement

Project Details of Government Veterinary Polyclinic Enhancement		
Key Plan	Land Ownership	Government
	Ward Number	26
	Project Area	Approx 0.16 Acres
	Survey Number	208-3(p), 208-4(p)
	Project Location	
		

The enhancement works will be planned based on detailed consultations with veterinary doctors, departmental officers, local farmers, dairy cooperatives, and livestock owners to ensure that the upgraded facility addresses actual field-level needs. The project also envisages strengthening extension services, farmer awareness programmes, and advisory support related to animal health, breeding, nutrition, and disease prevention.

The enhancement of the Government Veterinary Polyclinic is expected to improve the quality and reach of veterinary services in Haripad, reduce livestock mortality and disease-related losses, support income generation for farmers, and contribute to the sustainable growth of the Animal Husbandry sector as an integral component of the town's rural and agricultural development strategy.

Upgraded diagnostic facilities, improved infrastructure, and expanded outreach services will enable timely disease detection, preventive vaccination drives, and better advisory support to livestock owners. Strengthening the polyclinic will also enhance breeding management, fodder advisory, and extension services, thereby improving overall livestock productivity and ensuring greater resilience of the sector to climate and market-related challenges.



Figure 34.14 : Government Veterinary Polyclinic , Haripad

34.1.3.2 Cattle Feed Farming



The Cattle Feed Farming project is proposed as a supportive initiative to strengthen the animal husbandry sector in Haripad Municipality by ensuring the availability of healthy, affordable, and locally produced fodder. Haripad has a considerable number of vacant and underutilised plots within residential and peri-urban areas, which can be productively used for cultivating fodder crops such as hybrid Napier grass, guinea grass, fodder maize, and leguminous plants. Utilizing these lands for cattle feed cultivation will help maintain soil health, prevent land degradation, and enhance the overall green cover of the town.

The project aims to reduce farmers' dependence on externally sourced and often costly cattle feed, thereby lowering input costs and improving livestock productivity. It also creates an opportunity for residents, farmer groups, Kudumbashree units, youth clubs, and small landholders to engage in fodder cultivation either individually or collectively, generating supplementary income. Surplus fodder can be supplied to nearby dairy farms,



Figure 34.15 : Cattel feed farms

veterinary institutions, and milk cooperative societies, strengthening local supply chains.

By promoting local fodder production, the project supports sustainable livestock management, improves milk yield and animal health, and contributes to a circular rural economy where agricultural by-products and organic manure are efficiently reused. Overall, the Cattle Feed Farming initiative aligns with Haripad's vision of integrated agriculture and animal husbandry development, enhancing self-sufficiency, resilience, and livelihoods at the community level.

An Integrated Development Proposal - Primary Sector (Agriculture, Animal Husbandry & Fisheries)

An integrated development of the primary sector of Haripad would help the town to transform its agrarian identity into a driver of local economic growth and employment.

SECTOR	OBJECTIVES	STRATEGIES / ACTIONS	POTENTIAL LOCATIONS IN HARIPAD
Agriculture	Revitalize farmlands, enhance productivity, and promote modern farming	▪ Rehabilitate unused paddy fields and ponds for cultivation. ▪ Promote organic farming, precision agriculture, and farmer cooperatives. ▪ Develop marketing hubs for value-added products. ▪ Encourage women	▪ Kumarapuram, Pallippad, and Pathiyoor (large stretches of paddy fields). ▪ Haripad Municipality outskirts for vegetable cultivation. ▪ Temple lands (with community participation) for floriculture.
Animal Husbandry	Improve livestock health, fodder availability, and processing facilities	▪ Upgrade Haripad Veterinary Polyclinic. ▪ Establish a modern slaughterhouse. ▪ Promote fodder cultivation on public/unused lands. ▪ Support dairy cooperatives with cold storage and milk processing units. ▪ Train women/youth for poultry and goat rearing.	▪ Near Haripad Polyclinic (NH-66 side) for veterinary facility expansion. ▪ Pallippad/Pathiyoor boundary for slaughterhouse (easy NH access). ▪ Unused municipal/public lands for fodder banks. ▪ Peripheral wards for SHG-based poultry/goat farms.
Fisheries (Inland & Allied)	Strengthen inland aquaculture, fish processing, and disaster resilience	▪ Modernize fish landing centers with storage/ice plants. ▪ Rehabilitate ponds, canals, and backwaters for inland fisheries.	▪ Achankovil river banks for inland fish farming. ▪ Kumarapuram & Pallippad ponds for aquaculture.

		▪ Promote integrated fish–duck–paddy farming. ▪ Support women/youth cooperatives in fish processing and value addition.	▪ Pathiyoor kayal for integrated paddy–fish–duck systems. ▪ Haripad town center for fish markets and processing hubs.
Cross Cutting	Build climate/disaster resilience and integrate sectors	▪ Flood-resilient sheds for livestock. ▪ Crop–livestock–fisheries integrated farming. ▪ Livestock waste for biogas and manure. ▪ Cooperative-based marketing for all three sectors.	▪ Community ponds in Veeyapuram, Kumarapuram, and Pathiyoor for integrated farming. ▪ Haripad town markets for cooperative-based product sales.

34.2 INDUSTRY



The industry sector in Haripad is envisioned to evolve as a key driver of local economic growth by strengthening small and medium enterprises, with a special emphasis on promoting agro-based and value-added industries. The sectoral focus includes encouraging clean and green production, enhancing support infrastructure, improving industrial land use efficiency, and fostering skill-based employment and entrepreneurship. The goal is to position Haripad as a hub for sustainable, locally rooted industries- particularly those linked to agriculture- that generate jobs, diversify the economy, and align with the town's broader development vision. The proposals aimed at improving this sector are:

1. **Coir-based and traditional industries**
   - Strengthen and modernize coir-based industries through government support, technology upgradation, product diversification and marketing assistance
   - Facilitate common facility centers for coir processing, dyeing, and mechanized spinning to enhance productivity.
   - Promote eco-friendly coir products such as geotextiles and mats for both domestic and export markets
2. **Agro-based and food processing industries**
   - Establish agro based small-scale industries focusing on value addition in agricultural and animal husbandry products (e.g., coconut, milk, meat, fish).
   - Create food processing clusters with cold storage, packaging, and logistics facilities.
   - Encourage women and youth entrepreneurship in food preservation, spice grinding, and organic product lines.

- Perfume related industries promotion of perfumery, agarbhattis, floral related industries

3. Handicrafts and cottage industries

- Support revival of local handicrafts and artisan clusters through design training, branding, and marketing assistance.
- Set up craft hubs and weekly artisan markets to promote local products and generate tourism synergy

4. MSME and start-up support

- Develop an industrial facilitation center for assisting MSMEs with approvals, financing, and export promotion.
- Create a start-up incubation hub in collaboration with educational institutions to support innovation in green manufacturing and digital services

5. Sustainable industrial practice

- Encourage solar-powered industrial units and energy-efficient technologies.
- Encourage circular economy practices-recycling industrial by-products and minimizing waste
- Establish a skill development center focusing on coir, agro-processing, and service sector skills

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the industry sector to strengthen Haripad's local economic base, promote MSME-led and agro-based industries, encourage women and youth entrepreneurship, and support sustainable, inclusive, and resilient industrial development aligned with the town's agricultural and tourism-driven character.

The initiatives focus on leveraging locally available raw materials, traditional skills, and emerging market linkages to promote value addition within the region. Priority will be given to agro-processing units, food-based industries, handicrafts, and tourism-linked products, supported by skill development, incubation assistance, and common infrastructure facilities.

Through a resource-efficient and environmentally responsible approach, these interventions aim to generate employment, strengthen local supply chains, and foster a diversified economic structure while ensuring compatibility with Haripad's ecological and spatial planning framework.

34.2.1 Women Entrepreneurship Park



The Women Entrepreneurship Park is proposed as a dedicated capacity-building and enterprise-support facility aimed at strengthening the participation of women in Haripad's local economy. Studies and stakeholder interactions undertaken during the Master Plan preparation indicate that women and youth remain underrepresented in primary production and allied industrial activities, despite the town's strong potential in organic farming, floriculture, food processing, and agro-based value addition.

The project envisions the creation of a structured platform where women- especially members of Kudumbashree units, self-help groups, and young entrepreneurs- can access skill training, entrepreneurship development programs, mentoring, and shared workspaces. The facility will support micro and small enterprises related to organic produce processing, floriculture products, natural foods, handicrafts, and other locally relevant MSMEs. Common infrastructure such as training halls, incubation spaces, basic processing units, packaging support, marketing assistance, and digital literacy facilities will be provided to lower entry barriers for women-led enterprises.



Figure 34.16 : Conceptual view of Women Entrepreneurship Park, Haripad

By enabling women to move from informal, home-based activities to organised and market-linked enterprises, the Women Entrepreneurship Park will enhance livelihoods, improve household incomes, and contribute to Haripad's vision of a resilient, self-sufficient, and people-centric local economy. The project will also act as a social empowerment space, fostering confidence, leadership, and long-term economic independence among women, while strengthening the town's overall development trajectory.

Table 34.4 : Project Details of Proposed Women Entrepreneurship Park, Haripad

Project Details of Proposed Women Entrepreneurship Park, Haripad		
Key Plan	Land Ownership	Government
	Ward Number	26
	Project Area	Approx 0.65 Acres
	Survey Number	228(p)
	Project Location	
		

34.2.2 Haripad Agro-Processing Park & Value Addition Centres

The Haripad Agro-Processing Park & Value Addition Centre is proposed as a key economic infrastructure to support the town's vision of becoming a frontrunner in organic vegetable farming, floriculture, and allied agri-based enterprises. While Haripad has strong production potential, farmers and small entrepreneurs currently face limitations in processing, packaging, storage, and market access, which restricts value realisation and income growth. This project aims to bridge that gap by providing shared, modern facilities that enable local produce to be converted into high-quality, market-ready products.



The centre will offer common infrastructure such as grading and sorting units, cleaning and primary processing facilities, cold storage, packaging and labelling units, quality control support, and basic logistics coordination. These facilities can be accessed by farmers, Farmer Producer Organisations (FPOs), women's collectives, Kudumbashree units, MSMEs, and start-ups through a structured pre-booking and user-fee system, ensuring inclusivity and operational sustainability. Value-added products such as packed vegetables, processed foods, dried flowers, herbal products, and other agro-based items can be developed and marketed through organised channels.



Figure 34.17 : Conceptual view of Haripad Agro- Processing Park

The facility is proposed to be managed by the Haripad Farmer Producer Organisation, thereby strengthening institutional capacity while ensuring transparent, accountable, and farmer-centric governance. By reducing post-harvest losses, improving product quality, and enabling better price realisation through aggregation, grading, processing, and direct market linkages, the Agro-Processing Park will significantly enhance farm incomes. The project is also expected to generate substantial local employment—particularly for women and youth—while creating opportunities for entrepreneurship in allied agro-based MSMEs.

In addition, the facility will promote better integration between farmers, processors, and markets, fostering a more organised and efficient supply chain. The introduction of modern processing, storage, and packaging infrastructure will improve product competitiveness in regional and state-level markets. Overall, the project will play a catalytic role in strengthening Haripad's agricultural value chain, improving economic resilience, and positioning the town as a recognised hub for sustainable agri-business and value addition.

Table 34.5 : Project Details of Proposed Haripad Agro-Processing Park & Value Addition Centres

Project Details of Proposed Haripad Agro-Processing Park & Value Addition Centres		
Key Plan	Land Ownership	Government
	Ward Number	26
	Project Area	Approx 0.65 Acres
	Survey Number	228(p)
	Project Location	
		

34.3 TOURISM



Haripad offers a rich and diverse tourism landscape shaped by its spiritual heritage, agrarian traditions, ecological assets, and living culture. Pilgrimage tourism forms the backbone of the town's visitor economy, anchored by nationally and internationally known religious destinations such as the Subramanya Swamy Temple and Mannarasala Nagaraja Temple, which attract large footfalls throughout the year and peak crowds during festivals like Mannarasala Ayilyam. Alongside this, farm tourism is emerging as a strong avenue, drawing on Haripad's extensive paddy fields, canals, organic farming practices, floriculture, and allied agri-based activities, offering immersive experiences rooted in rural life and sustainability. Village tourism further complements this by showcasing traditional livelihoods, local cuisine, water-based mobility, homestays, and community-led cultural practices, particularly in settlements set amid agricultural and canal landscapes. In addition, heritage tourism holds significant potential through the conservation and adaptive reuse of historic structures, temple ponds, cultural corridors, and traditional urban spaces that reflect Haripad's historical role in regional trade, religion, and governance.

An integrated and well-coordinated approach that connects these tourism avenues through thematic circuits, shared infrastructure, improved mobility, unified branding, and community participation can transform Haripad into a well-rounded and sought-after destination. By linking pilgrimage routes with heritage walks, farm and village experiences, waterfront activities, and cultural hubs, the town can encourage longer stays, diversified visitor experiences, and inclusive local economic benefits. Such convergence will not only strengthen

Haripad's tourism identity but also ensure that tourism growth remains sustainable, culturally sensitive, and deeply rooted in the town's unique character.

34.3.1 Tourism circuit

Haripad occupies a distinctive position as a major religious and spiritual centre in Alappuzha district, marked by a rich concentration of historic temples, churches, and sacred groves that together reflect the deep-rooted cultural and spiritual traditions of the region. Renowned pilgrimage destinations such as the Subrahmanya Swamy Temple and the Mannarasala Nagaraja Temple draw devotees from across Kerala and beyond, especially during major festivals, giving the town a strong and established religious identity.

Owing to its strategic location and good regional connectivity by road and rail, Haripad has significant potential to evolve into a religious tourism hub for central Alappuzha and adjoining districts. From Haripad, pilgrims can easily branch out to multiple religious clusters in the region- temple circuits, church networks, and other sacred landscapes- making the town an ideal base for pilgrimage-oriented travel. With appropriate planning, visitor amenities, wayfinding systems, and coordinated transport and tourism services, Haripad can function as a nodal point that organizes, distributes, and enhances pilgrim movement across the wider region. By strengthening supporting infrastructure, improving public spaces around religious sites, and integrating pilgrimage tourism with cultural, heritage, and local economy initiatives, Haripad can position itself not merely as a destination, but as a gateway to the spiritual landscape of Alappuzha. Such a role would reinforce the town's cultural significance, boost tourism-driven livelihoods, and contribute to sustainable, heritage-led urban development.

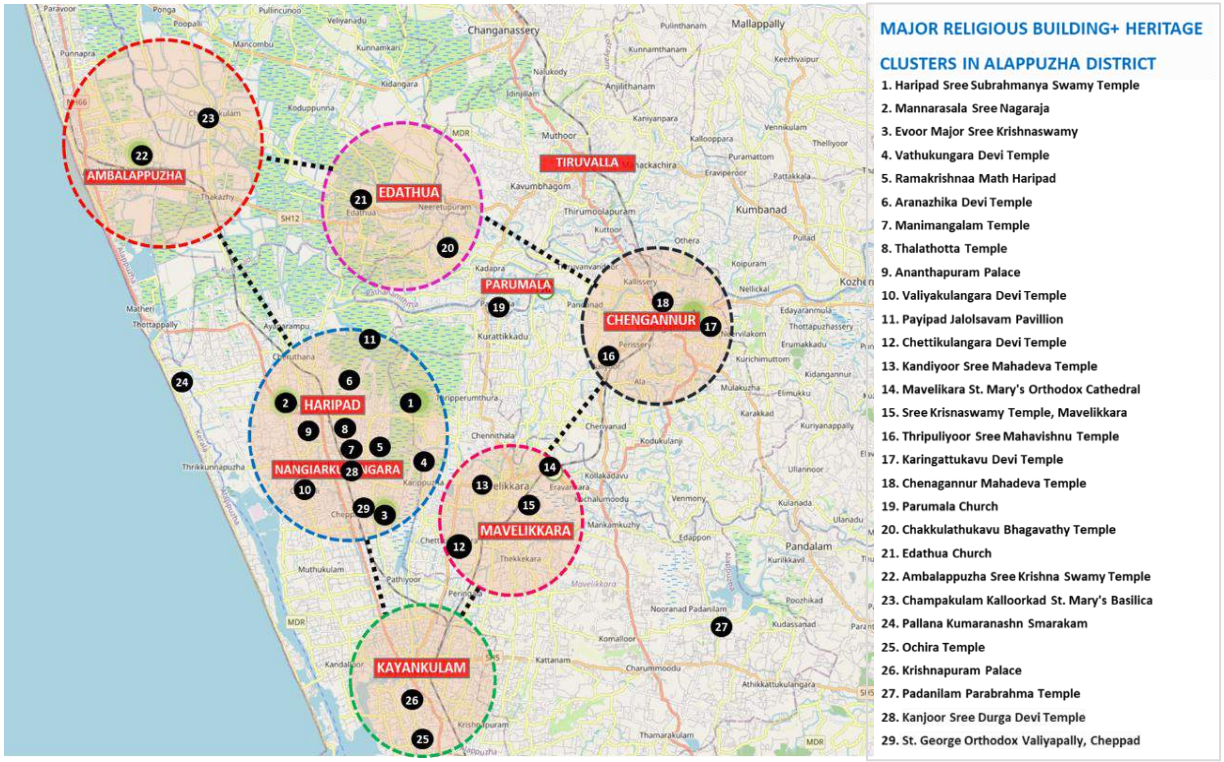


Figure 34.18 : Pilgrimage Cluster of Haripad Region

Eventhough tourism proposals and projects are clustered into specific tourism typologies such as Farm Tourism, Water Tourism, Village Tourism, Pilgrim Tourism, Heritage tourism etc;

generally, the following projects are proposed to support the tourism circuit proposal in Haripad.

34.3.1.1 Ha Ha Yatra - Haripad Heritage and Harmony Yatra



Ha Ha Yatra is envisioned as a Hop-On Hop-Off (HOHO) tourism mobility service designed to offer visitors a seamless, comfortable, and curated way to experience Haripad and its surrounding tourism clusters. The service will operate through a fleet of small, tourist-friendly mini-buses managed in coordination with the Tourism Department, with ticketing and visitor support anchored at the proposed Haripad Visitor's Centre at Karimpalil Palace. Visitors can purchase day passes or multi-day passes, allowing them the flexibility to board and alight at designated stops across predefined heritage, pilgrimage, farm tourism, and eco-tourism routes.

The system enables tourists to explore destinations at their own pace- getting down at a location of interest, spending time exploring, and rejoining the circuit on the next scheduled bus. Clearly marked stops, route maps, digital schedules, and audio-visual interpretation inside buses will enhance orientation and storytelling. The model draws inspiration from successful international HOHO systems such as those implemented in Kuala Lumpur, adapted to Haripad's scale, cultural context, and tourism character.

Ha Ha Yatra addresses a key gap in Haripad's tourism ecosystem by improving last-mile connectivity between dispersed attractions such as temples, heritage sites, canal fronts, farm tourism zones, and village tourism clusters. It reduces dependence on private vehicles, eases congestion, improves safety for pilgrims and visitors, and supports inclusive tourism for the elderly, children, and persons with disabilities. By integrating eco-friendly or electric mini-buses, the project also aligns with Haripad's sustainability and low-carbon mobility goals. Overall, Ha Ha Yatra transforms movement itself into a guided cultural experience- connecting people, places, and stories- while strengthening Haripad's position as a well-organised, visitor-friendly, and culturally rich tourism destination

34.3.1.2 Haripad Visitor Passport



The Haripad Visitor Passport is conceived as an innovative, gamified tourism engagement initiative aimed at encouraging deeper exploration of the town while enhancing visitor experience and local economic participation. The project proposes a physical visitor passport card- supported by a parallel mobile application- that can be purchased at the proposed Haripad Visitor Centre at Karimpalil Palace. Valid for a predefined period (approximately 10 days), the passport will act as a curated guide and engagement tool for tourists visiting Haripad.

The passport will list a range of tourism-related locations and experiences under clearly defined categories such as pilgrimage and heritage sites, farm and village tourism experiences, cultural activities, local cuisine and food spots, shopping and handicrafts, accommodation, and special events. Visitors may choose activities or locations based on their interests and, upon completing each experience, receive a physical stamp or digital verification in the app. Tourists who complete a minimum number of verified visits or activities within the validity period will be eligible for incentives such as commemorative souvenirs, shopping vouchers, food coupons, or discounts on local services.



Figure 34.19 : A representative poster about the Haripad Visitor Passport

Beyond enhancing visitor engagement, the Haripad Visitor Passport also functions as a destination management and revenue-generation tool. Local vendors, shopkeepers, homestay operators, guides, and tourism service providers can opt to be listed in the passport through a structured onboarding process, creating visibility for local enterprises while generating listing or partnership revenues for the municipality. Data collected through the digital platform- such as visitor movement patterns, popular attractions, and spending behaviour- will support informed tourism planning and future upgrades.



Figure 34.20 : Sample representation of Haripad Visitor Passport mobile app and physical card

The Haripad Visitor Passport transforms tourism into an interactive and rewarding

journey, motivating visitors to explore lesser-known destinations, spend more time in the town, and engage meaningfully with local culture and livelihoods. By combining storytelling, incentives, and smart digital integration, the project strengthens Haripad's identity as a welcoming, well-organised, and memorable tourism destination while supporting sustainable local economic growth.

34.3.2 Improvement in existing facilities

- Promote the planned development of canals, paddy fields, and adjoining waterbodies based on detailed environmental and hydrological studies, taking into account changes in riverbanks, wetlands, and broader environmental conditions to ensure ecological balance and climate resilience.
- Explore and promote water-based recreational activities by identifying suitable canal and waterbody stretches for cultural tourism and eco-tourism.
- Ensure active involvement of local stakeholders, including residents, farmers, tourism operators, and community groups, in tourism promotion, management, and maintenance.
- Introduce incentive schemes and cleanliness awards for hotels, homestays, and resorts within the municipal limits to encourage high standards of hygiene, sanitation, and responsible tourism practices.
- Prioritise infrastructure development in key tourist areas, particularly along canal fronts, temple precincts, and major visitor nodes, where the current lack of basic amenities adversely affects health, hygiene, visitor experience, and environmental quality.
- Provide the following essential amenities at all major tourist destinations in Haripad:
    - Lounge and resting spaces
    - Cafeteria or food kiosks
    - Parking facilities
    - Rubbish bins and waste segregation systems
    - Visitor Information Centres
    - Park benches and seating areas
    - Improved road access
    - Pedestrian pathways
    - Drinking water facilities
    - Toilet blocks / public comfort stations
    - Clear directional and interpretive signage
- Ensure that all public amenities are strategically located, clearly visible, universally accessible, and regularly maintained to prescribed standards.
- Mandate cleanliness, routine upkeep, and monitoring of all public facilities through appropriate institutional mechanisms.
- Organise public awareness programmes to promote civic responsibility, cleanliness, hygiene, and community participation in maintaining public spaces and environmental quality. These programmes should aim to foster behavioural change through sustained community engagement, educational campaigns, and collaboration with schools, resident associations, and local organisations to build a culture of shared ownership and collective stewardship of the urban environment.

As part of imporving the existing infrastructure facilties, the following projects have been identified in the town:

34.3.2.1 Bicycle-Friendly Haripad Initiative



The Bicycle-Friendly Haripad Initiative is envisioned as a sustainable mobility project aimed at promoting cycling as a safe, healthy, and convenient mode of transport for both residents and tourists. Given Haripad's relatively compact urban structure, flat terrain, scenic agricultural landscapes, temple corridors, and canal-side stretches, cycling offers a highly suitable and eco-friendly alternative for short-distance travel and recreational movement.

The project proposes the development of a comprehensive cycling ecosystem across the town. Key components include the introduction of dedicated and shared bicycle tracks wherever road widths and urban conditions permit, especially along tourism corridors, heritage routes, canal fronts, and important intra-town connectors. Public bicycle rental systems- modelled on successful initiatives such as the Kochi Metro cycle-sharing system- will be introduced at strategic locations including the railway station, bus stands, town centre, temple precincts, tourism nodes, and major public spaces. These bicycles can be accessed through a mobile application, enabling easy booking, payment, and return at multiple docking stations.

To support safe and convenient usage, the project also includes the provision of well-designed bicycle parking stands, signage, road markings, lighting, and basic repair facilities. Integration with other transport systems such as buses, auto-rickshaw stands, and proposed tourism shuttle services will encourage last-mile connectivity. Awareness programmes, cycling events, and safety campaigns will further promote adoption among school children, youth, office-goers, and elderly users.



Figure 34.21 : Conceptual view of cycle stands at Prathimukham Jucntion

Beyond mobility benefits, the Cycle-Friendly Haripad Initiative contributes to broader town objectives by reducing traffic congestion, lowering carbon emissions, improving public health, and enhancing the overall tourism experience. For visitors, cycling offers an intimate and slow-

paced way to explore Haripad's cultural, ecological, and heritage assets, while for residents it provides an affordable and active daily transport option. Collectively, the initiative strengthens Haripad's image as a people-friendly, climate-responsive, and forward-looking town aligned with sustainable urban development principles. In addition, the initiative supports the creation of safer and more inclusive streets by prioritising non-motorised transport infrastructure such as dedicated cycle tracks, traffic-calming measures, and improved signage. It also complements other town-level strategies related to tourism promotion, environmental conservation, and public health enhancement. By embedding cycling within the broader mobility framework, Haripad can foster a shift towards sustainable travel behaviour while reinforcing its commitment to resilient and low-carbon urban growth.

34.3.2.2 Vathukulangara Temple Premise Amenities Enhancement



The Vathukulangara Temple is one of the prominent religious landmarks in Haripad and holds significant cultural and community value for the surrounding neighbourhoods. Owing to its strategic location between Malikadavu and Nelpurakadavu- two key nodes proposed under Haripad's Farm Tourism and water-based tourism initiatives- the temple precinct has strong potential to function as an important orientation and transit hub for visitors entering the Farm Tourism Zone.

Project Details of Vathukulangara Temple Premise Amenities Enhancement		
Key Plan	Land Ownership	Government
	Ward Number	8
	Project Area	Approx 0.12 Acres
	Survey Number	399/4(p)
	Project Location	

The project proposes the systematic enhancement of amenities within and around the temple premises to support both pilgrims and tourists. Key interventions include the provision of

organised auto-rickshaw stands, bicycle rental facilities, seating areas, shaded resting spaces, traditional street lighting, clear wayfinding and tourism signage, and a small information desk to guide visitors on nearby farm tourism activities, boating routes, and village experiences. Limited, well-designed food and snack outlets selling local refreshments may also be introduced to enhance visitor comfort while supporting local livelihoods.

The proposed upgrades will be undertaken in a sensitive manner, respecting the spiritual character and spatial integrity of the temple precinct, while ensuring universal accessibility, safety, and cleanliness. Improved pedestrian circulation, lighting, and signage will enhance ease of movement and security, particularly during festivals and peak visitor periods. The Vathukulangara Temple Premise Amenities Enhancement project aims to transform the temple surroundings into a welcoming, functional, and well-connected public space that serves as both a spiritual destination and a gateway to Haripad's farm tourism landscape. The project strengthens the integration of religious tourism with emerging rural and experiential tourism initiatives, while improving everyday convenience for local residents and devotees.



Figure 34.22 : Conceptual view of intended developments a s part of Vathukulangara Temple Premise Amenities Enhancement

34.3.2.3 Danapady Thodu Green Spine- Danapady Thodu Green Corridor with Green Vending Zones & Street Food Parks



The Danapady Thodu corridor holds strong potential to emerge as one of Haripad's most vibrant and people-oriented urban spaces. Flowing parallel to the Danapady–Karthikappally Road, the thodu and its canal edges form a continuous linear stretch that can be transformed into a green urban spine integrating ecology, recreation, and local economic activity. At present, the canal edge

remains underutilised despite its strategic location and proximity to key commercial and movement corridors.

This project proposes the development of the Danapady Thodu edge as a landscaped green corridor, focusing on ecological improvement, public accessibility, and placemaking. The canal will be cleaned and its edges stabilised where required, followed by the creation of shaded walkways, seating areas, native landscaping, safety railings, and ambient lighting. These interventions will improve environmental quality, enhance walkability, and create a pleasant public realm along the water edge.

On the opposite side of the Danapady–Karthikappally Road, designated Green Vending Zones and Street Food Parks are proposed as complementary activity spaces. These zones will provide organised, hygienic, and well-designed spaces for local vendors, street food sellers, and small entrepreneurs, particularly those offering local cuisine and value-added agro products. Structured vending kiosks, shared seating, waste segregation facilities, drinking water points, and public toilets will be incorporated to ensure safety, cleanliness, and visitor comfort.

The project also aims to formalise informal vending activity, reduce encroachment on roadways, and improve traffic management along this stretch. By creating a regulated vending environment, the initiative supports livelihoods while enhancing the visual character and functionality of the area. Universal accessibility, climate-sensitive design, and flood-resilient construction will be integral to all interventions.

The Danapady Thodu Green Corridor project seeks to transform a neglected canal edge into a lively, inclusive, and environmentally responsive urban destination. By combining green infrastructure with local food culture and public spaces, the project strengthens Haripad's tourism appeal, supports small-scale economic activity, and offers residents a new recreational and social spine within the town.

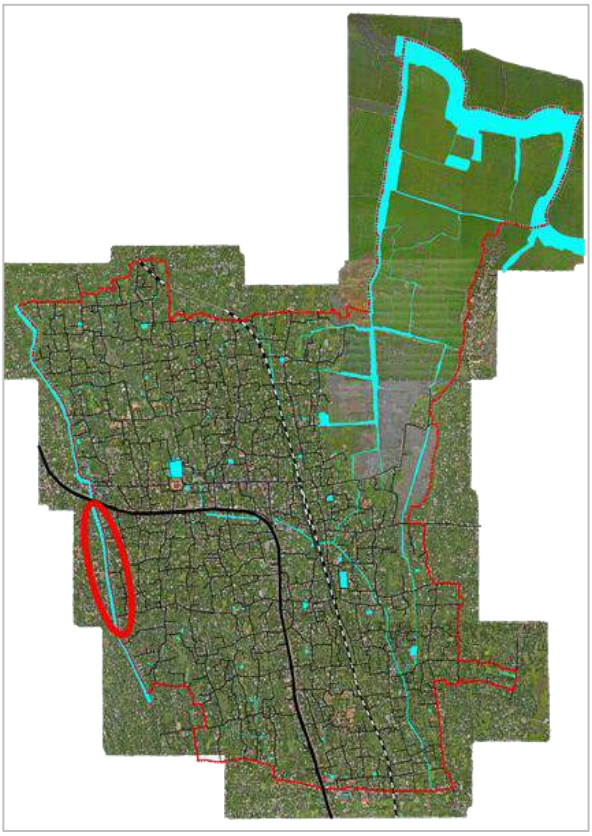


Figure 34.23 : Proposed stretch for Danapady Thodu Green Spine- Danapady Thodu Green Corridor with Green Vending Zones & Street Food Parks

34.3.3 Haripad Paithruka Veedhi/ Haripad Tourism Corridor

The Haripad Paithruka Veedhi / Haripad Tourism Corridor is envisioned not merely as a physical connector, but as a continuous cultural and experiential journey through the most significant quarters of the town. Extending from Haripad Railway Station to Mannarasala Nagaraja Temple, the corridor weaves together heritage, spirituality, ecology, and everyday

urban life into a single, legible experience for both visitors and residents. Conceived as a structured urban spine, it integrates mobility improvements with placemaking strategies, ensuring that movement through the town becomes an engaging and meaningful experience rather than a fragmented transit route.

As one moves along the corridor, a sequence of carefully planned interventions unfolds the story of Haripad. The Gateway to Haripad Visitor Centre and the rejuvenated Karimpalil Palace introduce the town's history and cultural identity, while upgraded stretches such as RJ Road, pedestrian-oriented sections near Ezhikkakath Junction and Town Hall Junction, and the Model Road leading to Haripad Sree Subrahmanya Swamy Temple ensure safe, comfortable, and walkable movement. Traffic calming, improved signage, façade improvements, and coordinated streetscape elements reinforce visual continuity along the route. The revitalised Pilla Thodu canal fronts add an ecological and recreational layer, transforming neglected waterways into active public spaces for rest, interaction, and leisure, while also contributing to urban flood resilience and environmental enhancement.

The corridor further strengthens Haripad's spiritual and cultural fabric through the Temple Corridor and Pond Rejuvenation, the Heritage Corridor connecting Haripad Temple and Mannarasala Temple via Tutu Junction, and the enhancement of the Mannarasala Temple premises. Junction redevelopments at Prathimukham and Tutu act as important pauses along the route, offering places to gather, orient, and transition between activity zones. By integrating tourism promotion with ecological restoration, pedestrian infrastructure, and heritage-sensitive design, the Paithruka Veedhi enhances walkability, public spaces, safety, and engagement with heritage. It transforms the corridor into the living spine of the town—where movement, culture, ecology, and community life converge—positioning Haripad as both a memorable destination and a more liveable and resilient urban centre.

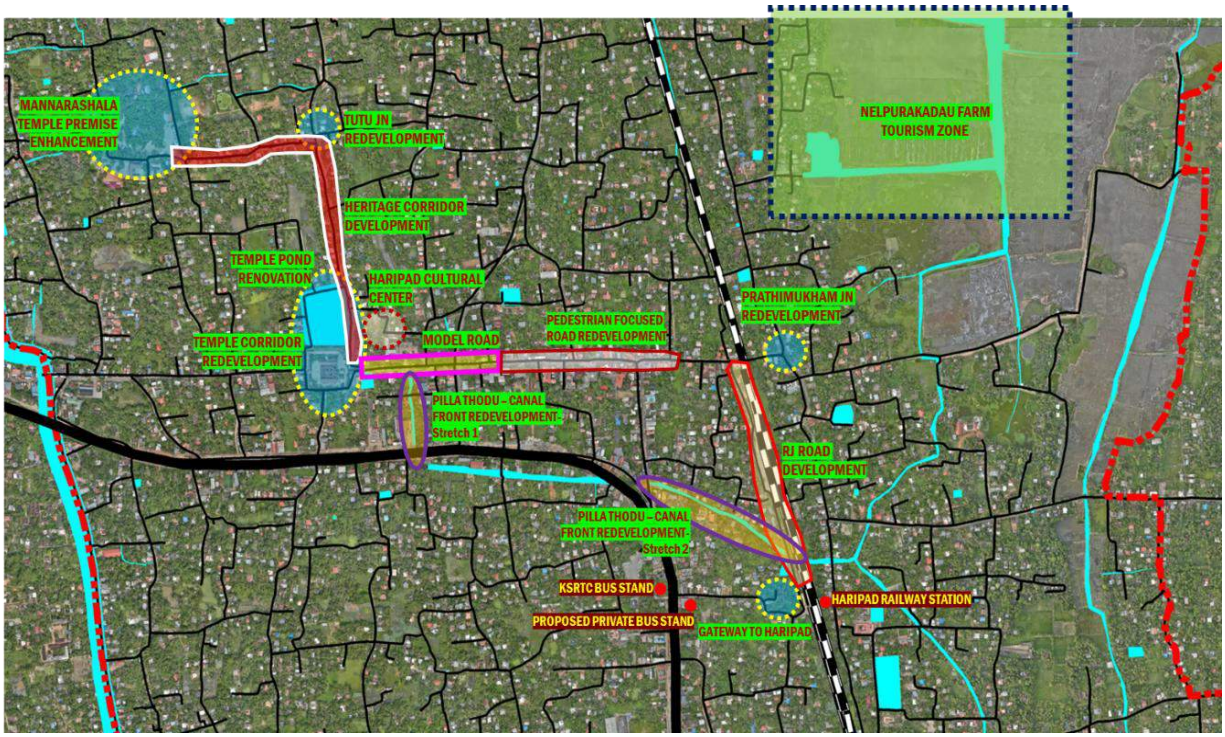


Figure 34.24 : Haripad tourism corridor

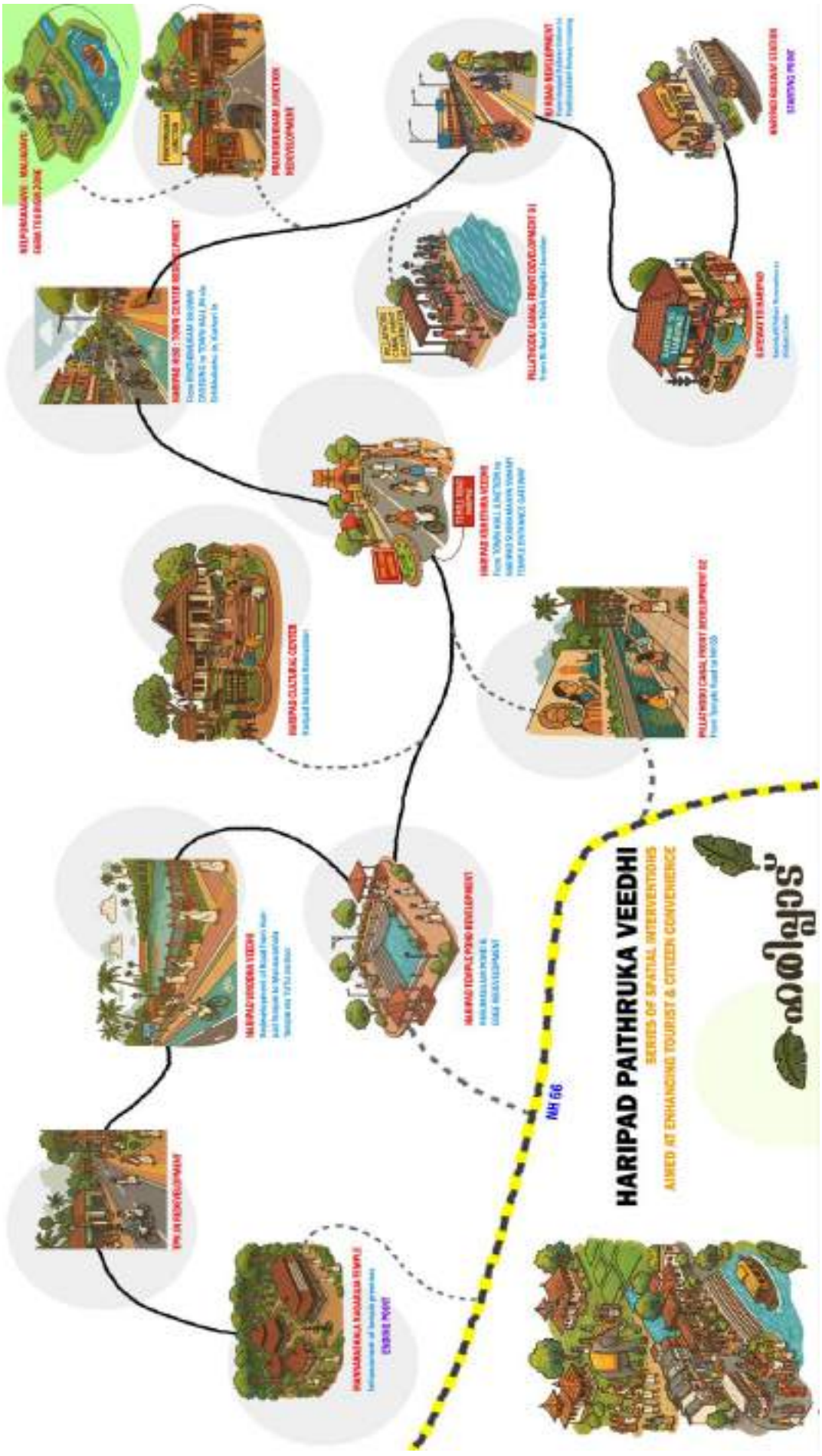


Figure 34.25 : Conceptual representation of Proposed Haripad Paithruka Veedhi stretch

As part of Haripad Paithruka Veedhi the following projects have been identified to achieve a wholistic tourism corridor in the town:

34.3.3.1 Road Redevelopment from NH 66 to Haripad Railway Station



The Road Redevelopment from Haripad KSRTC Bus Stand to Haripad Railway Station project is conceived as a critical mobility and tourism infrastructure upgrade for Haripad. This corridor, which currently operates with an 8-metre right of way, will be widened to a 12-metre urban road to improve capacity, safety, and accessibility. As the principal spine connecting the KSRTC Bus Stand, the Municipal Private Bus Stand, Haripad Railway Station, NH 66, and the proposed "Gateway to Haripad - Visitors' Centre at Karimbalil Palace," the redeveloped road will act as the primary lifeline for tourists, pilgrims, and daily commuters alike.

Table 34.6 : Project Details of Proposed Road Redevelopment from NH 66 to Haripad Railway Station

Project Details of Proposed Road Redevelopment from NH 66 to Haripad Railway Station		
Key Plan	Land Ownership	Road owned by Municipality or PWD. Land on either sides of road are partly private land and partly owned by Travancore Devaswom Board
	Ward Number	16
	Project Area	Approx 1.80 Acres
	Survey Number	463(p), 462(p), 459(p), 470(p), 471(p),
	Project Location	

The project will incorporate enhanced road geometry, well-designed junction improvements, and modern mobility features aimed at improving comfort and safety. Key components include road widening and resurfacing, pedestrian-friendly footpaths, streetlighting, reflective markers, thermoplastic road markings, signage systems, crash-proof bollards, and reflector mirrors at turning points. The visual character of the corridor will be significantly improved through landscaped median strips, planter boxes, tree-lined stretches, and curated wall art along adjacent compound walls- offering an aesthetically pleasing and welcoming approach for visitors entering Haripad. Provision for bus bays, auto/taxi pull-outs,

stormwater drainage upgrades, and designated pedestrian crossings will further ensure smooth movement and reduce congestion during peak tourist seasons and temple festivals. The project aims to strengthen regional connectivity, improve the daily commute experience, enhance tourist convenience, and present Haripad as a well-planned, visitor-friendly heritage town. The project has been discussed in detail in Sector 36.4.3 of Chapter 36 of this master plan.

34.3.3.2 Karimpalil Palace Redevelopment- Haripad Visitors Center



The Karimpalil Palace–Haripad Visitors' Centre project aims to transform one of Haripad's most culturally significant heritage precincts into a welcoming and well-organised gateway for tourists and pilgrims. Strategically located near the railway station, KSRTC stand, and the National Highway 66 junction, the site enjoys exceptional visibility and regional accessibility, making it ideally suited to function as the town's primary visitor interface. Its locational advantage enables it to serve as the first point of orientation for visitors arriving from multiple modes of transport. The initiative centres on the conservation and adaptive reuse of the historic palace structure, ensuring that its architectural integrity and heritage value are carefully preserved. The restored building will be integrated with modern visitor facilities, including information and interpretation services, rest areas, cloak and sanitation amenities, mobility assistance, ticketing support, and flexible community spaces for exhibitions and cultural programming. The project envisions a seamless blend of traditional architectural character with contemporary infrastructure standards.

Table 34.7 : Project Details of Karimpalil Palace Redevelopment- Haripad Visitors Center

Project Details of Karimpalil Palace Redevelopment- Haripad Visitors Center		
Key Plan	Land Ownership	Travancore Devaswom Board
	Ward Number	16
	Project Area	2.65 Acre
	Survey Number	459/11
	Project Location	
		

By combining heritage restoration with high-quality public infrastructure, the proposal reinforces Haripad's identity as a historic temple town and cultural destination. It enhances the overall tourism experience by providing organised amenities, improving visitor management, and reducing congestion in core temple areas. Within the broader urban regeneration framework, the precinct is positioned to function as a vibrant cultural node that catalyses surrounding public realm improvements, stimulates local economic activity, and strengthens the town's image as a well-managed and culturally rooted destination. The project has been discussed in detail in Section 36.4.1 of Chapter 36 of this master plan.

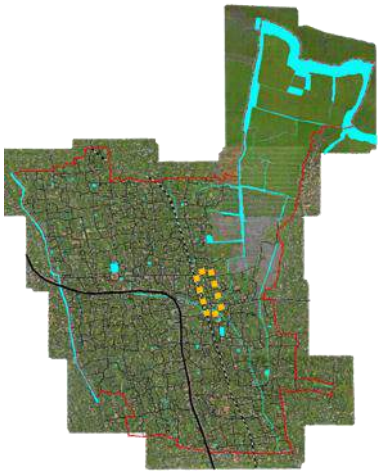
34.3.3.3 RJ Road Redevelopment



The RJ Road Redevelopment project focuses on upgrading the 700-metre stretch connecting Haripad Railway Station to the Haripad Town Junction- one of the most important intra-town links for daily commuters, students, and visitors. This corridor provides direct access to the Town Centre, which houses key civic and social infrastructure, including the court, police station, and two major educational institutions. Its improvement is therefore critical for enhancing mobility, safety, and overall urban experience.

The project proposes a comprehensive streetscape enhancement strategy, featuring a newly tarred carriageway, dedicated bicycle tracks, raised pedestrian footpaths with tactile markings, solar-powered street lighting, strategically placed street seats, waste receptacles, and clear signages and street markings. As the road runs parallel to the railway line, the inclusion of continuous safety railings ensures secure pedestrian and cyclist movement. Landscaping, hardscaping, and well-designed advertisement boards further uplift the corridor's aesthetic, functional, and economic value.

Table 34.8 : Project Details of RJ Road Redevelopment

Project Details of RJ Road Redevelopment		
Key Plan	Land Ownership	Indian Railways
	Ward Number	10, 16
	Project Area	0.03 Acre
	Survey Number	319. 315(p)
	Project Location	
		

RJ Road will also serve as an attractive, safe, and convenient pedestrian and cycling connector for tourists arriving at the railway station or the proposed Haripad Visitor Centre at Karimbalil Palace, enabling easy access to the Town Centre and the wider cultural corridor. The long, visible road stretch provides excellent potential for curated advertisement boards, creating a stable source of municipal revenue. By reducing travel distance and travel time while improving comfort, safety, and wayfinding, the project significantly enhances Haripad's urban mobility network and contributes meaningfully to a more vibrant and visitor-friendly town environment. The project has been discussed in detail in Section 36.4.5 of Chapter 36 of this master plan.

34.3.3.4 Prathimukham Jucntion Redevelopment



Prathimukham Junction is one of Haripad's most strategically positioned nodes, serving as a key connector between the proposed Farm Tourism Cluster at Nelpurakkadavu and the Pilgrim Tourism Circuit under the Haripad Paithruka Veedhi corridor. Recognized as a second-order urban node, the junction plays a pivotal role in supporting both local mobility and the emerging tourism-driven economy of the town.

The Prathimukham Junction Redevelopment project aims to transform the area into a safe, visually distinctive, and functionally efficient landmark junction with minimal land acquisition. The proposal includes well-designed pedestrian footpaths, clear street markings, improved traffic islands, and integrated street lighting to enhance visibility and safety. Wayfinding signages will guide visitors toward key destinations, while dedicated spaces for organic agro-produce outlets will support local farmers and strengthen the farm-to-market ecosystem. Through thoughtful urban design interventions, the project seeks to elevate Prathimukham Junction into a welcoming and memorable public space that enhances connectivity, supports tourism, and reinforces Haripad's identity as a culturally vibrant and economically progressive town.

Table 34.9 : Project Details of Prathimukham Junction Redevelopment

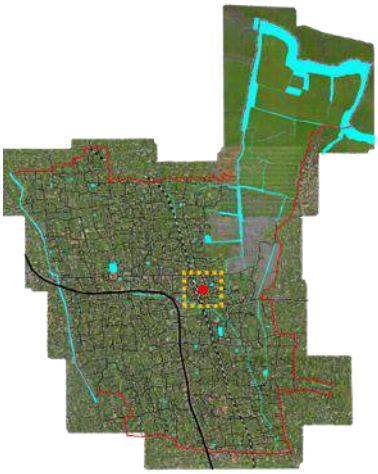
Project Details of Prathimukham Junction Redevelopment		
Key Plan	Land Ownership	PWD
	Ward Number	10
	Project Area	0.09 Acres
	Survey Number	327/1(p)
	Project Location	
		



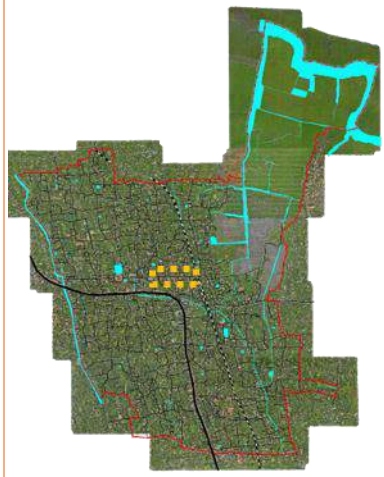
Figure 34.26 : Conceptual View of Proposed Prathimukham Junction redevelopment

34.3.3.5 Haripad Hub: Town Centre Redevelopment



The Haripad Hub project envisions the comprehensive redevelopment of the 790-metre central commercial spine extending from Haripad Town Junction to Town Hall Junction, passing through Ezhikkakath Junction and Kacheri Junction. As the civic and economic core of Haripad, this corridor accommodates a dense concentration of small and medium commercial establishments alongside major government institutions including the police station, court, fire station, government schools, and the revenue tower. With heavy pedestrian activity and daily movement of students, residents, and visitors, improving safety and walkability in this stretch has become a critical urban priority.

Table 34.10 : Project Details of Haripad Hub : Town Centre Redevelopment

Project Details of Haripad Hub : Town Centre Redevelopment		
Key Plan	Land Ownership	PWD
	Ward Number	6, 26
	Project Area	Approx 1.67 Acres
	Survey Number	296, 302, 303 333 (p)
	Project Location	
		

Currently, the corridor operates with one-way vehicular traffic, while the second lane is largely occupied by on-street parking. Pedestrian infrastructure remains inadequate despite high footfall. The redevelopment project addresses these challenges by adopting a pedestrian-first design approach with wider footpaths, protective railings for school zones, shaded seating pavilions, wheelchair-accessible ramps, dedicated bicycle lanes, improved wayfinding, more trees and landscaping, waste receptacles, drinking water kiosks, cycle stands, and solar-powered street lighting. Advertisement hoardings will be regulated to reduce visual clutter, enhancing streetscape quality. To balance mobility and accessibility, one-way traffic will be retained while relocating on-street parking to designated off-street parking areas nearby. This transition will free up road space, improve pedestrian safety, and enable smoother circulation. Rental cycle pick-up and drop-off points further support sustainable urban mobility. Upon completion, the Haripad Hub is expected to emerge as a vibrant, human-centric urban corridor- an active civic and commercial space that enhances walkability, safety, environmental quality, and the overall experience of Haripad's town centre.



Figure 34.27 : Conceptual View of Haripad Hub- Town Centre Redevelopment

34.3.3.6 Haripad Kshethra Veedhi- Temple Road Redevelopment



The Haripad Kshethra Veedhi project aims to transform the 300-metre approach road from Town Hall Junction to the Haripad Subramanya Swamy Temple into a model heritage street that reflects the spiritual and cultural identity of the temple town. The existing stretch- currently occupied by temporary vendor sheds, roadside parking, autorickshaw bays, and heavy pedestrian movement due to the adjacent Government Girls Higher Secondary School- requires comprehensive redesign to enhance both functionality and aesthetic quality.

The redevelopment proposal introduces dedicated pedestrian footpaths, a continuous bicycle track, shaded seating areas, traditional Kerala-style street lighting, increased tree cover, and strategically placed waste receptacles and water ATMs. A major component of the project is the relocation of informal street vendors to organized vendor zones, ensuring both livelihood protection and improved pedestrian comfort. Paid parking facilities on

adjacent plots will reduce on-street congestion, while tourist helpdesks and "Take a Break" amenities will support visitors and pilgrims.

To preserve the sanctity and visual prominence of the temple, a uniform architectural façade code is proposed for buildings along the stretch, accompanied by height restrictions that maintain an uninterrupted axial view of the temple gateway and gopuram. Through thoughtful heritage-sensitive streetscape design, the Haripad Kshethra Veedhi project envisions a dignified, safe, and culturally resonant approach road that enhances the pilgrimage experience and strengthens Haripad's identity as a significant temple town.

Table 34.11 : Project Details of Haripad Kshethra Veedhi- Temple Road Redevelopment

Project Details of Haripad Kshethra Veedhi- Temple Road Redevelopment		
Key Plan	Land Ownership	PWD & Haripad Municipality
	Ward Number	6
	Project Area	Approx 0.70 Acres
	Survey Number	283, 294
	Project Location	



Figure 34.28 : Conceptual View of Haripad Kshethra Veedhi- Temple Road Redevelopment

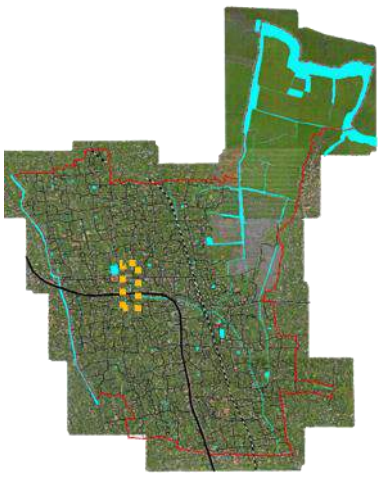
34.3.3.7 Pillathodu Canal Front Redevelopment - Stretch 01



The Pillathodu Canal Front Redevelopment - Stretch 01 project focuses on the environmental restoration and selective public-space enhancement of a 220-metre stretch of Pillathodu located between Haripad Temple Road and NH 66. Once a naturally flowing canal, this stretch has deteriorated over time due to pollution, unchecked weed growth, and lack of maintenance, resulting in stagnant water conditions and posing health and environmental risks to the surrounding residential neighbourhood.

The project proposes comprehensive cleaning and rejuvenation of the canal to restore water flow and improve overall water quality. In parallel, the immediate canal edges will be redeveloped in a sensitive and context-appropriate manner. Where space permits, the canal front will be transformed into a small urban recreation zone with seating areas, shaded pavilions, walking paths, paving, landscaping, and basic citizen amenities. In stretches abutting residential properties, the focus will be on strengthening canal sidewalls, pitching, and safety measures to ensure structural stability, prevent erosion, and improve sanitation conditions. Limited land acquisition, wherever essential, will be undertaken to enable proper execution of the project. The project aims to convert a polluted and neglected canal stretch into a cleaner, safer, and visually improved urban edge- balancing ecological restoration with neighbourhood-scale public use- thereby enhancing environmental quality, public health, and liveability in this part of Haripad.

Table 34.12 : Project Details of Pillathodu Canal Front redevelopment- Stretch 01

Project Details of Pillathodu Canal Front Redevelopment- Stretch 01		
Key Plan	Land Ownership	Municpality & Private
	Ward Number	26
	Project Area	Approx 0.62 Acres
	Survey Number	285-1, 286-1, 282-5(p), 282-10(p)
	Project Location	
		

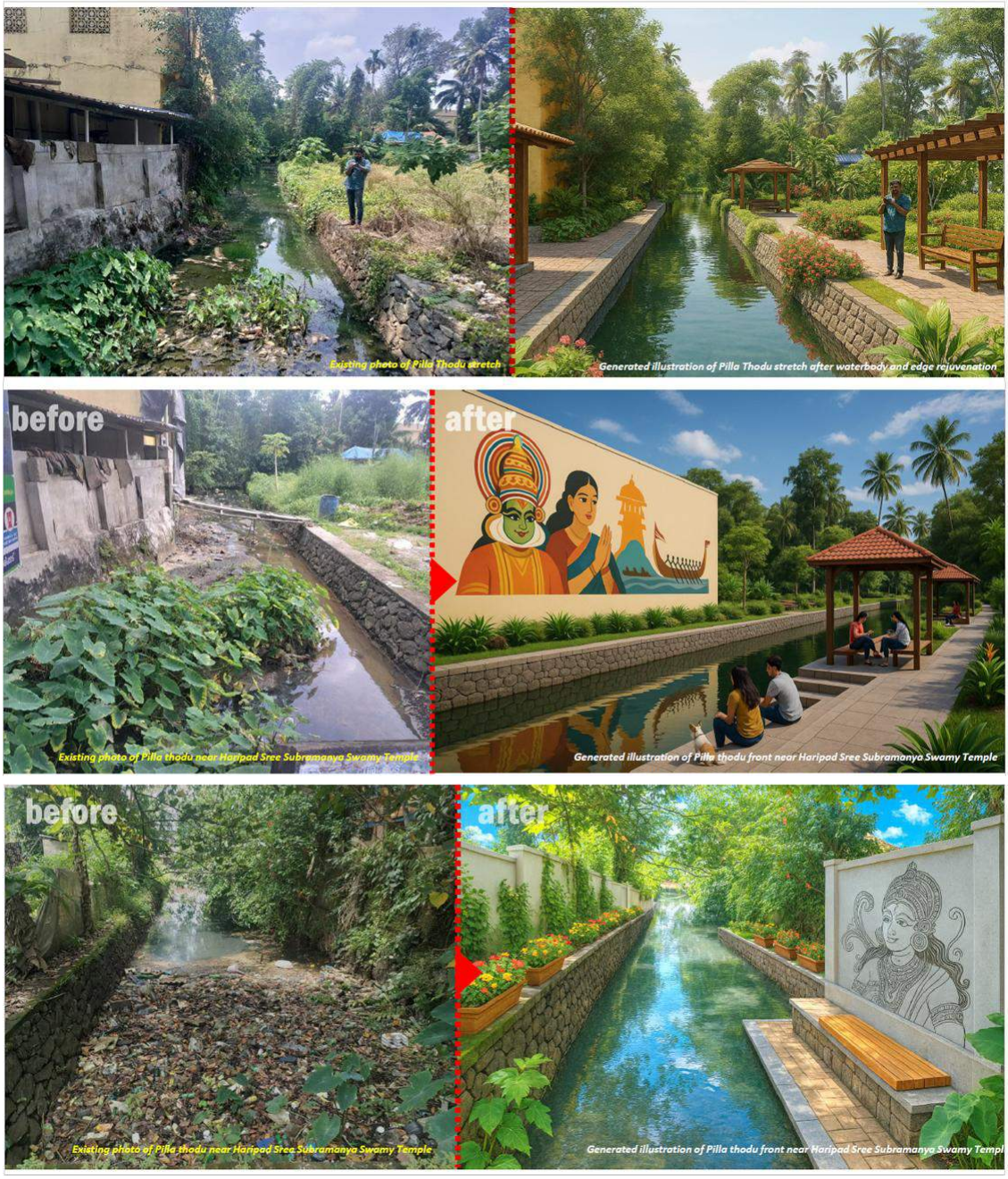


Figure 34.29 : Conceptual View of Pillathodu Stretch 1- Redevelopment

34.3.3.8 Haripad Temple Pond (Perumkulam) Renovation



The Haripad Temple Pond (Perumkulam) Renovation project aims to restore one of Haripad's most culturally significant and spiritually vibrant water bodies into a welcoming urban space for pilgrims, tourists, and local residents. Perumkulam, located adjacent to the Haripad Subramanya Swamy Temple, plays an important role during temple rituals and festivals, yet years of wear, siltation, and inadequate maintenance have diminished its structural integrity and aesthetic appeal. The proposed renovation seeks to strengthen the pond's edges, improve water quality, and enhance its surroundings to create a serene, culturally rooted public realm.

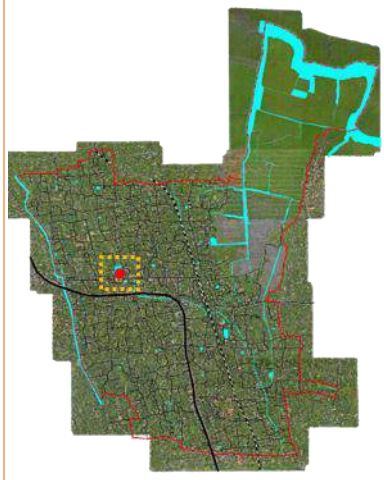
The project includes comprehensive cleaning and desilting of the pond bed, repair and reconstruction of retaining and pitching walls, and systematic treatment of the pond edges using durable and traditional materials. Landscape and hardscape features such as paved walkways, seating areas, and shaded mandapas/pavilions will be thoughtfully integrated to support pilgrim movement and create contemplative spaces. Traditional Kerala-style street lighting, improved access pathways, signage, and barrier-free design will ensure comfort and safety for all visitors.

By revitalizing Perumkulam, the project aims to elevate the cultural experience of the temple precinct, provide high-quality public amenities, and strengthen Haripad's identity as a major religious tourism destination. The renovated pond will serve not only as a sacred element of the temple environment but also as a beautifully designed urban open space reflecting the heritage and spiritual character of the town.



Figure 34.30 : Conceptual View of Perumkulam Redevelopment

Table 34.13 : Project Details of Pillathodu Canal Front redevelopment- Stretch 01

Project Details of Pillathodu Canal Front Redevelopment- Stretch 01		
Key Plan	Land Ownership	Devaswom Board
	Ward Number	28
	Project Area	Approx 4.6 Acres
	Survey Number	175-1
	Project Location	
		

34.3.3.9 Haripad Vinoda Veedhi - Haripad Temple to Mannarashala Temple Road Redevelopment



The Haripad Vinoda Veedhi project envisions transforming the 1.2 km stretch between Haripad Subramanya Swamy Temple and Mannarashala Temple into a vibrant, pedestrian-friendly cultural corridor. Designed as a scenic walkway, the project aims to provide a comfortable, safe, and aesthetically rich experience for pilgrims and visitors walking between two of the town's most significant spiritual landmarks. The proposal includes a well-designed pedestrian footpath equipped with seating areas, shaded pavilions, traditional street lighting, wayfinding signages, waste receptacles, safety railings, and thoughtfully curated landscaping and hardscaping.

Key supporting interventions include the renovation of the Subramanya Swamy Temple pond, redevelopment of TPN (Tutu) Junction, creation of a jogging track around the temple pond, relocation of existing encroachments along the temple road, and widening of surrounding minor roads to ensure smooth crowd movement during festivals. A dedicated street vending zone will also be introduced to organize informal activities and enhance the overall visitor experience. The removal of parking from the temple pond edge and allocation of dedicated parking grounds further contribute to improved pedestrian safety and visual quality. Once completed, Vinodha Veedhi will serve as Haripad's premier cultural tourism spine- linking the Subramanya Swamy Temple, the temple pond, the proposed Haripad Cultural Centre, and the Mannarashala Nagaraja Temple. The corridor is expected to become one of the most culturally vibrant and pedestrian-active stretches in the town, making the journey between the two temples both meaningful and enjoyable.

Table 34.14 : Project Details of Haripad Vinodha Veedhi

Project Details of Haripad Vinodha Veedhi		
Key Plan	Land Ownership	PWD & Municipality
	Ward Number	28, 29, 3, 6
	Project Area	Approx 2.86 Acres
	Survey Number	163-1, 162-1, 179-1, 185-1
	Project Location	
		



Figure 34.31 : Conceptual View of Proposed Haripad Vinodha Veedhi

34.3.3.10 TPN Junction Redevelopment



The TPN Junction Redevelopment project aims to transform Thulamparambu North (TPN) Junction into a safe, pedestrian-friendly, and aesthetically enhanced public space along the proposed Haripad Vinodha Veedhi corridor. Located between the Haripad Subramanya Swamy Temple and the Mannarasala Nagaraja Temple, the junction serves as a crucial pause point for devotees, pedestrians, and cyclists moving between these two major cultural landmarks. At present, the four-road junction is congested, lined with small shops, and lacks dedicated pedestrian infrastructure.

The redevelopment proposes well-designed footpaths, attractive paving patterns, dedicated seating areas, landscaped edges, and junction beautification measures that create a more comfortable environment for users. Improved lighting, signage, wayfinding, and pedestrian safety features will further strengthen the junction's role as a welcoming rest point along the cultural tourism corridor. Once completed, the upgraded TPN Junction will function as both a functional mobility node and

a vibrant public realm element, enriching the walking experience from Haripad Temple to Mannarasala Temple.



Figure 34.32 : Conceptual View of Proposed Redevelopment of TPN Jucntion

34.3.4 Pilgrim Tourism- Promotion of religious and pilgrimage tourism

- Position Haripad as a key hub for religious tourism, linking visitors to prominent destinations across Alappuzha and integrating it within a broader regional pilgrimage circuit to enhance cultural connectivity and tourism potential.
- Develop an integrated pilgrimage tourism circuit connecting Sree Subrahmanya Swamy Temple, Mannarasala Temple, and nearby shrines.
- Undertake comprehensive regional development focusing on infrastructure, accessibility, and visitor experience.
- Ensure a planned and efficient road network linking all key pilgrimage destinations.
- Enhance street character through well-designed road edges, landscaped footpaths, street furniture, signage, and traffic signals to create a cohesive visual identity.
- Provide essential pilgrim amenities such as accommodation facilities, rest areas and comfort stations, information and guidance centers, shopping and local handicraft outlets.

As part of the pilgrim tourism, the following projects are proposed in the town:

34.3.4.1 Haripad Temple Town - Entry Gate



The Haripad Temple Town - Entry Gateway project proposes the creation of a landmark gateway at Madhava Junction, the primary access point to Haripad Subrahmanya Swamy Temple from NH-66. Designed in traditional Kerala vernacular architecture, the gateway will symbolize Haripad's cultural identity and serve as a prominent visual marker for pilgrims and visitors approaching the town- visible both from the national highway and the upcoming flyover at the junction. The project will be implemented following the Madhava Junction Redevelopment and will integrate pedestrian footpaths, safety railings, road markings, and directional signage to ensure a cohesive, safe, and aesthetically enhanced arrival experience. Through this intervention, Haripad aims to establish a dignified and memorable entry that reflects its heritage and strengthens its image as a prominent temple town.

34.3.4.2 Pilgrim Amenities Centre



The Pilgrim Amenities Centre is proposed at the strategic junction between the Haripad Subramanya Swamy Temple and the adjacent temple pond, ensuring convenient access for devotees. Designed in traditional Kerala architectural style, the facility will serve as a dedicated support hub offering essential amenities that enhance the pilgrimage experience.



Figure 34.33: Location of Proposed Pilgrim Amenity Centre

The centre will include organized shoe racks, cloak and mobile–phone deposit counters, dress-changing rooms, clean drinking water kiosks, accessible restrooms, wash areas, and dedicated waste management facilities. Additional features such as shaded seating, landscaped areas, directional signage, and barrier-free access will ensure comfort, safety, and inclusivity for all visitors. By providing these structured amenities within a culturally sensitive built form, the project aims to reduce congestion at the temple entrance, improve hygiene and crowd management, and create a welcoming environment for devotees during daily visits as well as during festivals and peak pilgrimage seasons. The Pilgrim Amenities Centre thus plays a crucial role in strengthening Haripad's identity as a well-managed and pilgrim-friendly temple town.



Figure 34.34 : Conceptual View of Proposed Pilgrim Amenities Centre

34.3.4.3 Mannarasala Temple Premise Redevelopment



The Mannarasala Temple Premise Redevelopment project aims to upgrade the surroundings of one of Haripad's most revered cultural and religious landmarks- Mannarasala Nagaraja Temple. Renowned across Kerala, especially during the grand Mannarashala Ayilyam festival that draws thousands of pilgrims, the temple requires a well-planned, resilient, and visitor-friendly environment to support its heavy footfall. The proposed redevelopment focuses on creating an organised, safe, and comfortable pilgrimage experience by improving mobility, amenities, and the overall aesthetic quality of the precinct.

Key components of the project include improved road markings and directional signage, dedicated cycle tracks, pedestrian-friendly pathways, heritage street lighting, and enhanced landscaping and beautification. To support smooth pilgrim movement, the project also provides eco-friendly transit options and designated pick-up and drop-off zones for vehicles. Public amenities- such as drinking water kiosks, cloakroom facilities, toilets, shaded waiting areas, and resting spaces- will be upgraded to meet the needs of pilgrims of all age groups. Dedicated spaces for parking, autorickshaw and taxi stands, and bicycle parking will help ease congestion and improve circulation around the temple.

The redevelopment is designed to honour the spiritual significance of Mannarashala while ensuring safety, convenience, and dignity for all visitors. By blending heritage-sensitive design with modern public infrastructure, the project strengthens Haripad's identity as a leading cultural and religious tourism destination.





34.3.4.4 Mannarasala Heritage Interpretation Centre



The Mannarasala Heritage Interpretation Centre is envisioned as a dynamic cultural and educational facility that brings to life the rich heritage, mythology, and living traditions of the famed Mannarasala Nagaraja Temple. Designed as an immersive space for pilgrims, tourists, researchers, and cultural enthusiasts, the centre will use a blend of modern technology and traditional storytelling to communicate the origins of the temple, the significance of serpent worship, and the unique rituals associated with the Mannarasala Ayilyam festival. The centre will integrate a range of interactive and interpretive tools- including augmented reality experiences, digital projection walls, audio-visual exhibits, curated artefact displays, and touch-screen knowledge panels. Dedicated galleries will narrate the temple's history, its architectural evolution, lineage of the priestess (Valiya Amma), ritual practices, and the cultural legacy of the region. Spaces for guided tours, small workshops, and cultural demonstrations will complement the experience. Supporting amenities such as reception and information desks, seating lounges, washrooms, drinking water points, and accessible pathways will ensure comfort and usability for all visitors. By presenting heritage through engaging, technology-enabled formats, the Mannarasala Heritage Interpretation Centre aims to deepen visitor understanding, enhance cultural appreciation, and strengthen Haripad's identity as a major heritage tourism destination- while safeguarding the temple's traditions for future generations.

34.3.4.5 Mannarasala Ayilyam- Festival Infrastructure Plan



The Mannarashala Ayilyam Festival Infrastructure Plan is envisioned as a comprehensive blueprint to support the safe, organized, and culturally respectful conduct of one of Haripad's most celebrated religious festivals. Mannarashala Ayilyam attracts an exceptionally large number of pilgrims each year, with footfall continuing to rise due to growing visibility on social media and the deep cultural significance of the temple. The festival's temporary yet highly intense nature demands careful planning, coordinated management, and structured allocation of space and amenities. This project will map all land parcels within and around the temple precinct, identify ownership and permissible uses, and establish clear zoning for various festival activities such as queuing areas, pedestrian movement corridors, vehicle holding zones, annadanam areas, temporary vendor zones, ritual spaces, emergency access routes, and crowd dispersal pathways. The plan will also outline infrastructure requirements including drinking water points, sanitation facilities, lighting, pilgrim shelters, medical assistance stations, waste management systems, traffic management strategies, and signage networks.

By providing an integrated approach- similar to large-scale festival frameworks like the Kumbh Mela or Rath Yatra- the Mannarashala Ayilyam Festival Infrastructure Plan aims to ensure safety, comfort, and a seamless spiritual experience for pilgrims, while enabling temple authorities and government agencies to coordinate efficiently. Overall, the plan will strengthen Haripad's capacity to manage large

religious gatherings and preserve the sanctity and heritage value of the Mannarashala Temple and its iconic Ayilyam festival.

34.3.5 Heritage Tourism

- Renovation & redevelopment of karimpali palace, haripad palace and ananthapuram palace into museums, visitor centres, citizen infrastructure to ensure preservation and attract tourists
- Curated workshops of mask making, kalamezhuthu, kolam varavu etc of kanjoor devi temple
- Create dedicated spaces for traditional arts, crafts, and local product sales, integrating live demonstrations and workshops.
- Revive indigenous crafts, coir-making, weaving, and food processing practices as tourism experiences.



Figure 34.35: Kolam Varavu and Kalamezhuthu

As part of the heritag tourism, the following projects are proposed in the town:

34.3.5.1 Annual Haripad Heritage & River Festival



The Annual Haripad Heritage & River Festival is envisioned as a flagship cultural event that celebrates the town's rich heritage, living traditions, and deep relationship with water. Haripad is uniquely defined by its network of rivers, canals, temple ponds, agricultural landscapes, and historic settlements, all of which have shaped its culture, livelihoods, cuisine, and festivals over centuries. This project proposes an annual, well-curated festival that brings together these diverse elements into a single public celebration.

The festival will showcase Haripad's traditional art forms, temple rituals, folk performances, music, dance, local cuisine, agricultural practices, crafts, and water-based activities such as boat displays, river walks, and canal-side events. Heritage spaces, temple corridors, canal fronts, farm tourism zones, and public grounds can be used as festival venues, creating a distributed and walkable event structure across the town. Local farmers, artisans, women's self-help groups, youth clubs, and cultural organisations will play a central role in programming and management, ensuring strong community ownership.

Beyond celebration, the festival is intended as a strategic tourism and economic development initiative. It will enhance Haripad's visibility as a cultural and eco-tourism destination, extend tourist stays, generate seasonal livelihoods, and promote local food, crafts, and value-added products.

Environmentally sensitive planning, waste management, and river conservation awareness will be integral to the festival design, reinforcing respect for Haripad's fragile water ecosystems. Overall, the Annual Haripad Heritage & River Festival will function as a unifying civic event- strengthening cultural identity, activating public spaces, supporting the local economy, and positioning Haripad as a vibrant town where heritage, rivers, and community life are celebrated together.

34.3.5.2 Karimpalil Palace- Haripad Visitors Center



The Karimpalil Palace–Haripad Visitors' Centre project aims to transform one of Haripad's most culturally significant heritage precincts into a welcoming gateway for tourists and pilgrims. Located near the railway station, KSRTC stand, and NH-66 junction, the site offers exceptional visibility and accessibility, making it ideal as the town's primary visitor interface. The initiative focuses on the conservation and adaptive reuse of the historic Karimpalil Palace, integrating it with modern visitor facilities such as information services, rest and cloak amenities, mobility support, and community spaces. By combining heritage restoration with high-quality public infrastructure, the project strengthens Haripad's identity as a temple town, enhances the overall tourism experience, and positions the precinct as a vibrant cultural node within the broader urban regeneration framework.

34.3.5.3 Haripad Cultural centre- Haripad Kottaram Premise Redevelopment



The Haripad Cultural Centre project envisions the comprehensive conservation and adaptive reuse of the historic Haripad Kottaram, an Ettukettu palace complex located directly opposite the Haripad Subramanya Swamy Temple. Currently functioning as the office of the Deputy Chairman, Travancore Devaswom Board, the structure and its surrounding premises are in a deteriorated state, despite their immense architectural, cultural, and historical significance. Redeveloping the site into a vibrant cultural hub offers an opportunity to showcase Haripad's rich temple traditions, performing arts, ritual practices, and heritage craft forms.

The proposal includes restoring the Ettukettu structure using conservation-led architectural techniques and converting it into a cultural museum and intimate performance space that narrates the heritage of Haripad and its temple ecosystem. The broader campus will be reimagined as a multifunctional cultural precinct featuring an open-air amphitheatre for traditional art forms, a tourist facilitation centre, curated craft experience zones, a traditional Kerala restaurant, landscaped courtyards, and dedicated pedestrian areas. Additional components include bicycle parking and rental facilities, souvenir shops, a community hall for small functions, accessible walkways, interpretive signage, and improved lighting and safety infrastructure.

The centre will also host curated cultural residencies and workshops- such as Kalamezhuthu, mask-making, temple art, percussion, and craft demonstrations- providing immersive experiences for tourists and creating livelihood opportunities for local artists. Proper relocation of the existing elephant shelter, provision of adequate utilities, and strict heritage-compatible architectural controls will ensure that all interventions respect the cultural integrity of the site.When fully developed, the Haripad Cultural Centre will serve not only as a major tourism anchor but also as a civic gathering space that celebrates living traditions, supports artisans, and strengthens Haripad's identity as a culturally vibrant temple town. This transformative project aims to position the Kottaram precinct as a landmark destination for heritage interpretation, community engagement, and cultural continuity.





Figure 34.36: Conceptual view of Haripad Cultural Centre (Haripad Kottaram Redevelopment)

34.3.6 Farm Tourism

- Establish a farm tourism hub
- Develop a well-equipped and easily accessible farm tourism hub at Nelpurakkadavu, integrating natural, cultural, and agricultural experiences.
- Include a heritage museum or interpretation centre to showcase Haripad's agrarian history, traditional farming systems, and cultural heritage.



Figure 34.37 : White lily Faming at Malikadavu

- White lily farming at Malikadavu develop Malikadau– Nelpurakadavu as a major lily-fields during non-paddy season.

As part of the farm tourism, the following projects are proposed in the town:

34.3.6.1 Malikadavu Ambal Padam (Water Lily–Based Farm Tourism Initiative)



The Malikadavu Ambal Padam project is envisioned as a unique farm-tourism and ecological tourism initiative in the northern part of Haripad Municipality. Malikadavu is characterised by vast, scenic paddy fields where cultivation is presently limited to a single crop cycle, leaving the land largely fallow for much of the year. During this non-cropping period, water lilies (ambal flowers) naturally flourish in the fields, presenting a valuable opportunity to activate the landscape for tourism while respecting its agricultural and ecological character.

The project proposes to promote controlled water lily cultivation during non-crop seasons and develop the area as an experiential tourism destination. Existing water channels around the fields will be cleaned and desilted to improve flow and made navigable using small row boats. Visitors will be able to experience boating routes connecting Malikadavu and Nelpurakadavu, move through the water lily fields, pluck flowers, and engage in photography and nature-based recreation. Safe and accessible pathways along field bunds will be developed, along with temporary wooden walkways, viewing decks, and simple boarding platforms at Malikadavu and Nelpurakadavu for boat operations.

As the entire area falls within an Ecological Conservation Zone under the Master Plan, no permanent structures are proposed. All interventions will be low-impact, reversible, and constructed using eco-friendly materials. In addition, the well-maintained road connecting Malikadavu and Nelpurakadavu will be promoted as a mixed-use rural activity stretch, encouraging local residents to operate small ethnic food outlets, eateries, and farm-based enterprises, thereby generating supplementary income. Overall, the Malikadavu Ambal Padam project aims to create a model for sustainable farm tourism in Haripad- one that enhances livelihoods, attracts visitors, and celebrates the seasonal beauty of the agricultural landscape while maintaining ecological balance.

34.3.6.2 Nelpurakadavu Farm Tourism



The Nelpurakadavu Farm Tourism project proposes to revitalise one of Haripad's oldest and most historically significant riverine nodes into a signature farm tourism destination. With a legacy dating back over a century, Nelpurakadavu once served as a vital trans-shipment point where agricultural produce from Haripad was transported by boat through canals and the Achankovil River to the Travancore kingdom, including for offerings at the Sree Padmanabhaswamy Temple, Thiruvananthapuram. The iconic light mast at Nelpurakadavu, historically used as a navigation landmark, stands today in a dilapidated condition, while the canal and its banks suffer from pollution, siltation, and neglect.

Located amidst vast paddy fields, Nelpurakadavu is ideally positioned to anchor Haripad's farm tourism circuit. The project proposes reconstruction of the historic light mast as a landmark, desilting and clearing of canals to restore navigability, and development of a boating terminal to facilitate self-row boat journeys between Nelpurakadavu and Malikadavu. These canal journeys will offer immersive views of lush paddy landscapes and seasonal ambal (water lily) fields. Canal edges will be rehabilitated and developed into tourist-friendly promenades with seating, shaded pavilions, safety railings, lighting, CCTV surveillance, and sensitively designed landscaping and hardscaping.

In addition to physical infrastructure, the project introduces curated farm tourism experiences, including designated walking trails, demonstration zones, crop identification and storytelling panels, hands-on farming activities, irrigation system displays, and interactive knowledge sessions with local farmers. Visitor programmes will include paddy cultivation experiences, "farmer-for-a-day" initiatives, farm-to-table cafés, children-friendly activities such as waterwheels and mud play, photography stops, and workshops on composting, seed balls, and sustainable farming practices. Overall, the Nelpurakadavu Farm Tourism project is envisioned as a heritage-led, experiential tourism model that celebrates Haripad's agricultural traditions, strengthens local livelihoods, attracts visitors throughout the year, and reinforces the town's identity as a centre for eco-friendly and community-driven tourism.

34.3.6.3 Farm Experience & Guided Walks



The Farm Experience & Guided Walks project is envisioned as a people-centric agri-tourism initiative that brings Haripad's rich agricultural landscape closer to residents, students, and visitors. Designed as an immersive learning and recreation experience, the project proposes curated farm trails and guided walks through paddy fields, vegetable plots, and irrigation networks, allowing participants to understand farming as a living, evolving practice rather than a distant activity. The initiative aligns closely with Haripad's vision of promoting organic farming, farm tourism, and community engagement with agriculture.

The project will include clearly designated walking trails, demonstration zones, and interactive farm pockets where visitors can learn about crop varieties, seasonal cycles, traditional irrigation systems,

and sustainable farming methods through storytelling and direct interaction with farmers. Hands-on activities such as paddy cultivation experiences, farmer-for-a-day programmes, composting and seed-ball workshops, and children-friendly play elements like waterwheels and mud play areas will make the experience engaging across age groups. Knowledge sessions led by local farmers and agricultural experts will strengthen awareness, while photography stops and viewing decks will enhance the visual and recreational appeal of the trails.

By creating safe, well-marked, and managed farm access without disturbing cultivation activities, the project ensures that farmers benefit economically while retaining control over their land. It also opens new livelihood opportunities for local youth as guides, facilitators, and programme coordinators. Overall, the Farm Experience & Guided Walks project transforms Haripad's agricultural fields into open classrooms and leisure landscapes- celebrating farming heritage, strengthening rural livelihoods, and positioning the town as a meaningful destination for experiential and educational tourism.

34.3.6.4 Local Cuisine Experience Food Stretch - Malikadavu–Nelpurakadavu



The Local Cuisine Experience Food Stretch is envisioned as a unique culinary and cultural corridor along the Malikadavu–Nelpurakadavu stretch, celebrating Haripad's rich food heritage rooted in agriculture, waterways, and traditional livelihoods. Located within the larger farm tourism and canal-based tourism zone, this stretch will offer visitors an authentic taste of local cuisine while creating sustainable livelihood opportunities for local households, women's collectives, and self-help groups.

The project proposes a series of small-scale, well-designed food kiosks and eateries that showcase traditional Haripad and Kuttanad cuisines- using locally sourced paddy, vegetables, fish, duck, coconut-based products, and seasonal ingredients. Emphasis will be placed on traditional cooking methods, indigenous recipes, and value-added local food products, making food itself a storytelling medium that reflects the region's agrarian and riverine culture. Temporary and eco-sensitive structures will be encouraged, ensuring harmony with the surrounding agricultural fields and canal edges.

The food stretch will be supported by basic public amenities such as seating, shaded pavilions, waste management facilities, drinking water points, lighting, and safe pedestrian access. Clear design guidelines will ensure hygiene, visual coherence, and environmental sensitivity. Integration with boating terminals, farm trails, cycling routes, and walking paths will allow tourists to seamlessly combine food experiences with farm visits, canal rides, and leisure walks.

By promoting local cuisine as a tourism product, the project strengthens Haripad's identity as a farm- and culture-led destination while directly benefiting local communities. It encourages micro-entrepreneurship, especially among women and youth, supports farm-to-table practices, reduces food miles, and enhances the overall visitor experience. The Local Cuisine Experience Food Stretch thus becomes not just a place to eat, but a vibrant social and cultural space that brings together food, landscape, livelihoods, and tourism in a sustainable and inclusive manner.

34.3.7 Water Tourism

- Enhance land and water connectivity

- Clear and restore waterways and canals to enable scenic water-based access and improve ecological function.
- Introduce eco-friendly boating and guided canal tours linking farms, temples, and heritage site
- Introduce farm experience walks, guided farm tours, designated walking trails, demonstration zones, crop identification & storytelling, hands-on participation, knowledge sessions with farmers, children-friendly activities- waterwheels, mud play, fishing as part of experiential tourism activities
- Introduce Kayaking as a major water-based activity in the area.

As part of Water Tourism, the following projects are identified in the town:

34.3.7.1 Chooralackal Kayaking Terminal



The Kayaking Terminal at Chooralackal is proposed as a key tourism infrastructure project within the emerging Chooralackal Village Tourism Zone of Haripad. Designed as the primary launching point for guided and self-guided kayaking experiences, the terminal will serve as the starting and ending hub for visitors kayaking from Chooralackal towards Malikadavu and Nelpurakadavu. The project aims to promote low-impact, nature-based tourism while showcasing the region's scenic canal network, expansive paddy fields, and serene rural landscapes.

The terminal will be developed as a small yet well-organized facility that accommodates tourists arriving by two-wheelers, bicycles, and cars. The site will include designated parking areas, a kayak launching deck, equipment storage, rental kiosks, and safe landing/boarding platforms. Visitor amenities such as shaded waiting areas, seating, drinking water points, washrooms, and tourist information signage will ensure a comfortable and welcoming experience. Provision for CCTV surveillance, night lighting, and lifejacket storage will strengthen safety and security. Clear wayfinding markers and interpretive signage along the canal routes will guide visitors through the picturesque paddling trail that meanders through lush agricultural fields and rural settlements.

Designed as a barrier-free, eco-friendly facility, the Chooralackal Kayaking Terminal will function as an anchor attraction within the village tourism circuit. The project will help diversify local tourism offerings, support livelihood opportunities, and position Haripad as a destination for experiential and agricultural landscape tourism

34.3.8 Village Tourism

- Promote rural tourism and strengthen local livelihoods through the development of cottages, homestays, and farm stays that offer authentic village experiences rooted in Haripad's agrarian culture.
- Encourage active community participation by engaging cooperatives, Kudumbashree units, self-help groups, and local youth in hospitality services, traditional cuisine, catering, eco-guiding, and visitor management.

- Create dedicated spaces for showcasing traditional arts, crafts, and local products, supported by live demonstrations, hands-on workshops, and interactive visitor experiences.
- Revive indigenous practices such as coir-making, weaving, traditional food processing, and farming methods as experiential tourism activities that also support local income generation.
- Develop cultural trails and interpretive signage narrating Haripad's farming history, river-based trade, heritage landmarks, and evolving rural landscape.
- Adopt eco-friendly construction materials, renewable energy systems, and climate-sensitive design approaches in all tourism-related facilities.
- Implement decentralised waste management systems and water conservation measures to ensure long-term environmental sustainability.
- Strengthen supporting infrastructure by introducing electric carts, covered walkways, bicycle stands, seating areas, and wayfinding elements at strategic locations to enhance visitor comfort and accessibility.

As part of the villiage tourism activities, the following project has been identified:

34.3.8.1 Chooralackal Village Tourism - Master Plan



The Chooralackal Village Tourism Master Plan is proposed as a comprehensive framework to develop Chooralackal - located in the eastern part of Haripad Municipality- as a model village tourism destination rooted in agriculture, water-based landscapes, and local culture. Surrounded by expansive paddy fields, water channels, and traditional village settlements, Chooralackal possesses strong potential to offer an authentic rural experience that complements Haripad's broader tourism vision.

The project aims to systematically identify, plan, and promote village-scale tourism activities such as farm walks, paddy cultivation experiences, duck farming, kayaking through canals, local cuisine experiences, cultural interactions, and nature-based recreation. The Master Plan will define appropriate zones for tourism activities, circulation routes for pedestrians, cyclists, and kayaks, locations for homestays and village cottages, and guidelines for infrastructure development that is low-impact, context-sensitive, and environmentally sustainable. Emphasis will be placed on preserving the agrarian character of the area while enhancing basic amenities such as pathways, signage, lighting, safety measures, and sanitation.

Local participation forms the core of the project. The plan will encourage local households to operate homestays, small eateries, craft units, and guided experiences, thereby ensuring direct economic benefits to residents, especially women, youth, and farming communities. Capacity building, training, and institutional support will be integrated through coordination with tourism, agriculture, and local self-government institutions to ensure quality, safety, and long-term viability.

By preparing a structured Village Tourism Master Plan, Chooralackal can be developed in a phased, regulated, and inclusive manner- avoiding unplanned growth while unlocking its tourism potential.

The project will strengthen Haripad's tourism portfolio by adding a strong village and experiential tourism component, enhance rural livelihoods, promote conservation of landscapes and traditions, and position Chooralackal as a tranquil yet vibrant rural destination within the town's overall tourism network.

34.4 TRADE AND COMMERCE



The trade and commerce sector in Haripad is envisioned to strengthen the town's role as a vibrant local economic center by modernizing commercial infrastructure, improving market efficiency, and enhancing the overall business environment. The focus is on upgrading traditional markets, supporting emerging retail and service enterprises, promoting organized and sustainable commercial growth, and improving accessibility to commercial areas. Emphasis is also placed on fostering entrepreneurship, leveraging Haripad's strategic connectivity, and ensuring climate-resilient and inclusive commercial development. The goal is to create a robust, well-regulated trade ecosystem that supports livelihoods, stimulates local economic activity, and complements the town's broader development priorities. The proposals aimed at improving this sector are:

1. **Access to commercial areas**
   - Establish centralized parking facilities and enhance overall traffic circulation within the town.
   - Upgradation of road networks, footpaths, and drainage systems along key commercial corridors such as Town Hall–Ezhikkakathu–Taluk Hospital Road to improve accessibility and urban mobility.
2. **Street Vendors Management**
   - Identification and demarcation of vending zones at strategic locations such as transport hubs, markets, and residential areas.
   - Integration of vending spaces within public areas, transport terminals, and commercial complexes.
   - Issue identity cards to all registered street vendors for better regulation and inclusion.
3. **Redevelopment of Market**
   - Redevelop Danapady Market and the adjoining commercial areas with improved infrastructure, proper sanitation, and disaster-resilient features to enhance safety, accessibility and sustainability.
   - Industrial facilitation center and truck parking near coirfed godown



Figure 34.38 : Proposal for market redevelopment

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the Trade and Commerce sector to strengthen Haripad's local economy, improve market efficiency, support small traders and informal livelihoods, and enhance the town's role as a vibrant commercial and service hub aligned with its tourism, agriculture, and cultural development aspirations.

34.4.1 Street Vending Kiosks



The Street Vending Kiosks project forms an integral component of the Haripad Kshetra Veedhi - Temple Road Redevelopment initiative. To decongest the existing temple approach road and enhance the pedestrian experience, temporary street vendors currently lining the Subramanya Swamy Temple Road will be relocated to designated vending zones near Pilla Thodu, along the Velakulam edge, and on the Mannarasala Road stretch.

The proposal includes the development of aesthetically designed vending kiosks that follow a uniform architectural language inspired by traditional Kerala vernacular style. These structures will offer dignified, well-organized spaces for livelihood activities while ensuring easy accessibility for customers. By integrating the kiosks seamlessly into the cultural landscape, the project safeguards the economic interests of street vendors, improves overall visitor comfort, and preserves the heritage character of the temple surroundings.



Figure 34.39: Location of proposed street vending Kiosks

34.4.2 Ethnic Food Outlets, Prathimukham



The Ethnic Food Outlets at Prathimukham Junction project is envisioned as a place-based livelihood and tourism-support initiative that strengthens Haripad's emerging farm tourism identity. Prathimukham Junction is proposed as a future second-order node, strategically located at the intersection of the Haripad Paithruka Veedhi corridor and the Farm Tourism Zone. As a key transit point for visitors moving between major tourism clusters, the junction offers strong potential to function as a welcoming stopover and local experience hub.

The project proposes the development of well-designed ethnic food outlets that showcase Haripad's agricultural heritage through the sale of value-added and packaged food products. These will include products made from sesame (ellu), traditional paddy varieties, organic vegetables, and other locally sourced farm produce. In addition, select outlets will retail

handicrafts and artisanal items prepared using agricultural by-products, thereby promoting sustainable practices and local craftsmanship.

Designed with a strong local character, the outlets will be supported by appropriate pedestrian-friendly infrastructure, signage, seating, landscaping, and basic visitor amenities. The project aims to support local farmers, women's collectives, and micro-entrepreneurs while enhancing the visitor experience and reinforcing Prathimukham Junction's role as an important cultural and economic node within Haripad's tourism network. Through thoughtful relocation and design, the vending zones will contribute to a cleaner, safer, and visually cohesive environment, enhancing both the pilgrimage experience and the urban quality of Haripad's temple precinct.



Figure 34.40: Conceptual view of street vending kiosks

34.4.3 Danapady Market Redevelopment



The *Danapady Market Redevelopment* project aims to transform one of Haripad's oldest and most important commercial hubs into a modern, well-organized, and customer-friendly marketplace. Strategically located near a key entry point to the town and in close proximity to NH 66, Danapady Market plays a central role in local trade and daily commerce. However, ageing infrastructure, limited customer amenities, and inadequate storage facilities have constrained the market's efficiency and overall user experience. The proposed redevelopment seeks to upgrade the market into a vibrant, functional, and professionally managed commercial node that supports both local livelihood activities and town-level economic growth.

The project envisions the creation of structurally sound shop units, improved circulation areas, and enhanced customer amenities. Components include modern retail outlets, hygienic vending spaces, covered walkways, dedicated areas for fresh produce, and upgraded sanitation blocks. To strengthen the supply chain and ensure year-round availability of perishables, the redevelopment plan includes common warehouse facilities, cold storage units, loading–unloading bays for trucks, and designated spaces for last-mile distribution. Adequate parking, waste management systems, internal roads, stormwater drainage, and pedestrian-friendly edges are also part of the proposal.

Given its location near the Danapady Thodu, the market area also has the potential to evolve as a small-scale tourist attraction, particularly if supported with improved public realm features such as signage, shaded seating, landscaping, and river-edge beautification. The redevelopment will not only improve the market's functionality but also enhance the overall aesthetics and safety of the surrounding area. The Danapady Market Redevelopment project is envisioned as a comprehensive, forward-looking urban upgrade- one that strengthens Haripad's local economy, supports small traders, promotes safer and more hygienic market practices, and creates a welcoming commercial environment for both residents and visitors

34.4.4 Haripad Green Basket - Local Food Security Network



The *Haripad Green Basket - Local Food Security Network* is envisioned as a town-level service initiative aimed at strengthening food security, supporting local farmers, and ensuring reliable access to fresh, safe, and organic produce for residents of Haripad. As the town moves towards becoming a frontrunner in organic vegetable farming, floriculture, dairy, and allied activities, an efficient and dependable last-mile delivery system becomes critical to connect producers directly with consumers.

The project proposes the creation of a digital and logistics-based platform- either as a dedicated mobile application or through partnerships with existing local delivery apps- to facilitate doorstep delivery of fresh organic vegetables, milk, eggs, and other locally produced essentials. By aggregating produce from farmers, Kudumbashree units, dairy cooperatives, and small producers, the Green Basket network will reduce post-harvest losses, ensure fair prices for farmers, and offer consumers consistent access to high-quality local food.

In addition to home delivery, the system can support subscription-based models, neighbourhood pickup points, and institutional supply to schools, hostels, and offices. The initiative will promote short supply chains, reduce dependency on external markets, and enhance resilience during disruptions such as floods or transport constraints. Operated in coordination with Farmer Producer Organisations (FPOs), self-help groups, and youth-led enterprises, the Haripad Green Basket will strengthen the local economy while fostering healthier food habits and sustainable consumption. The project is designed as a people-centric, technology-enabled food network that aligns with Haripad's broader vision of sustainable agriculture, inclusive livelihoods, and long-term urban resilience.

34.4.5 Truck Parking Terminal



The Truck Parking and Terminal project is proposed as a supporting infrastructure facility for the upcoming Danapady Market Redevelopment. Located within the premises of the existing Coir Godown under the Government of Kerala, the site offers a strategic location for temporary truck parking, resting, and goods-handling activities. As the Danapady Market is expected to see increased commercial movement and improved logistics operations, a dedicated truck parking area becomes essential to reduce roadside congestion, ensure smoother market operations, and enhance safety in the surrounding neighbourhood.

The facility is envisioned as a compact, efficient, and well-organized truck holding area equipped with essential amenities for drivers and loading–unloading staff. Key components of the project include designated truck bays, paved parking surfaces, a basic rest area for drivers, gender-separated washrooms, drinking water points, shaded seating, and night-time security lighting. Provision for CCTV monitoring, signage for easy navigation, and a small kiosk for registration or entry management may also be included. Drainage arrangements, waste bins, and a secure boundary edge will ensure that the facility remains clean, safe, and functional throughout the day.

The Truck Parking and Terminal will support the efficiency of the redeveloped Danapady Market by providing an organized space for goods vehicles, improving traffic flow, and ensuring better working conditions for truck drivers and workers involved in the supply chain.

34.5 WATER SUPPLY



The water supply sector in Haripad aims to ensure reliable, safe, and equitable access to potable water through system strengthening, infrastructure modernization, and efficient resource management. The focus is on enhancing source sustainability, improving distribution networks, integrating advanced treatment and monitoring mechanisms, and adopting climate-resilient practices to address seasonal variability and future demand. Emphasis is also placed on reducing non-revenue water, promoting conservation, and ensuring service delivery that is inclusive and responsive to community needs. The goal is to establish a robust and sustainable water supply system that supports public health, economic growth, and the long-term resilience of Haripad.

The proposals aimed at improving this sector are:

1. **Water ATM**

   Install low-cost water vending machines across Haripad Municipality to provide safe, purified drinking water, supported by a robust water quality monitoring and feedback system to ensure drinking water safety.

2. Rain Water Harvesting

Rainwater harvesting refers to the direct collection and storage of rainwater to conserve surface and groundwater resources for efficient utilization. Considering the increasing water demand in the town area, groundwater recharge should be adopted as a futuristic approach. A policy-level initiative is required to promote rainwater harvesting as a mass movement. Community rainwater banks may be established to store excess rainwater for collective use, while all open wells and ponds within the Municipality can be recharged through point recharging by directing rooftop rainwater into them. Encourage policy-level initiatives to make rainwater harvesting a mass movement.

3. Storm Runoff Collection and Recharge

Groundwater recharge is the primary process through which water enters an aquifer, typically occurs in the zone below plant roots and expressed as a flux to the water table. To improve groundwater levels, storm runoff should be reduced through tree planting and effectively utilized by diverting it into suitably designed recharge structures near pavements, parking lots, municipal parks, playgrounds, stadiums, airports, and by earmarking open spaces exclusively for this purpose.

4. **Suggested** proposals from KWA

Sl. No.	Scheme	Project
1	NRDWP - CWSS	50 MLD Comprehensive Water Supply Scheme for Haripad Municipality and 13 adjoining panchayats (Executed by Project Division, Alappuzha)
2	AMRUT 2.0 - UWSS	Laying of distribution line for Haripad Municipality
3	AMRUT 2.0 - UWSS	Drilling tube well, construction of temporary pump house, laying pumping main, commissioning of new tube well, and installation of pump set near Tagore Central School (Ward 24) and Shishuvihar Anganwadi No. 26 (Ward 8), under PH Division, Kayamkulam
4	AMRUT 2.0 - UWSS	Construction of 9.00 LL OHSR at Thrippakudam
5	AMRUT 2.0 - UWSS	Providing Functional Household Tap Connections (FHTCs) in Haripad Municipality
6	AMRUT 2.0 - UWSS	Laying transmission main to the newly constructed OHSR at Thrippakudam

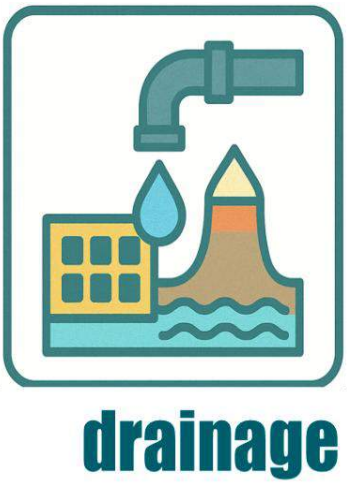
Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the Water Supply sector to strengthen Haripad's water security, improve service reliability, and ensure equitable access to safe drinking water. These interventions aim to address seasonal shortages, enhance distribution efficiency, protect water sources, and build resilience against climate-related risks, thereby supporting public health, urban growth, and the town's long-term sustainability goals

34.5.1 Water ATMs



The Water ATMs project aims to provide reliable, affordable, and safe drinking water access across Haripad by installing automated purified water dispensing units at key public locations. Designed to address seasonal shortages, water quality concerns, and the needs of commuters and vulnerable groups, the initiative strengthens the town's public health framework while promoting a refill culture that reduces plastic waste. By integrating smart monitoring, regular quality checks, and community-friendly operation models, the project enhances urban resilience and ensures equitable access to clean drinking water across

34.6 DRAINAGE



The drainage sector in Haripad focuses on establishing an efficient, climate-resilient, and environmentally safe stormwater management system that addresses existing vulnerabilities and supports future urban growth. The proposals aim to improve the town's natural and engineered drainage networks, enhance outflow efficiency, prevent waterlogging, and reduce flooding risks through integrated planning and scientifically designed interventions. Emphasis is placed on restoring natural drains, upgrading critical bottlenecks, adopting sustainable urban drainage solutions, and ensuring regular maintenance and community resilience. The goal is to create a robust drainage system that safeguards public health, protects infrastructure, and strengthens Haripad's overall disaster preparedness and urban livability. The proposals aimed at improving this sector are:

1. Restore and rejuvenate Pillathodu and Danapadi thodu, widening channels and removing encroachments to improve flow and reduce flooding.
2. Reopen, desilt and rehabilitate blocked natural streamsto enhance stormwater conveyance and groundwater recharge.
3. Construct continuous roadside drains with proper gradient, covering both arterial and internal roads to ensure efficient stormwater runoff.
4. Provide proper outfall connectivity for all roadside and tertiary drains to natural streams or recharge structures.
5. Strict regulations to be enforced against sewage discharge and waste dumping into stormwater drains.
6. Enforce zoning regulations and development controls to prevent construction and encroachments along natural drains and water bodies.
7. Introduce regular desilting and maintenance schedules, especially before the monsoon, with ward-level monitoring.

8. Development of a comprehensive stormwater drainage master plan, integrating natural and artificial drainage systems across all wards.
9. Usage of sustainable drainage systems (suds) like vegetated swales, soak pits, and bio-retention zones where feasible.
10. Reinforce vulnerable canal and thodu embankments with eco-friendly retaining structures (e.g., gabion walls, vegetative edges).
11. Installation of check dams and sediment traps at critical locations to slow runoff and reduce siltation downstream.
12. Integrating urban water logging management using gis-based mapping and hydrological modeling to identify flood-prone areas.
13. Promote community participation in maintaining local drains and awareness campaigns on keeping waterways clean.
14. Develop rainwater harvesting-linked stormwater recharge pits along major roads and public spaces.

Based on the challenges identified and the opportunities assessed, a set of focused interventions is proposed under the Drainage Sector to strengthen Haripad's stormwater management system, reduce flood and waterlogging risks, protect public health and infrastructure, and enhance the town's overall resilience to climate-related impacts, while supporting safe, sustainable, and well-managed urban growth.

34.6.1 Drainage Network Plan and Redevelopment



The Drainage Network Plan and Redevelopment project aims to strengthen Haripad's entire town-wide drainage system and address long-standing issues of waterlogging and urban flooding. This project begins with a detailed evaluation of the existing stormwater and wastewater drainage network, looking closely at how each drain, canal stretch, and outfall currently functions.

Across Haripad, all drainage arms will be mapped and assessed to understand their present condition- whether they are damaged, partially functional, silted up, or performing well. Based on this assessment, each stretch will be classified and suitable solutions will be planned. These will include the demolition and reconstruction of severely damaged drains, repair and rehabilitation of stretches that can be restored, and the introduction of new drain links wherever gaps exist. Together, these interventions will help create a more connected and efficient drainage and canal network for the entire town.

The project will involve key components such as drain pipes, manholes, inlets, outfall improvements, canal protection works, and pitching along selected stretches. All works will be planned across the entire municipal area, not limited to any single location, ensuring that the whole of Haripad benefits from a cleaner, safer, and more reliable drainage system. Overall,

this project is an important step towards reducing flooding risks, improving daily living conditions, and building a more resilient urban environment for the people of Haripad.

34.6.2 Haripad Flood Resilience Program - Community Awareness & Capacity Building Initiative



The Haripad Flood Resilience Program is envisioned as a comprehensive community-focused initiative aimed at strengthening the town's preparedness, response, and resilience to recurring flood events. Given Haripad's vulnerability to monsoon flooding and waterlogging- particularly in low-lying wards and areas along the Achankovil stretch- the project prioritizes empowering residents with accurate information, practical guidelines, and the skills needed to respond effectively during emergencies.

A key component of the program is the development of user-friendly information booklets and digital resources containing essential flood-related guidance, including do's and don'ts, evacuation protocols, mapped relief shelters, safe access routes, emergency helplines, locations of nearest hospitals, contacts of trained first responders (such as snake catchers, mechanics for flood-affected vehicles, first-aid volunteers), and other critical support services. These materials will be distributed in both print and digital formats, ensuring wide accessibility across the municipality. Ward Councillors will play a central role in community-level dissemination, aligning the initiative with the spirit of Kerala's Nammal Namukkai participatory governance program.

In addition to public awareness, the project focuses on enhancing the institutional capacity of those directly involved in disaster response. Tailored training programs will be organised for government officials, school children, youth groups, self-help groups, and volunteer networks- equipping them with practical knowledge on emergency coordination, evacuation support, first-aid assistance, and community-level flood management.

Overall, the project seeks to build a culture of preparedness, strengthen community ownership, and ensure that Haripad is better equipped- socially and institutionally- to face future flood challenges with confidence and resilience.

34.6.3 Pilla Thodu - Canal Front Redevelopment (Stretch 02)



The Pilla Thodu Canal Front Redevelopment - Stretch 02 project focuses on the ecological restoration and neighbourhood-scale redevelopment of a 450-metre stretch of Pilla Thodu between RJ Road and Taluk Hospital Junction in Haripad. Historically, this canal functioned as a naturally flowing drainage and water conveyance channel supporting the surrounding urban fabric. Over the years, however, the stretch has deteriorated due to unchecked pollution, accumulation of solid waste, invasive weed growth, siltation, and lack of systematic maintenance. These conditions have resulted in stagnant water, foul odour, mosquito breeding, and heightened public health and environmental risks for the adjoining residential areas.

The project proposes a comprehensive cleaning and rejuvenation of the canal to restore its hydraulic function and improve water quality. Key interventions include desilting, removal of weeds and debris,

strengthening of canal beds and sidewalls, and measures to ensure uninterrupted water flow. These works are aimed at converting the canal from a polluted drain into a functioning urban water system that supports improved drainage and environmental health. In parallel, the canal edges will be redeveloped in a context-sensitive manner, responding to variations in available space and adjoining land use. In stretches where adequate right-of-way exists, the canal front will be developed as a small-scale urban recreation space with pedestrian walkways, seating areas, shaded pavilions, paved surfaces, landscaping, and basic public amenities. These interventions will create much-needed open spaces for local residents, encourage passive recreation, and improve the overall visual character of the neighbourhood.

In sections abutting residential properties or constrained by narrow widths, the focus will be on infrastructure strengthening and safety. This includes construction and repair of canal sidewalls, pitching works to prevent erosion, installation of safety railings, and improvement of sanitation conditions along the canal edge. Limited land acquisition, wherever unavoidable, will be undertaken to ensure continuity of the canal section and proper execution of critical infrastructure works.

Overall, the project aims to transform this neglected and environmentally stressed canal stretch into a cleaner, safer, and more resilient urban edge. By balancing ecological restoration with carefully planned public realm improvements, the Pilla Thodu Canal Front Redevelopment - Stretch 02 will contribute to improved drainage performance, enhanced public health, neighbourhood liveability, and the long-term environmental resilience of Haripad town

34.7 WASTE WATER



The wastewater sector in Haripad aims to establish a safe, efficient, and environmentally compliant system for managing domestic and institutional wastewater across the town. The proposals focus on expanding collection, conveyance, and treatment infrastructure; promoting decentralized and sustainable treatment solutions; and reducing pollution loads on local water bodies. Emphasis is placed on improving household-level connectivity, integrating modern treatment technologies, and ensuring proper operation and maintenance to enhance system reliability. The goal is to build a resilient and future-ready wastewater management framework that safeguards public health, protects the environment, and supports Haripad's long-term urban development objectives. The proposals aimed at improving this sector are:

1. Establish a modern sewage treatment plant (STP) with facilities for water reuse in irrigation, landscaping, and other non-potable purposes.
2. Mobile septage treatment unit (MSTU) deployment for efficient on-site treatment and coverage of unsewered areas.
3. Mapping & rehabilitation of existing drainage and septic systems to prevent leakages and groundwater contamination.
4. Localized decentralized treatment units (DEWATS) to be developed in densely built and low-lying areas.
5. Stormwater–wastewater segregation to be implemented to reduce overflows and contamination during monsoons.

6. Rainwater harvesting and greywater reuse to be promoted at household and institutional levels.
7. Regular monitoring and maintenance systems to be established with trained personnel and GIS-based tracking of wastewater networks.
8. Community awareness programs to be conducted on proper sewage disposal and maintenance of septic systems especially in nearby panchayats to prevent waste water drainage into canals.



Figure 34.41 : Mobile septage treatment unit

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the Wastewater Sector to improve sanitation coverage, protect public health, and safeguard Haripad's water bodies. These interventions aim to strengthen wastewater collection, treatment, and disposal systems, reduce groundwater and surface water contamination, and support the town's long-term vision for environmentally sustainable, resilient, and inclusive urban development.

34.7.1 Decentralized Wastewater Reuse Gardens



The Decentralized Wastewater Reuse Gardens project is proposed as a sustainable water management and green infrastructure initiative under the Haripad Master Plan. The project focuses on the safe reuse of treated wastewater for gardening, landscaping, and floriculture, thereby reducing freshwater demand and improving environmental resilience. In a town like Haripad- characterised by scattered agricultural plots, emerging floriculture activities, and the absence of a centralized sewerage system- decentralized wastewater reuse offers a practical and efficient solution. Under this project, small-scale, localized wastewater treatment and reuse systems will be developed in suitable locations, aligned with existing drainage networks and nearby green spaces. Treated greywater from residential clusters, public buildings, and institutions can be reused for irrigating gardens, floriculture plots, road medians, parks, and community green spaces. By decentralising treatment and reuse, the project reduces the load on drainage systems, minimises pollution of canals and water bodies, and ensures easier operation and maintenance. The initiative directly supports Haripad's vision of promoting organic farming, floriculture, and sustainable land use, especially in isolated and underutilised agricultural parcels. It also contributes to water conservation, climate resilience, and circular economy principles by treating wastewater as a resource rather than a liability.

34.8 SOLID WASTE DISPOSAL



The solid waste management sector in Haripad focuses on establishing an efficient, sustainable, and environmentally responsible system for waste collection, processing, and disposal. The proposals aim to strengthen door-to-door collection, promote source segregation, enhance material recovery, and expand decentralized waste processing capacities suited to the town's scale and character. Emphasis is placed on improving operational efficiency, integrating modern waste-handling technologies, promoting community participation, and ensuring compliance with environmental standards. The goal is to create a clean, healthy, and circular waste management ecosystem that supports public well-being, reduces landfill dependency, and aligns with Haripad's long-term vision for sustainable urban development. The proposals aimed at improving this sector are:

1. **Strengthening Workforce and Welfare**
   - Increase the number of Harithakarmasena workers from 31 to the required level of 58 to cover all 29 wards effectively.
   - Ensure fair wages, social security benefits, and provision of safety equipment to workers.
   - Provide basic facilities such as toilets, drinking water, and rest areas at Material Collection Facilities (MCFs) and work sites.
2. **Upgradation of Material Collection Facilities (MCFs)**
   - Upgrade existing MCFs, with proper infrastructure for sorting, collection, and storage of waste in all-weather conditions.
   - Ensure regular removal of accumulated waste from MCFs to prevent overloading and unsanitary conditions.
3. **Efficient Collection and Processing of Waste**
   - Revise and strictly implement the waste collection calendar, ensuring timely and door-to-door collection of both biodegradable and non-biodegradable waste.
   - Expand collection beyond plastics to include all categories of inorganic waste.
   - Strengthen and modernize Thumboormuzhi composting units, ensuring efficient operation and proper maintenance for processing biodegradable waste.
   - Promote decentralized composting at household and community levels.
4. **Sanitary and Hazardous Waste Management**
   - Introduce a structured system for the collection and scientific disposal of sanitary waste, including sanitary pads and diapers, through tie-ups with authorized biomedical waste treatment facilities.

- Provide households with color-coded bins and awareness programs for segregating sanitary and hazardous waste.

5. Prevention of Waste Dumping in Water Bodies

- Enforce strict regulations and penalties against indiscriminate dumping of waste into rivers, canals, and other water bodies.
- Install surveillance mechanisms and conduct regular inspections near vulnerable dumping points.
- Undertake community awareness campaigns to discourage open dumping and promote responsible waste disposal practices.

6. City level solid waste treatment facility

- City level solid waste treatment facility project under consideration at land opposite cremation ground near Choorellackal (project will be taken up only after proposed land conversion is approved)

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the Solid Waste Management sector to strengthen Haripad's waste handling systems, promote source segregation and resource recovery, reduce environmental and public health risks, and move towards a cleaner, more efficient, and sustainable urban sanitation framework.

34.8.1 Town-Level Sewage Treatment Plant (STP) and Solid Waste Processing Facility, Choorellackal



The Sewage Treatment Plant and Solid Waste Processing Facility is proposed as a critical environmental and public health infrastructure project for Haripad Municipality. With the town experiencing growing challenges related to wastewater management, septic waste handling, and solid waste accumulation, the establishment of a modern, scientifically managed treatment plant has become essential. The facility is envisioned to serve the entire municipal area, ensuring that the town transitions from conventional, scattered waste disposal practices to a centralized, efficient, and environmentally responsible system.

The project will integrate a sewage treatment plant capable of treating domestic wastewater generated across the town, ensuring safe discharge and reuse of treated water for landscaping or non-potable municipal applications. In addition, a solid waste processing zone will be developed to manage biodegradable waste, segregated recyclables, and inert materials systematically. Key components include primary and secondary treatment units, sludge drying beds, screening chambers, aeration systems, leachate management, waste segregation platforms, composting/vermicomposting units, vehicle washing areas, internal circulation roads, green buffers, and a centralized control room. Adequate lighting, boundary fencing, CCTV surveillance, and safety protocols will ensure smooth and secure operation. This project is vital for improving public health, reducing pollution of local water bodies, ensuring

compliance with environmental regulations, and building a more sustainable future for Haripad.

34.9 ENERGY



The energy sector proposals for Haripad aim to enhance the town's transition toward a reliable, efficient, and sustainable energy ecosystem. The focus is on strengthening power distribution infrastructure, promoting renewable energy adoption- particularly solar solutions- improving energy efficiency across public and private sectors, and integrating smart technologies for monitoring and management. Emphasis is also placed on ensuring uninterrupted power supply for essential services, supporting climate resilience, and encouraging community participation in clean energy initiatives. The goal is to build an energy-secure and environmentally responsible urban system that supports Haripad's economic activities, public services, and long-term sustainable development. The proposals aimed at improving this sector are:

1. Piezoelectric flooring technology



Figure 34.42 : Piezoelectic walkways

Piezoelectric flooring technology is an innovative energy-harvesting method that generates electricity from human footsteps by utilizing the piezoelectric effect, special tiles or mats contain materials (e.g., PZT, PVDF) produce electric charges when subjected to mechanical stress. By embedding piezoelectric tiles in high-footfall areas such as airports, railway stations, malls, stadiums, or public streets, the mechanical energy from pedestrian movement can be converted into electrical energy to power low-consumption applications like LED lighting, sensors, or display systems. Though the energy output from each step is minimal, large-scale installations in busy spaces can provide a supplementary renewable energy source, while also promoting public awareness of sustainable technologies.

2. Maximise Use of Solar Energy

Considering the year-round potential for solar energy generation, the town should aim to achieve complete solar power adoption in housing, offices, and commercial establishments. As an interim measure, it is recommended that all new building constructions be mandated to include solar panel installations. To promote sustainable energy, tax reductions, subsidies, and other incentives may be provided to the public. Awareness programs at the ward level should be organized to encourage participation.

3. Upgradation of Power Distribution through Underground Cabling



Figure 34.43: Power distribution through underground cabling

The existing power distribution system, which depends on overhead lines, is highly vulnerable to disruptions caused by external factors. To ensure a safer, more reliable, and efficient supply, it is proposed to gradually transition to underground cabling. This approach will minimize power interruptions, reduce transmission losses, enhance safety, and improve the overall urban environment, while also creating a modern and resilient energy infrastructure.

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the **energy sector** to enhance energy security, promote renewable and clean energy adoption, improve reliability of supply, and support Haripad's transition towards a sustainable, resilient, and low-carbon urban future.

34.9.1 Bioenergy from Agro-Waste Project



The Bioenergy from Agro-Waste Project is proposed as a sustainable energy initiative under the Energy Sector of the Haripad Master Plan, aligned with the town's strong agricultural base and organic farming vision. Haripad generates substantial quantities of agricultural residues, vegetable waste, floriculture waste, cattle dung, and other biodegradable by-products from farms, markets, agro-processing units, and households. At present, much of this waste is underutilised or disposed of inefficiently, contributing to environmental concerns. This project aims to convert agro-waste into clean and renewable energy through decentralised bioenergy solutions such as biogas plants and small-scale biomass systems. The energy generated can be used for cooking, lighting, cold storage, agro-processing units, community facilities, and possibly fed into local micro-grids. The project will also produce nutrient-rich slurry as a by-product, which can be reused as organic manure, strengthening circular economy practices within the agriculture and energy sectors.

By reducing dependence on conventional fuels, improving waste management, and providing affordable energy solutions, the Bioenergy from Agro-Waste Project supports Haripad's goals of energy resilience, climate action, and sustainable livelihoods. The initiative can be implemented through partnerships with farmer groups, Kudumbashree units, Farmer Producer Organisations (FPOs), and relevant government schemes, making it both economically viable and socially inclusive. The project positions Haripad as a model town

where clean energy generation is closely integrated with agriculture, waste reduction, and local self-sufficiency.

34.9.2 Solar Rooftop Subsidy Drive (One Ward–One Solar Model)



The Solar Rooftop Subsidy Drive (One Ward–One Solar Model) is proposed as a flagship energy transition initiative under the Haripad Master Plan, aimed at accelerating the adoption of clean, renewable energy across the municipality. Given Haripad's vulnerability to power disruptions during floods, its heavy dependence on hydroelectric power, and rising energy costs, promoting decentralized solar energy has become both a strategic necessity and an opportunity for long-term resilience.

The project envisions a ward-wise implementation approach, wherein each ward is encouraged to achieve substantial solar rooftop coverage across residential, commercial, institutional, and public buildings. Through coordinated awareness campaigns, technical assistance, and facilitation of state and central government subsidies, households and establishments will be supported to install grid-connected rooftop solar systems. The initiative will leverage existing schemes of MNRE, KSEB, and state renewable energy missions to reduce upfront costs and simplify approval processes.

As part of the drive, demonstration installations on public buildings such as schools, anganwadis, offices, and community halls will act as visible pilots, building public confidence and awareness. Capacity-building programmes, vendor empanelment, net-metering facilitation, and ward-level energy champions will be introduced to ensure smooth implementation. Special focus will be given to low-income households, apartments, and small commercial establishments to ensure inclusivity.

The One Ward–One Solar Model aims to reduce dependence on conventional power sources, lower electricity bills for residents, cut carbon emissions, and strengthen Haripad's energy security. Over time, this initiative will help position Haripad as a climate-responsive town that actively contributes to Kerala's renewable energy goals while empowering communities to participate directly in the clean energy transition.

34.9.3 Public EV Charging & Solar Bus Shelter Network



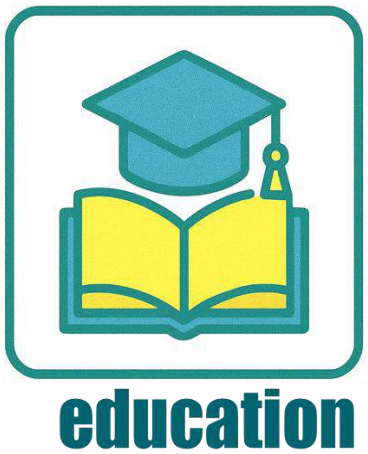
The Public EV Charging & Solar Bus Shelter Network project is proposed as a forward-looking energy and mobility initiative under the Haripad Master Plan, aimed at supporting the town's transition towards clean, low-carbon transport. With the increasing adoption of electric vehicles (EVs) across Kerala and Haripad's strategic role as a regional transit

and tourism hub, the availability of reliable EV charging infrastructure has become essential.

The project proposes the installation of public EV charging stations at key locations such as the KSRTC Bus Stand, proposed Private Bus Stand, Town Centre, market areas, tourist nodes, and major junctions. These facilities will cater to electric two-wheelers, three-wheelers, cars, and eventually electric buses, supporting both local users and visitors. To enhance sustainability, selected bus shelters across the town will be upgraded into solar-powered bus shelters, equipped with rooftop solar panels, energy-efficient lighting, digital information boards, seating, and provisions for slow EV charging where feasible.

By integrating renewable energy with public transport infrastructure, the project reduces dependence on conventional power sources, lowers operational emissions, and improves commuter comfort. The initiative also aligns with state and national policies promoting electric mobility and renewable energy adoption, while strengthening Haripad's image as an environmentally responsible and future-ready town. Overall, the Public EV Charging & Solar Bus Shelter Network will support cleaner mobility, encourage EV adoption, improve public transport amenities, and contribute to Haripad's broader goals of energy sustainability, climate resilience, and improved urban liveability.

34.10 EDUCATION



The education sector proposals for Haripad focus on strengthening the town's learning ecosystem through improved infrastructure, enhanced accessibility, and quality-driven educational services. The aim is to upgrade school facilities, promote digital and skill-based learning, ensure safe and inclusive environments, and support capacity building for teachers and institutions. Emphasis is placed on bridging infrastructure gaps, expanding opportunities for higher and vocational education, and aligning educational outcomes with emerging economic and technological needs. The goal is to build a robust, equitable, and future-ready education system that empowers Haripad's youth, supports community development, and contributes to the town's long-term socio-economic progress. The proposals aimed at improving this sector are:



1. **<u>Expansion of Higher Education</u>**
    - Establish a polytechnic college to provide vocational and technical education.
    - Explore setting up a health education institution (nursing, paramedical courses).

2. **Upgradation of Existing Institutions**
    - Improve laboratories, libraries, computer facilities, furniture, and study materials in schools and colleges.
    - Develop playgrounds and sports facilities in schools.
    - Integrate digital classrooms and e-learning platforms.
    - Enhancing & equipping the existing educational infrastructure to act as appropriate disaster relief facilities and gathering hubs.



Figure 34.44: Digital Classrooms

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the education sector to strengthen learning infrastructure, enhance access and safety, integrate digital and climate-resilient facilities, and support inclusive, future-ready education that aligns with Haripad's long-term social development vision.

34.10.1 Smart Anganwadis & Digital Classrooms (Phase I)



The Smart Anganwadis & Digital Classrooms (Phase I) project aims to strengthen Haripad's social infrastructure by upgrading schools and Anganwadis with modern, safe, and energy-efficient learning environments. Recognising the critical role of early childhood care and foundational education in long-term human development, the project focuses on integrating digital classrooms, improved learning tools, and child-friendly infrastructure across municipal schools and Anganwadis.

Key interventions include the provision of smart classrooms with digital boards, tablets/projectors, reliable power supply supported by rooftop solar where feasible, energy-efficient lighting, and basic ICT infrastructure to enhance teaching and learning outcomes. Anganwadis will be upgraded with safe indoor learning spaces, secure outdoor play areas, age-appropriate equipment, improved ventilation, drinking water facilities, and child-safe sanitation. Emphasis will be placed on creating inclusive, barrier-free environments that support children, caregivers, and frontline workers.

By combining digital education with clean energy solutions, the project supports Haripad's broader energy transition goals while improving service delivery in education and early childcare. The initiative will enhance learning quality, reduce operational energy costs, build digital literacy from an early age, and ensure safer, more resilient community facilities-contributing directly to human capital development and long-term social resilience in Haripad.

34.10.2 Renovation of Anganwadis



The Renovation of Anganwadis project proposes the upgradation of existing Anganwadi centres in Ward 1 and Ward 7 to ensure safe, healthy, and child-friendly environments for early childhood care and development. Anganwadis play a critical role in delivering nutrition, pre-school education, and basic health services, particularly for children, pregnant women, and lactating mothers. However, ageing infrastructure, limited safety features, and inadequate amenities affect the quality of service delivery in certain centres.

The project includes structural repairs, improvement of indoor and outdoor learning spaces, provision of safe play areas, upgraded sanitation facilities, improved lighting and ventilation, child-friendly furniture, and energy-efficient fittings. Special attention will be given to safety, accessibility, and hygiene, ensuring compliance with ICDS and child welfare norms. Where feasible, basic digital and electrical upgrades will also be introduced to support learning activities and administrative efficiency.

By improving physical infrastructure and overall functionality, the project aims to enhance the quality of early childhood education and care services, strengthen community trust in Anganwadi centres, and support the health and development of children in Haripad. This intervention contributes to social infrastructure strengthening and aligns with the town's broader goals of inclusive development, human capital enhancement, and long-term social resilience.

34.10.3 Renovation and Relocation of Anganwadis (Flood-Resilient Facilities)



The Renovation and Relocation of Anganwadis project is proposed to ensure safe, resilient, and child-friendly early childhood care facilities in Haripad, particularly in areas vulnerable to flooding. Several Anganwadis in the town are located within flood-prone zones, which disrupts service delivery during monsoons and poses risks to children, pregnant women, and Anganwadi staff. As part of this initiative, Anganwadis in Ward 4, Ward 22, and Ward 26, which fall within identified flood-prone areas, are proposed to be relocated to safer, accessible locations within the respective wards or nearby areas.

The project aims to develop upgraded Anganwadi buildings with improved structural safety, adequate indoor and outdoor spaces, child-friendly toilets, safe drinking water, proper ventilation, and resilient electrical and sanitation systems. Special emphasis will be placed on flood-resilient design, barrier-free access, safe play areas, and provision of basic digital and learning infrastructure. The relocation will be undertaken in consultation with the ICDS department, local communities, and ward councillors to ensure continuity of services and ease of access for beneficiaries. Overall, the project seeks to safeguard essential nutrition, health, and early learning services by relocating vulnerable Anganwadis to secure locations and upgrading facilities to meet current standards. This intervention will strengthen Haripad's social infrastructure, enhance disaster preparedness, and ensure uninterrupted support for children and mothers, especially during extreme weather events

34.11 HEALTH



The health sector proposals for Haripad aim to strengthen the town's healthcare ecosystem through improved infrastructure, enhanced service delivery, and equitable access to quality medical care. The focus is on upgrading public health facilities, expanding preventive and primary healthcare services, promoting digital health systems, and ensuring rapid emergency response capabilities. Emphasis is also placed on addressing gaps in maternal, child, and geriatric care, enhancing community health awareness, and building resilience against climate-related and communicable diseases. The goal is to create a robust, inclusive, and responsive healthcare framework that supports the well-being of all residents and aligns with Haripad's broader vision for sustainable and healthy urban development. The proposals aimed at improving this sector are:

1. **Strengthen Healthcare Infrastructure**
   - Upgrade existing PHCs and wellness centres with adequate medical staff, modern diagnostics equipment, and treatment facilities.
   - Develop satellite clinics and mobile health units in peripheral wards to improve last-mile healthcare access
2. **Enhance public health preparedness and resilience**
   - Construct and retrofit healthcare buildings with disaster-resilient designs to ensure operational continuity during floods and other hazards
   - Establish emergency health response units equipped with boats, ambulances, and mobile communication systems
   - Develop a municipal-level health emergency management plan integrated with the district disaster management authority
3. **Expand preventive & community health programs**
   - Strengthen immunization, maternal and child health programs, and non-communicable disease (NCD) control initiatives
   - Conduct regular health awareness and screening campaigns for lifestyle diseases, vector-borne diseases, and mental health

4. **Improve sanitation, hygiene, and nutrition standards**
    - Promote school health and nutrition programs with regular health check-ups, hygiene education, and mid-day meal quality monitoring
    - Establish community nutrition centres for women, children, and the elderly in low-income neighborhood
    - Implement regular vector control measures and regular fogging in vulnerable areas
5. **Strengthen diagnostic and laboratory facilities**
    - Expand testing and diagnostic facilities in public hospitals to ensure timely detection and treatment.
    - Integrate laboratory services with digital health records and e-health platforms for efficiency
6. **Encourage alternative and preventive healthcare systems**
    - Promote ayush clinics and wellness centres for holistic and preventive healthcare
    - Introduce community yoga, fitness, and mental wellness programs in parks and public spaces
    - Support traditional medicinal plant gardens in schools and institutions for awareness and self-reliance

Based on the challenges identified and the opportunities assessed, a set of targeted projects is proposed under the health sector to strengthen Haripad's public healthcare system, improve access to quality services, and enhance resilience to health risks. These interventions aim to address gaps in infrastructure, outreach, and preparedness, with a focus on vulnerable groups, preventive care, and responsive service delivery, thereby supporting a healthier, more inclusive, and resilient urban community.

34.11.1 Government Homeopathy Clinic Upgradation



Homeopathy is a widely accepted and government-recognized system of medicine with strong public patronage in Haripad, particularly among children, the elderly, and patients seeking long-term, non-invasive treatment options. The existing Government Homeopathy Clinic plays an important role in providing affordable healthcare to residents across the municipality, including economically weaker sections. However, increasing patient footfall and expanding treatment requirements have placed pressure on the current infrastructure and service capacity.

The proposed Government Homeopathy Clinic Upgradation project aims to strengthen and modernize the existing facility to improve accessibility, comfort, and quality of care. The project envisages enhancement of physical infrastructure through additional consultation rooms, improved waiting areas, upgraded pharmacy and storage facilities, better sanitation, and barrier-free access for elderly persons and persons with disabilities. Provision of improved

medical equipment, digital record-keeping systems, and patient information counters is also proposed to ensure efficient service delivery.

Given Haripad's vulnerability to floods and public health risks, strengthening primary and alternative healthcare facilities is critical for building community resilience. Upgrading the homeopathy clinic will help decongest other healthcare institutions, provide timely treatment- especially for children and chronic patients- and reinforce preventive healthcare practices within the town. Overall, the project seeks to enhance the capacity and reach of homeopathic services in Haripad, making quality alternative healthcare more accessible, reliable, and patient-friendly, while supporting the town's broader vision of inclusive and resilient urban health infrastructure.

34.11.2 Mobile Health Clinics for Elderly & Women



The Mobile Health Clinics for Elderly & Women project is proposed to strengthen last-mile healthcare delivery in Haripad, with a specific focus on senior citizens, women, and residents of flood-prone and underserved neighbourhoods. While Haripad has a network of healthcare facilities, access remains a challenge for elderly persons, pregnant women, and those with mobility constraints- especially during monsoons, extreme weather events, and health emergencies.

The project proposes the deployment of well-equipped mobile health units staffed with a doctor, nurse, and paramedical personnel, operating on fixed routes and schedules across wards. These clinics will provide basic outpatient services, maternal and child health check-ups, geriatric care, screening for non-communicable diseases (diabetes, hypertension), vaccination support, basic diagnostics, medicine distribution, and health counselling. Telemedicine linkages with government hospitals and specialty centres can further enhance service delivery.

Special emphasis will be placed on women's health services, including antenatal and postnatal care, nutrition counselling, reproductive health awareness, and screening programmes. For the elderly, the clinics will offer routine health monitoring, physiotherapy guidance, and referral support. During floods or disasters, the mobile clinics can function as rapid-response health units, ensuring continuity of essential services. Overall, the Mobile Health Clinics for Elderly & Women project will improve healthcare accessibility, reduce travel burdens, strengthen preventive care, and enhance public health resilience in Haripad- supporting the town's vision of inclusive, people-centric, and resilient urban development.

34.12 HOUSING



The housing sector proposals for Haripad focus on fostering inclusive, affordable, and resilient residential development that meets the evolving needs of the town's diverse population. The emphasis is on addressing existing housing shortages, upgrading substandard and vulnerable settlements, and promoting planned residential layouts that align with infrastructure capacities and environmental considerations. Key priorities include enhancing access to basic services, encouraging climate-resilient construction practices, supporting affordable housing schemes, and guiding orderly urban expansion. The goal is to create a safe, livable, and equitable housing environment that strengthens community well-being and supports Haripad's long-term urban growth objectives.

- Strengthen the ongoing implementation of Pradhan Mantri Awas Yojana (PMAY) and ensure timely completion of pending houses to enhance housing availability.
- Promote disaster-resilient and eco-friendly housing models, particularly in flood- and waterlogging-prone areas
- Promote vertical housing in high-density areas to optimize land use.
- Develop rental housing schemes for migrant workers, students.

Based on the challenges identified and the development potential assessed, the following project has been proposed to strengthen the housing sector in Haripad and enhance its resilience, safety, and long-term liveability.

34.12.1 Flood Resilient Housing Scheme



The Flood Resilient Housing Scheme is proposed to strengthen housing safety and reduce vulnerability in flood-prone areas of Haripad Municipality. Given the town's low-lying coastal setting and recurring incidents of flooding and waterlogging, residential buildings- particularly those belonging to economically vulnerable households- are at high risk of structural damage, health hazards, and displacement. This project aims to address these challenges by promoting flood-resilient housing practices through a combination of technical guidance, design support, and capacity building.

Under the scheme, households will be provided with practical assistance on flood-resilient construction and retrofitting measures such as raised plinth levels, use of flood-resistant building materials, improved foundation design, proper drainage around plots, safe placement of electrical systems, and ventilation strategies to reduce dampness. The project will also offer technical support through empanelled engineers and architects, standard design templates, and awareness programmes for homeowners, masons, and local contractors. Wherever feasible, the scheme will be aligned with existing government housing and disaster mitigation programmes to leverage financial assistance and subsidies.





Figure 34.45: Disaster-resilient housing and Vertical housing

34.13 RECREATION



The recreation sector proposals for Haripad aim to enhance the town's livability by expanding accessible, inclusive, and well-designed public recreational spaces. The focus is on developing parks, open spaces, riverfront areas, and community-level recreational facilities that promote social interaction, physical well-being, and environmental stewardship. Emphasis is placed on upgrading existing amenities, creating safe pedestrian-friendly environments, and integrating green and blue infrastructure to enrich the town's urban character. The goal is to establish a vibrant network of recreational spaces that supports community health, strengthens cultural identity, and contributes to Haripad's overall quality of life and sustainable urban development. The proposals aimed at improving this sector are:

- Renovate the Haripad Palace to serve as a central hub for cultural, recreational, and community activities.
- Promote the adaptive use of water bodies (Danapady thodu and Pillathodu) and their surroundings to compensate for the shortage of open spaces by developing waterfront promenades, leisure parks, and eco-recreation zones.
- Establishment of public reading rooms, art galleries, and an open-air theatre to strengthen cultural engagement.
- Renovate the Balamuruga Temple pond and develop a park around it to enhance the recreational and aesthetic value of the area.
- Beautify and develop a park around the Arayakulangara Temple pond to enhance its environmental and recreational value.

Based on the issues identified and the potential assessed, the following projects have been proposed to strengthen and enhance recreational facilities in Haripad.

34.13.1 Narayana Kulam - Pond rejuvenation & pond front redevelopment



The Narayana Kulam - Pond Rejuvenation & Pond-Front Redevelopment project aims to restore and enhance one of the most significant traditional water bodies in the Kuttedath Junction neighbourhood of Haripad. Narayana Kulam has long served as an important community asset, both functionally and socially, and its rejuvenation is envisioned as a key step toward improving the environmental quality and public realm of the locality.

The project includes comprehensive cleaning and desilting of the pond, structural strengthening through the construction of properly engineered pitching walls, and overall improvement of the water-holding capacity. The pond-front area will be redeveloped to create a safe, accessible, and socially vibrant public space. Proposed amenities include dedicated seating zones, traditional-style street lighting, walking tracks, shaded pavilions, landscaped edges, and improved access pathways, all designed to encourage daily use by residents and enhance community interaction.

Beyond its social and recreational value, the rejuvenated Narayana Kulam will play an important hydrological role. As the site falls within a flood-prone zone of Haripad, the upgraded pond will function effectively as a retention basin during intense rainfall, helping to manage stormwater and reduce local flooding.

Overall, the project aims to transform Narayana Kulam into a clean, active, climate-responsive, and culturally rooted public space, contributing both to neighbourhood wellbeing and to the broader environmental resilience strategy of Haripad Municipality

34.13.2 Kuzhiyilikulangara Pond - Rejuvenation & Pond-Front Redevelopment



The Kuzhiyilikulangara Pond Rejuvenation & Pond-Front Redevelopment project focuses on restoring and upgrading one of the compact yet culturally significant neighbourhood ponds within Haripad Municipality. Although small in scale, Kuzhiyilikulangara Pond plays an important role in the daily life of the surrounding community, offering both environmental value and the potential to serve as a meaningful social space. This project aims to enhance the pond's ecological health while creating a well-designed, accessible public environment for residents of the locality.

The proposed works include complete cleaning and desilting of the pond, strengthening of its edges through properly engineered pitching walls, and improving its water-holding capacity. The pond-front will be redeveloped with thoughtfully planned amenities such as comfortable seating areas, traditional-style street lighting, walking tracks, landscaped surroundings, and

shaded pavilions. These interventions intend to transform the pond edge into a welcoming, safe, and vibrant gathering space for people of all age groups.

As Kuzhiyilikulangara lies within a flood-prone part of Haripad, the rejuvenated pond will also serve an important hydrological function by acting as a retention pond during heavy rainfall events. This will support local stormwater management efforts and contribute to reducing waterlogging in the neighbourhood.

Overall, the project is envisioned as a community-centric environmental improvement initiative that enhances social infrastructure, strengthens resilience to flooding, and preserves the natural and cultural value of one of Haripad's cherished neighbourhood water bodies.

34.13.3 Kolath Temple Pond - Rejuvenation & Pond-Edge Redevelopment



The Kolath Temple Pond Rejuvenation & Pond-Edge Redevelopment project is conceived as an important cultural and community-focused environmental improvement initiative within Haripad Municipality. The Kolath Devi Temple is a well-known landmark in the region, deeply valued by local residents and frequently visited by devotees. Revitalizing the adjoining temple pond and upgrading its edges into a safe, accessible, and serene public space will greatly benefit the community- especially the elderly population who rely on such spaces for daily walks, social interaction, and spiritual reflection.

The project includes comprehensive cleaning and desilting of the pond, repair and strengthening of pond walls, and enhancement of the water-holding capacity. Surrounding areas will be redeveloped with elderly-friendly and barrier-free amenities such as comfortable seating, shaded pavilions, landscaped planters, walking paths, low-height railings/bollards, and small recreation decks that encourage relaxation and social gatherings. All design components will be developed with universal accessibility in mind, ensuring that older residents can use the space freely and comfortably throughout the day.



Figure 34.46: Map showing the location of ponds

Beyond improving cultural and social infrastructure, the rejuvenated Kolath Temple Pond will also support Haripad's flood resilience. Located within a flood-prone zone, the pond- once restored- will act as an effective retention basin for stormwater during intense rainfall, helping mitigate local flooding and improving drainage performance in the neighbourhood.

Overall, the project aims to honour the cultural significance of the Kolath Devi Temple while creating a calm, inclusive, and environmentally responsible public space that supports the wellbeing of both devotees and the wider community of Haripad.

34.13.4 Butterfly Park and Organic Vegetable Farming Park Trail - Ward 22



The Butterfly Park and Organic Vegetable Farming Park Trail is envisioned as a flagship eco-tourism and community recreation project in Ward 22 of Haripad Municipality. Set amidst an extensive stretch of agricultural land, the project is strategically located to support Haripad's broader vision of becoming a state-level hub and model for organic vegetable farming. With increasing interest from tourists, students, and urban families in sustainable farming practices, the project aims to create an engaging destination where visitors can experience organic farming, floriculture, and natural habitat-based attractions in a single cohesive environment.

The proposed park will be integrated with Kudumbashree-led floriculture initiatives and surrounded by a network of organic vegetable farms, creating a vibrant agricultural tourism corridor. A dedicated Butterfly Park- carefully designed to support local biodiversity and surrounded by flowering farms- will serve as the signature attraction of the site. The project also includes rejuvenation of the existing pond within the site, ensuring ecological balance and enhancing the visual and recreational experience for visitors.

Key components of the project include well-planned walkways, shaded pavilions, seating clusters, landscaped viewing points, bicycle parking and rental facilities, tourist signage, organic vegetable outlets, CCTV surveillance, street lighting, and barrier-free access throughout the park. Designed to be child-friendly, elderly-friendly, and universally accessible, the park will function as an active social infrastructure asset for the neighbourhood while also strengthening Haripad's tourism appeal.

Overall, the Butterfly Park and Organic Vegetable Farming Park Trail is envisioned as a unique blend of environmental education, nature-based recreation, and sustainable tourism- positioning Haripad as an exemplar for eco-friendly agricultural development in Kerala.

34.13.5 Gender Park near Arayakulangara Devi Temple Pond



The Gender Park near Arayakulangara Devi Temple Pond is envisioned as a nature-based, inclusive public space that brings together ecological restoration, cultural heritage, and community wellbeing in one cohesive environment. Located beside the culturally significant Arayakulangara Devi Temple Pond, the project aims to rejuvenate the pond ecosystem while creating a vibrant recreational and social infrastructure accessible to all residents- irrespective of age, gender, or ability. Designed as a model public space rooted in sustainability and cultural sensitivity, the park will contribute directly to Haripad's goals of

improving liveability, promoting public health, enhancing tourism, and strengthening community bonds.

The project integrates environmental stewardship with user-friendly amenities. Ecological interventions focus on pond-edge greening, improved water management, and sensitive landscaping. Community-oriented features include a scenic jogging/walking track, an open mini-gym to promote fitness, dedicated children's play zones, and landscaped garden spaces that support relaxation and well-being. A small open stage will serve as a platform for cultural events, neighbourhood gatherings, and awareness programmes, encouraging active community participation. Ambient lighting, clear signage, comfortable seating, and barrier-free pathways will ensure that the park remains safe, welcoming, and accessible throughout the day and evening. By combining ecological restoration, recreational development, and cultural preservation, the Gender Park near Arayakulangara Devi Temple Pond will serve as a multi-functional public asset- supporting tourism, community engagement, environmental resilience, and improved urban quality of life for the people of Haripad.

34.13.6 Urban Park near Manimangalam Balamuruga Temple



The Urban Park near Manimangalam Balamuruga Temple is proposed as a town-level recreational space designed to serve the residents of Haripad with accessible, high-quality public infrastructure. Located close to one of the culturally significant temples of the region, the park is intended to offer a peaceful and vibrant urban environment where people of all age groups can gather, exercise, relax, and interact. As Haripad continues to grow, the need for well-planned, inclusive, and environmentally rich urban parks becomes essential for improving public health, fostering community connections, and enhancing the overall liveability of the town.

The proposed development includes a network of walkways and jogging tracks, enabling daily fitness activities in a safe and green setting. Seating areas, shaded rest points, and landscaped zones will make the park comfortable for families, senior citizens, and casual visitors. Extensive plantation, butterfly gardens, and thoughtfully designed hardscaping elements will create a visually appealing and ecologically vibrant space. The park will also feature smart dustbins, ensure cleanliness and enabling better waste management. Special attention is given to facilities for the elderly and persons with disabilities, making the entire park barrier-free and universally accessible. A designated children's play area with safe play equipment will serve the recreational needs of younger visitors.

Overall, the Urban Park is envisioned as a safe, inclusive, and nature-friendly recreational destination that elevates the quality of public open spaces in Haripad, encourages healthier lifestyles, and strengthens the cultural and social vitality of the neighbourhood.

34.13.7 Children's Park and Outdoor Fitness Centre



The Children's Park and Outdoor Fitness Centre project proposes the redevelopment of the existing West Transformer site in Ward 26 into a safe, inclusive, and vibrant neighbourhood-level open space for recreation and wellness. Haripad currently faces a shortage of well-distributed public recreational areas, particularly spaces that cater simultaneously to children, adults, and the elderly. This project addresses that gap by transforming an underutilised urban parcel into a community-focused social infrastructure asset.

The proposed facility will include a dedicated children's play area with age-appropriate, safe play equipment, soft landscaping, and shaded seating for caregivers. Complementing this, an outdoor fitness zone will be developed for adults and senior citizens, equipped with open-air gym equipment, walking and jogging paths, and rest areas. Universal accessibility, safety, and comfort will guide the design, with features such as barrier-free pathways, adequate lighting, clear visibility, drinking water points, and waste bins.

By activating the West Transformer site with recreational and fitness-oriented uses, the project will promote healthy lifestyles, encourage intergenerational interaction, and enhance the quality of life for residents of Ward 26. The park is envisioned as a green neighbourhood anchor- supporting physical well-being, social interaction, and everyday leisure- while contributing to Haripad's broader vision of creating a healthier, more liveable, and people-friendly urban environment.

34.13.8 Swimming Classes for Children and Adults



The Swimming Classes for Children and Adults project is proposed as a community-focused health, safety, and skill-development initiative under the Haripad Master Plan. Swimming is widely recognised as a low-impact, full-body physical activity with long-term health benefits for people of all age groups. In a town like Haripad, which is endowed with numerous ponds, canals, and water bodies, swimming is not only a recreational skill but also an essential life skill linked to water safety and disaster preparedness. The project proposes to organise structured swimming training programmes for children, youth, adults, and senior citizens through certified trainers and lifeguards. These programmes may be conducted either as annual weekly classes or as intensive courses during summer vacations. Selected public ponds and safe water bodies will be identified and upgraded with basic safety infrastructure such as steps, railings, depth markings, safety ropes, changing areas,

and first-aid support. Emphasis will be placed on teaching swimming techniques along with water safety awareness, rescue basics, and the dos and don'ts of entering natural water bodies.

By utilising existing public ponds in a planned and supervised manner, the project promotes cost-effective use of local resources while encouraging physical fitness, confidence, and community engagement. The initiative will also help reduce the risk of drowning accidents, particularly during floods and monsoon seasons, and foster a culture of respect and safety around water. Overall, the Swimming Classes for Children and Adults project aims to improve public health, enhance life skills, and strengthen Haripad's resilience as a water-rich town

34.13.9 Municipal Sports Centre and Playground



The Municipal Sports Centre and Playground project aims to upgrade and revitalise the existing municipal ground at Thrippakudam into a modern, inclusive, and multi-functional sports facility for Haripad. With the ongoing construction of the 7 LL OHSR under AMRUT 2.0 within the same premises, the need for a well-planned, dedicated sports infrastructure has become even more important for the town's youth and sporting community. The proposed initiative envisions a compact yet high-quality sports centre equipped with indoor training spaces, fitness amenities, changing rooms, and basic utilities, alongside an enhanced outdoor playground suitable for athletics, football, cricket, and community-level recreation.

The redevelopment will include improved turfing, boundary fencing, seating stands for spectators, night lighting, jogging tracks, practice nets, children's play facilities, and landscaped green buffers to ensure safety and comfort. The sports centre will also serve as a hub for youth engagement, coaching programmes, inter-school tournaments, and community wellness activities. By strengthening physical infrastructure and creating accessible recreational spaces, the project supports Haripad's broader vision of promoting healthy living, youth development, and social wellbeing across the municipality.



Figure 34.47: Conceptual view of proposed Sports Centre and playground at Thrippakudam

34.14 OTHER CIVIC AMENITIES



The proposals for Other Civic Amenities in Haripad aim to enhance the quality, accessibility, and reliability of essential public services that support everyday urban life. The focus is on upgrading community facilities such as public toilets, crematoriums, community halls, and markets, while improving maintenance standards and service delivery mechanisms. Emphasis is placed on ensuring universal accessibility, integrating user-friendly design, and strengthening operational efficiency through modern management practices. The goal is to create a well-equipped and responsive civic infrastructure system that upholds public convenience, supports community well-being, and contributes to Haripad's broader vision of a livable and inclusive town

- Complete and operationalize the crematorium with proper flood-resilient infrastructure, including improved access road, stormwater drainage, and landscaping to prevent waterlogging.
- Establish additional public toilets and comfort stations in high-traffic areas to meet the sanitation needs of residents and visitors.
- Upgrade the infrastructural facilities associated with civic amenities.

Based on the key issues identified and the development potential assessed, the following projects have been proposed to strengthen and upgrade Other Civic Amenities in Haripad, with the aim of improving service delivery, accessibility, and overall quality of urban life.

34.14.1 Municipal Crematorium, Chooralackal



The Municipal Crematorium at Chooralackal is proposed as a modern, inclusive, and dignified cremation facility serving the entire Haripad Municipal area. As the town continues to grow, the need for a well-equipped, hygienic, and accessible crematorium that accommodates people of all faiths has become increasingly important. The project aims to provide a respectful, safe, and user-friendly environment for families during times of bereavement, while ensuring that all cremation practices take place in accordance with environmental norms and public health standards.

The proposed crematorium will include modern cremation chambers, waiting and resting areas for families, sheltered seating zones, washrooms, a prayer/ritual platform, and designated spaces for multi-faith ceremonies. The site will also incorporate landscaped surroundings, proper lighting, internal pathways, a reception/help desk, drinking water points, and secure boundary fencing. To meet environmental compliance, the project will include emission-controlled cremation units, ash collection and storage areas, waste handling systems, and

dedicated access for hearse vehicles. Adequate parking, CCTV surveillance, and disaster/safety measures will further ensure smooth and safe operations.

Overall, the Municipal Crematorium at Chooralackal is envisioned as a crucial civic amenity that provides dignity, comfort, and accessibility to residents of Haripad, while strengthening the town's social infrastructure and environmental responsibility.

34.14.2 Janamandapam - Town Hall and Urban Library



The Janamandapam - Town Hall and Urban Library project is envisioned as a key civic and cultural landmark for Haripad, located at the historic Town Hall Junction in the heart of the town. Town halls and public libraries play a vital role in nurturing civic life, providing inclusive spaces for public dialogue, cultural expression, learning, and community engagement. Haripad earlier had a town hall at this very location, which had to be demolished due to legal and maintenance challenges, leaving a significant gap in the town's public infrastructure. At present, only a small library and reading room operate on the site, with limited capacity and facilities.

The proposed project seeks to redevelop the site into a modern, well-designed Town Hall and Urban Library complex that reflects Haripad's cultural legacy, heritage, and evolving urban aspirations. The new facility will house a multipurpose town hall suitable for public meetings, cultural programmes, seminars, exhibitions, and civic events, along with a contemporary library equipped with reading halls, children's sections, digital resources, and community learning spaces. The design will emphasize accessibility, inclusivity, and flexibility, ensuring that people of all age groups can use the facility comfortably.

Envisioned as a vibrant public anchor, Janamandapam will strengthen community life, support cultural activities, encourage reading and lifelong learning, and provide a dignified space for civic interaction. As part of Haripad's future development vision, the project will help reinforce the town centre's identity, enhance social infrastructure, and create a shared public space that truly belongs to the people of Haripad.

34.14.3 Smart Streetlight Management System



The Smart Streetlight Management System is proposed as a key urban infrastructure upgrade under the Haripad Master Plan, aimed at improving energy efficiency, public safety, and operational management of street lighting across the town. At present, conventional streetlights result in high energy consumption, limited monitoring capability, delayed maintenance response, and avoidable power losses. With Haripad increasingly focusing on sustainability, smart governance, and climate resilience, upgrading to an intelligent lighting system is both timely and necessary.

Under this project, existing streetlights will be progressively replaced or retrofitted with IoT-enabled LED and solar-hybrid streetlights. These lights will be centrally monitored through a digital control platform that allows real-time tracking of energy consumption, fault detection, dimming schedules, and on–off automation based on time, traffic movement, or ambient light conditions. Solar-hybrid systems will reduce dependency on grid power, especially in residential streets, parks, canal fronts, and pedestrian corridors.

The system will significantly reduce electricity costs, carbon emissions, and maintenance downtime, while improving nighttime visibility and safety for pedestrians, cyclists, and motorists. Integration with emergency response systems and CCTV infrastructure can further enhance urban safety. The project also supports disaster resilience by ensuring uninterrupted lighting in critical areas during floods or power disruptions.

Overall, the Smart Streetlight Management System will help Haripad transition towards a smarter, greener, and more efficient urban environment, strengthening municipal service delivery while aligning with the town's long-term sustainability and energy goals.

34.14.4 Ward-Level Citizen Facilitation Centres - Local counters for decentralized service delivery & Pakalveedus



The Ward-Level Citizen Facilitation Centres are envisioned as inclusive, community-focused facilities that strengthen grassroots governance and improve access to essential public services across Haripad. Public participation and responsive local administration are critical for the effective functioning of a town, and Ward Councillors play a key role as the first point of contact between citizens and the municipal system. This project proposes the establishment of dedicated centres at the ward level to make councillors more accessible and to provide a convenient, neighbourhood-based platform for service delivery and community engagement.

Each centre will function as a local office for the Ward Councillor, equipped to handle citizen grievances, consultations, and ward-level coordination. In addition, the centres will offer digital facilitation services such as assistance with online applications, certificates, welfare schemes, pensions, utility payments, and other e-governance services- particularly benefiting the elderly, women, and digitally underserved sections of the population. The facilities will also include multipurpose spaces forward meetings, public discussions, awareness programmes, and community activities, thereby strengthening participatory planning and local decision-making. Recognising the growing need for senior citizen care infrastructure, the project also integrates Pakalveedu (day-care centres for the elderly) within these facilities. These spaces will provide a safe, supportive, and socially engaging environment for older residents during the day, offering opportunities for recreation, interaction, basic health monitoring, and rest. This integration responds to Haripad's changing demographic profile and supports ageing-in-place within neighbourhoods.

The Ward-Level Citizen Facilitation Centres with Pakalveedus aim to decentralise service delivery, enhance transparency and citizen trust, promote social inclusion, and build stronger, more resilient communities. By bringing governance, services, and care facilities closer to people's homes, the project directly contributes to improved quality of life and more responsive urban management in Haripad.

34.14.5 Inclusive Public Comfort Stations / "Take a Break" Facilities - Nelpurakadavu, Mannarasala Temple, Town Centre & Danapady Road



The Inclusive Public Comfort Stations / "Take a Break" project is proposed as an essential urban amenity initiative to improve public convenience, hygiene, and inclusivity across key activity nodes of Haripad. Locations such as Nelpurakadavu, Mannarasala Temple, the Town Centre, and Danapady Road witness high daily footfall from residents, pilgrims, tourists, traders, and commuters, yet currently lack adequate, well-maintained public comfort facilities. The absence of such infrastructure affects public health, particularly women, children, the elderly, and persons with disabilities, and reduces the overall quality of the public realm.The project envisages the development of clean, safe, and universally accessible comfort stations integrated with rest areas, in line with the State Government's "Take a Break" initiative. Each facility will include gender-segregated toilets, accessible toilets for persons with disabilities, baby-care and feeding rooms, drinking water points, hand-wash stations, shaded seating, and basic first-aid provisions. Solar-powered lighting, rainwater harvesting, wastewater treatment where feasible, CCTV surveillance, and proper solid waste management systems will be incorporated to ensure sustainability, safety, and ease of maintenance.

Designed as small yet dignified public facilities, these comfort stations will also act as resting points for pilgrims, tourists, elderly citizens, and workers, particularly along temple corridors, tourism zones, and commercial stretches. By improving sanitation infrastructure at strategic locations, the project will enhance public health outcomes, support tourism and economic activity, and significantly improve the everyday experience of people using Haripad's public spaces. The initiative strengthens Haripad's social infrastructure by ensuring that essential public amenities are accessible, inclusive, and responsive to the needs of a growing and diverse population.

34.14.6 Municipal Private Bus Stand



The Municipal Private Bus Stand is proposed as a key urban mobility infrastructure project aimed at strengthening Haripad's regional and intra-town connectivity. With the town steadily improving its civic amenities and positioning itself as a growing tourism and pilgrimage destination, the need for an organized, efficient, and well-located private bus terminal has become critical. The proposed site, strategically located near NH

66, offers seamless access for commuters and visitors entering the town from major regional routes. The facility is envisioned to serve both intra-town and short-distance regional travel, ensuring that residents, daily commuters, and tourists experience smooth and reliable public transport. A notable feature of the project is the planned integration of mini-buses and shared mini-auto routes, designed to reach neighbourhoods and peripheral areas where formal bus services are currently limited or unavailable. These last-mile services will be especially beneficial for tourists and pilgrims visiting Haripad's major temples and cultural destinations, offering easy access from the terminal to different parts of the town.

Key project components include designated bus bays, sheltered passenger waiting areas, ticketing counters, digital information displays, washrooms, drinking water facilities, parking for autos and mini-buses, dedicated pick-up and drop-off lanes, CCTV surveillance, street lighting, and barrier-free pathways for universal access. Provision for kiosks, seating, landscaping, and clear signage will further enhance user comfort and overall experience.

The Municipal Private Bus Stand is envisioned as an essential mobility infrastructure project that supports Haripad's economic growth, strengthens tourism, improves last-mile connectivity, and provides a safe, organized, and commuter-friendly public transport environment for the entire town.

34.14.7 Haripad KSRTC Bus Stand - Passenger Amenities Enhancement Project



The Haripad KSRTC Bus Stand Amenities Enhancement project is proposed as a key town-level public infrastructure upgrade aimed at improving regional connectivity and strengthening Haripad's position as an emerging hub for religious and cultural tourism. KSRTC is one of the most widely used modes of transport for visitors arriving from across Kerala, especially during temple festivals and major events. Although Haripad currently has a functioning KSRTC bus stand, the facility lacks several essential passenger amenities that are critical for traveller comfort, safety, and convenience.

Upgrading the bus stand with modern, user-friendly facilities will significantly enhance the travel experience, promote tourism, and support Haripad's growing influx of pilgrims and visitors.

The proposed enhancement will include clean and well-maintained restrooms, a cloakroom, drinking water kiosks, digital information displays, covered waiting areas, improved seating, and a dedicated help desk. Additional components such as CCTV surveillance, improved lighting, accessible pathways, structured bus bays, vending kiosks, first-aid booths, mobile charging points, and directional signage will further strengthen the quality of service offered at the bus stand. Landscaping, queue management systems, and improved pedestrian safety features will ensure that the facility remains organised and welcoming even during peak festival seasons. The Haripad KSRTC Bus Stand Amenities Enhancement project aims to provide a safe, comfortable, and modern transit environment for daily commuters, tourists, and

pilgrims- contributing significantly to the town's tourism vision, civic pride, and overall liveability.

34.14.8 Urban Bus Shelters



The Urban Bus Shelters at Danapady and Subramanya Swamy Temple Road project aims to enhance public transport convenience and passenger comfort at two of Haripad's most prominent transit locations, identified through NATPAC's Traffic and Transportation Study for Haripad. The proposed shelters will be equipped with modern, commuter-friendly amenities including comfortable seating, digital display boards, drinking water kiosks, mobile charging points, waste receptacles, and barrier-free ramps, ensuring universal accessibility. Located strategically near Danapady Junction and along the Subramanya Swamy Temple Road, these shelters will significantly improve last-mile connectivity to major religious destinations such as the Subramanya Swamy Temple and Mannarasala Temple, while also easing travel for daily commuters. Designed with safety, convenience, and inclusivity in mind, the upgraded shelters will contribute to a more organized urban transport experience and support Haripad's broader vision of becoming a well-connected, visitor-friendly town

34.15 ENVIRONMENT



The environment sector proposals for Haripad focus on safeguarding the town's natural assets while promoting sustainable and climate-resilient urban development. The interventions aim to protect ecologically sensitive areas, enhance green cover, conserve water bodies, and improve overall environmental quality through scientifically guided management practices. Emphasis is placed on reducing pollution, strengthening climate adaptation and disaster resilience, and integrating nature-based solutions into urban planning. The goal is to create a clean, healthy, and ecologically balanced environment that supports public well-being, enhances resilience to climate risks, and aligns with Haripad's long-term vision for sustainable growth. The proposals aimed at improving this sector are:

- Restore ponds, canals and marshy lands to enhance ecological functions and water storage capacity.
- Promote eco-tourism projects by preserving and integrating Nelpurakadavu, canals, streams, and adjacent paddy fields
- Develop eco-friendly walkways, cycle tracks, and waterfront promenades along renovated canals and ponds.
- Enforce waste management regulations to prevent dumping into canals and fields.

Environmental conservation is a critical priority for Haripad, given its rich ecological assets and vulnerability to climate-related risks. Accordingly, in addition to policy measures and regulatory frameworks, a set of targeted projects has been identified under the Environment

Sector to strengthen ecological resilience, enhance green cover, and promote sustainable environmental management across the town.

34.15.1 Mangrove Fringe along canals and agricultural fields



The Mangrove Fringe along Canals and Fields project is proposed as an ecological and climate-resilience initiative aimed at protecting Haripad's flood-prone agricultural landscapes along the Achankovil stretch. Frequent saline intrusion and seasonal flooding have significantly reduced agricultural productivity, forcing farmers to shift from multiple crop cycles to a single annual harvest. Establishing a scientifically planned mangrove buffer along vulnerable canal edges, riverbanks, and field boundaries will help restore natural protection systems while strengthening long-term agricultural sustainability.

The project involves the strategic plantation of native mangrove species such as Rhizophora mucronata, Rhizophora apiculata, Avicennia officinalis, and Acanthus ilicifolius- all known for their ability to reduce wave impact, stabilize soil, minimize erosion, and serve as a biological barrier against saline intrusion. The width, density, and planting pattern of the mangrove belts will be determined through scientific assessment, ensuring that the intervention is ecologically appropriate and effective for the local hydrological conditions. The initiative will help revive the traditional multi-crop cultivation system, reduce field degradation, enhance biodiversity, and create a natural defense line for both farmlands and rural settlements. Overall, the project aims to blend environmental conservation with agricultural resilience, supporting farmers, improving local ecology, and enhancing Haripad's long-term climate adaptation capacity.

34.15.2 Pachathuruthu - Miyawaki Urban Forest Initiative



The Pachathuruthu - Miyawaki Forest project is proposed as a green infrastructure initiative aimed at significantly increasing the urban green cover of Haripad. The project envisages the creation of dense, native-species mini forests using the Miyawaki method on suitable vacant plots, unused municipal lands, and underutilized public spaces across the town. This approach enables rapid growth of self-sustaining forests within a small footprint, making it particularly suitable for an urban context like Haripad, where land availability is limited but ecological needs are high.

By planting a diverse mix of indigenous tree, shrub, and ground-cover species in high density, the project will help improve local microclimates, enhance biodiversity, reduce urban heat island effects, and improve air quality. Pachathuruthu forests can also act as natural buffers against flooding by improving soil infiltration and reducing surface runoff- an important consideration given Haripad's vulnerability to waterlogging and climate-related risks.

In addition to ecological benefits, the project is envisioned as a community-driven initiative. Local residents, schools, youth groups, Kudumbashree units, and ward-level institutions can be actively involved in plantation and maintenance, fostering environmental stewardship and public ownership. Over time, these green pockets can serve as informal learning spaces, neighbourhood recreation areas, and visual relief within the urban fabric.

Overall, the Pachathuruthu - Miyawaki Forest project supports Haripad's vision of becoming a greener, healthier, and more climate-resilient town, while demonstrating how small-scale, low-cost ecological interventions can deliver long-term environmental and social benefits.

34.16 HERITAGE



The heritage sector proposals for Haripad focus on preserving, revitalizing, and celebrating the town's rich cultural, architectural, and religious legacy. The interventions aim to protect significant heritage structures, strengthen traditional precincts, and enhance the cultural identity of Haripad through sensitive conservation and context-appropriate development. Emphasis is placed on improving visitor amenities, promoting cultural tourism, documenting intangible heritage, and integrating heritage-led planning into the broader urban framework. The goal is to safeguard Haripad's historical character while enabling sustainable economic and cultural opportunities that reinforce the town's unique identity and long-term development vision.

- Promote adaptive reuse of historic buildings as cultural centers, museums, and community spaces to integrate heritage into daily life
- Develop temple-based tourism circuits, heritage walks, and cultural festivals to attract visitors while preserving authenticity
- Creation of curated workshops for mask making, kalamezhuthu, kolam varavu etc based on Kanjoor devi temple practices.

Haripad possesses several buildings and precincts of significant heritage value; however, many of these structures are presently in a dilapidated state due to inadequate maintenance and lack of conservation efforts. Despite their condition, these heritage assets hold considerable potential for cultural revival and tourism development if appropriately conserved, restored, and adaptively reused. Accordingly, the following projects have been identified to strengthen the conservation and sustainable utilisation of Haripad's built heritage.

34.16.1 Karimpalil Palace- Haripad Visitors Center



The Karimpalil Palace–Haripad Visitors' Centre project aims to transform one of Haripad's most culturally significant heritage precincts into a welcoming gateway for tourists and pilgrims. Located near the railway station, KSRTC stand, and NH-66 junction, the site offers exceptional visibility and accessibility, making it ideal as the town's primary visitor interface. The initiative focuses on the conservation and adaptive reuse of the historic Karimpalil Palace, integrating it with modern visitor

facilities such as information services, rest and cloak amenities, mobility support, and community spaces. By combining heritage restoration with high-quality public infrastructure, the project strengthens Haripad's identity as a temple town, enhances the overall tourism experience, and positions the precinct as a vibrant cultural node within the broader urban regeneration framework.

34.16.2 Haripad Cultural centre- Haripad Kottaram Premise Redevelopment



The Haripad Cultural Centre project envisions the comprehensive conservation and adaptive reuse of the historic Haripad Kottaram, an Ettukettu palace complex located directly opposite the Haripad Subramanya Swamy Temple. Currently functioning as the office of the Deputy Chairman, Travancore Devaswom Board, the structure and its surrounding premises are in a deteriorated state, despite their immense architectural, cultural, and historical significance. Redeveloping the site into a vibrant cultural hub offers an opportunity to showcase Haripad's rich temple traditions, performing arts, ritual practices, and heritage craft forms.

The proposal includes restoring the Ettukettu structure using conservation-led architectural techniques and converting it into a cultural museum and intimate performance space that narrates the heritage of Haripad and its temple ecosystem. The broader campus will be reimagined as a multifunctional cultural precinct featuring an open-air amphitheatre for traditional art forms, a tourist facilitation centre, curated craft experience zones, a traditional Kerala restaurant, landscaped courtyards, and dedicated pedestrian areas. Additional components include bicycle parking and rental facilities, souvenir shops, a community hall for small functions, accessible walkways, interpretive signage, and improved lighting and safety infrastructure.

The centre will also host curated cultural residencies and workshops- such as Kalamezhuthu, mask-making, temple art, percussion, and craft demonstrations- providing immersive experiences for tourists and creating livelihood opportunities for local artists. Proper relocation of the existing elephant shelter, provision of adequate utilities, and strict heritage-compatible architectural controls will ensure that all interventions respect the cultural integrity of the site.



Figure 34.48: Map showing the location of Haripad Cultural Centre

When fully developed, the Haripad Cultural Centre will serve not only as a major tourism anchor but also as a civic gathering space that celebrates living traditions, supports artisans, and strengthens Haripad's identity as a culturally vibrant temple town. This transformative project aims to position the Kottaram precinct as a landmark destination for heritage interpretation, community engagement, and cultural continuity.



Figure 34.49: Conceptual view of Haripad Cultural Centre (Haripad Kottaram Redevelopment)

34.17 SPECIAL CONCERN AREAS



The proposals for Special Concern Areas in Haripad focus on addressing locations and communities that require prioritized attention due to environmental sensitivity, socio-economic vulnerability, development imbalances, or strategic importance. This includes interventions targeted at marginalized groups, Other Backward Classes (OBC), and socially disadvantaged communities to ensure equitable access to opportunities and essential services. The emphasis is on improving welfare facilities, enhancing basic infrastructure, strengthening disaster resilience, and promoting inclusive community development through context-specific planning solutions. The goal is to create a safer, more balanced, and socially just urban environment where all residents- especially those in vulnerable or underserved areas- benefit from Haripad's development vision.

- Improve roads, drainage, and sanitation for better accessibility and hygiene in Nagar areas

- Promote resilient housing through government schemes in Nagar areas
- Support self-help groups (SHGs and micro-enterprises for income generation in Nagar areas

Certain areas within Haripad require focused and sensitive planning interventions due to their unique social, environmental, cultural, or functional significance. Addressing these areas with priority is essential to ensure inclusive development, risk reduction, and long-term sustainability. In this context, the following project has been identified to strengthen and address the needs of Special Concern Areas within the town

34.17.1 Urban Pulse Hub - Youth & Innovation Centre



The Urban Pulse Hub is envisioned as a vibrant, multi-functional youth development and innovation centre for Haripad. Conceived as a single destination for learning, skill-building, and recreation, the facility aims to bring together young people from across the town and provide them with the resources, opportunities, and environment needed to enhance their employability, creativity, and overall wellbeing.

The project will include a mini library, Akshaya service centre, incubation and entrepreneurship support facilities, capacity-building classrooms, co-working spaces, a gymnasium, and dedicated recreation zones. By integrating digital access, training opportunities, and shared workspaces under one roof, the Urban Pulse Hub is designed to nurture talent, encourage innovation, and strengthen youth participation in the town's social and economic growth.

As a landmark civic space, the Urban Pulse Hub will play a key role in empowering Haripad's youth- offering them a supportive environment to learn, collaborate, and pursue personal and professional development.



Figure 34.50: Conceptual view of Urban Pulse Hub

34.18 GOVERNANCE



The governance sector proposals for Haripad aim to strengthen institutional capacity, improve administrative efficiency, and enhance service delivery across all municipal functions. The focus is on modernizing governance systems through digital platforms, promoting data-driven decision-making, ensuring transparent and accountable processes, and strengthening inter-departmental coordination. Emphasis is placed on building the capacity of municipal staff, improving citizen engagement mechanisms, and integrating regulatory reforms that support effective implementation of the Master Plan. The goal is to establish a responsive, efficient, and future-ready urban governance framework that enables sustainable development, fosters public trust, and ensures that Haripad's growth is managed in a coordinated and equitable manner.

- Strengthen municipal institutional capacity through staff training, digital tools, and improved inter-departmental coordination.
- Promote transparency by publishing periodic municipal performance and progress reports.
- Implement e-governance platforms for core municipal services such as revenue, licensing, and health management.
- Promote app-based tourism promotion ideas

34.19 GOAL BASED DECISION TREE

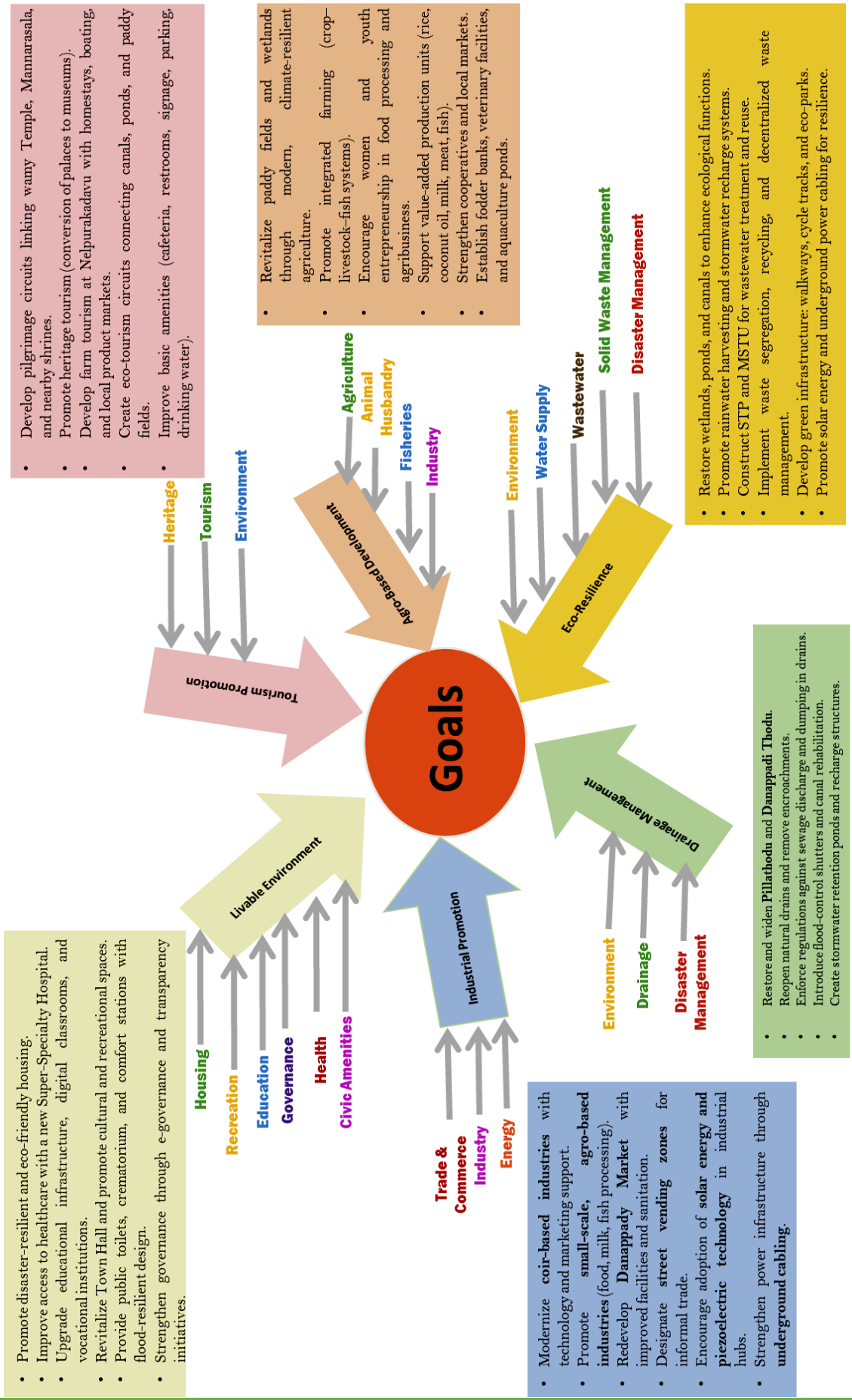


Figure 34.51 : Goal Based Decision Tree

CHAPTER
35

DISASTER RISK REDUCTION (DRR), MITIGATION AND CLIMATE CHANGE ADAPTATION



The Master Plan adopts an integrated framework for Disaster Risk Reduction, Mitigation and Climate Resilience, combining structural measures - such as drainage upgrades, embankment strengthening and ecosystem-based solutions - with non-structural strategies like zoning, hazard mapping, early warning systems and community capacity building. By mainstreaming climate adaptation and enhancing institutional coordination across key sectors - agriculture, fisheries, industry, tourism and water management - the plan seeks to safeguard livelihoods, sustain essential services and promote resilient, sustainable growth.

- Introduction
- DRR Strategies, Actions And Projects In Haripad
- Priority Focus Areas For DRR And Mitigation Planning
- Non Structural Measures
- Structural Measures
- Proposals For Vulnerability Reduction
- Proposals For Climate Change Adaptation
- Inference

35. DISASTER RISK REDUCTION (DRR), MITIGATION AND CLIMATE CHANGE ADAPTATION

35.1 General

Haripad Municipality, located in a multi-hazard prone region of Kerala, faces recurring natural and climate-induced risks including floods, droughts and heat waves. The growing impacts of climate change are expected to increase the frequency and intensity of these hazards, posing significant threats to lives, livelihoods, infrastructure, and ecosystems. These risks are aggravated by unregulated development in flood-prone areas, inadequate drainage, groundwater depletion, and changing land-use patterns such as the decline of paddy cultivation and the expansion of rubber and other commercial crops. Reduced youth participation in agriculture and rising rainfall variability have further weakened local resilience, intensified urban heat stress and undermined agricultural productivity.

In response, the Master Plan adopts an integrated framework for Disaster Risk Reduction (DRR), Mitigation, and Climate Resilience that combines both structural and non-structural measures. Structural measures include drainage enhancement, embankment strengthening, flood retention ponds, and ecosystem-based interventions, while non-structural measures encompass zoning regulations, hazard mapping, early warning systems, capacity building, and community awareness. The plan emphasizes strengthening institutions, improving coordination among agencies, and mainstreaming climate adaptation into governance and development practices. By embedding resilience strategies across key sectors - agriculture, fisheries, industries, tourism, water management, and ecosystem restoration - the plan seeks to safeguard livelihoods, sustain essential services, and promote balanced growth. Through this integrated, forward-looking approach, the plan aims to reduce vulnerabilities, enhance adaptive capacity, and build a climate-resilient future for the people and environment of the town.

Through this integrated, sector-focused approach, the Master Plan aims not only to reduce immediate risks but also to build long-term resilience. The vision is to safeguard lives, protect livelihoods, and promote sustainable urban and rural development, positioning Haripad to adapt effectively to an increasingly uncertain climate future.

35.1.1 Disaster Risk Reduction

Disaster Risk Reduction (DRR) is a systematic approach aimed at identifying, assessing, and minimizing the risks of disasters through proactive planning, preparedness, and resilience-building. It is based on the recognition that disasters are not merely the outcome of natural hazards but are significantly shaped by conditions of exposure, vulnerability, and insufficient adaptive capacity. Effective DRR therefore seeks to address not only the hazards themselves but also the social, economic, and environmental vulnerabilities that transform hazards into disasters. It emphasizes an integrated and multi-sectoral approach involving governments, communities, and institutions to reduce potential losses and enhance long-term sustainability. By strengthening early warning systems, promoting risk-informed development planning, and fostering community awareness, DRR contributes to safer and more resilient societies.



Figure 35.1 : Guiding principles for implementing Disaster Risk Reduction

Mitigation refers to the long-term measures undertaken to reduce the adverse impacts of hazards and climate-induced risks. It includes both structural interventions (such as embankments, drainage systems, resilient infrastructure) and non-structural measures (such as land-use regulation, awareness generation, risk-informed planning, and institutional coordination). Mitigation efforts aim to break the cycle of recurrent losses and build a foundation of resilience that strengthens communities against future events.

Climate change has emerged as a critical driver that magnifies disaster risks. Increasingly erratic rainfall, sea-level rise, rising temperatures, and more frequent extreme weather events intensify vulnerabilities across sectors. Urban centres, agrarian communities, and coastal regions are particularly at risk. Integrating climate change adaptation into DRR and development planning is now considered indispensable for ensuring sustainable and resilient urban and regional development. National and global frameworks such as the Sendai Framework for Disaster Risk Reduction (2015–2030), the Paris Agreement on Climate Change (2015), and India's National Disaster Management Plan (2019) emphasize the need for integrated strategies that simultaneously address disaster preparedness, mitigation, and climate resilience.

35.1.2 The Prime Minister's Ten Point Agenda for Disaster Risk Reduction

The Prime Minister's Ten Point Agenda for Disaster Risk Reduction (Figure 35.2), announced at the 2016 Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR) in New Delhi, and provides a practical framework to integrate disaster preparedness, resilience, and sustainability into development planning. It emphasizes awareness, capacity building, and collaboration across sectors to build a safer and more resilient India.

THE PRIME MINISTER'S TEN-POINT AGENDA ON DRR	MAJOR STEPS TAKEN TOWARDS THE IMPLEMENTATION OF PRIME MINISTER'S TEN-POINT AGENDA ON DISASTER RISK REDUCTION.
1.  **All development sectors must imbibe the principles of disaster risk management.**	◦ National Disaster Management Authority (NDMA) has developed the first National Disaster Management Plan (NDMP) in 2016 ◦ NDMA has approved 36 disaster management plans of different Ministries / Departments. ◦ India was instrumental in the establishment of Coalition for Disaster Resilient Infrastructure (CDRI). It is headquartered in New Delhi.
2.  **Risk coverage must include all, starting from poor households to SMEs to multi-national corporations to nation states.**	◦ NDMA has been working with several national institutions like IDRAI, General Insurance Corporation of India etc. in designing insurance products.
3.  **Women's leadership and greater involvement should be central to disaster risk management.**	◦ Participation of women in disaster risk management is increased through imparting training to women as Aapda Mitra volunteers, maintenance and management of Cyclone Shelter Management & Maintenance Committees (CSMMC) in the country through 50% women participation. ◦ Key roles to women are ensured in various Task Force Groups related to disaster preparedness and rescue operations, training and mock drills etc. ◦ Mahila Contingent from Central Armed Police Forces (CAPFs) are also trained and deployed for National Disaster Response Force (NDRF)
4.  **Invest in risk mapping globally to improve global understanding of nature and disaster risks.**	◦ NDMA has developed a web-based Dynamic Composite Risk Atlas and Decision Support System (Web-DCRA & DSS tool) for cyclone risk mitigation and response planning. ◦ Flood Hazard Atlas have been developed by National Remote Sensing Centre (NRSC) for flood prone states. ◦ Building Material & Technology Promotion Council (BMTPC) has developed a digital atlas that captures the vulnerability of various parts of the country to different hazards ◦ NRSC has prepared a comprehensive data set of 28,000 glacial lakes in the Indian Himalayan Region. ◦ National Centre for Seismology has prepared a seismic micro-zonation of Delhi and has supported seismic micro-zonation of several other cities.
5.  **Leverage technology to enhance the efficiency of disaster risk management efforts.**	◦ India Metrological Department (IMD) issues regular and precise weather forecasts ◦ IMD uses a suite of quality observations from Satellites, Radars and Conventional & Automatic Weather Stations for monitoring of cyclones developing over the Bay of Bengal and Arabian Sea. It includes INSAT 3D, 3DR and SCATSAT satellites, Doppler Weather Radars (DWRs) along the coast and coastal Automated Weather Stations (AWS). ◦ Under the National Cyclone Risk Mitigation Project (NCRMP) Early Warning Systems have been installed in the Coastal States ◦ Common Alerting Protocol (CAP) based Integrated Alert System' has been initiated with an outlay of Rs. 354.83 Crore, for dissemination of geo targeted early warnings/alerts. ◦ Emergency Response Support System (ERSS) is a Pan-India single number (112) based emergency response system for citizens in emergencies.

6. Develop a network of universities to work on disaster-related issues.	◦ Indian Universities and Institutions Network (IUINDRR-NIDM) has been established, under the aegis of National Institute of Disaster Management (NIDM), to highlight the role of education, research and training in disaster resilience.
7. Utilise the opportunities provided by social media and mobile technologies for disaster risk reduction.	◦ A number of new mobile Applications such as Damini, Mausam, Sachet etc. have been developed for timely dissemination of early warnings ◦ Various social media platforms are extensively used for awareness generation activities ◦ The Social Media is also used to amplify the reach of content delivered on print media (such as OpEd written by NDMA officers) and broadcast media (such as "Aapada Ka Samna" programmes).
8. Build on local capacity and initiative to enhance disaster risk reduction.	◦ In order to deepen disaster preparedness and response capacity at the local level in the country, Aapda Mitra Scheme, having an outlay of Rs. 369.40 Crore, has been launched to train 1,00,000 community volunteers. ◦ NDMA has been producing knowledge products to empower citizens. Eg. Home Owner's guide for Earthquake & Cyclone safety (2019), Simplified Guidelines for Earthquake Safety (2021). ◦ Mock exercises and community awareness programmes are regularly conducted by NDMA and NDRF
9. Make use of every opportunity to learn from disasters and, to achieve that, there must be studies on the lessons after every disaster.	◦ In the aftermath of major disasters, NIDM as well as NDMA undertake field visits to document the lessons learned. Example of such studies include: Biparjoy cyclone (June 2023); Good Practices in COVID response (2022);
10. Bring about greater cohesion in international response to disasters.	◦ Government has advanced regional cooperation on disaster risk management through SCO, BIMSTEC, IORA ◦ Response to disasters was discussed during the deliberations of Disaster Risk Reduction Working Group established under India's G20 presidency. ◦ Humanitarian Assistance and Disaster Relief Support to disaster hit countries.

Figure 35.2 : Prime Minister's Ten Point Agenda on DRR

35.2 DRR Strategies, Actions and Projects in Haripad

The Municipality of Haripad spans an area of 16.34 sq.km, of which approximately 7.13 sq.km (43.64%) falls within the identified Flood Prone Area (FPA) as per the 1 in 50-year Return Probability map Published by KSDMA. This significant extent of flood exposure illustrates the scale of vulnerability and the urgency of mainstreaming disaster risk reduction into spatial planning and development management. Based on the analysis done on the various land uses and their flood proneness in Haripad (discussed in Section 5.7 of Chapter 5 of this Master Plan), it is evident that flooding exerts differentiated yet interlinked impacts across ecological, residential, economic, and infrastructural systems within the municipality.

- Paddy lands emerge as the most exposed land use category, with nearly 88% of their extent falling within the Flood Prone Area (FPA). While these fields function as natural flood

retention basins that moderate peak flows, repeated inundation results in significant crop losses, reduced farm incomes, and declining farmer resilience. Over time, such recurrent damage discourages agricultural activity and accelerates land-use conversion pressures, undermining both livelihood security and the ecological buffering capacity of the landscape.

- Waterbodies, with approximately 78% located within FPA, reflect their inherent role in the hydrological system as storage and drainage corridors. However, degradation, siltation, and encroachment compromise their carrying capacity, intensifying flood impacts across adjoining settlements. Their vulnerability underscores the urgency of ecosystem-based flood management strategies that prioritize restoration, desiltation, and protection of natural drainage networks.
- Residential areas account for the largest share of urban land use, with nearly one-fifth situated in flood-prone zones. This translates into direct exposure of a substantial population segment, particularly in low-lying and economically weaker neighborhoods where building resilience is limited. Flood events disrupt housing stability, damage property, increase public health risks, and strain evacuation and rehabilitation systems, thereby creating recurring socio-economic stress.
- Marshy lands, though limited in spatial extent, play a critical ecological role as natural sponges. With a significant proportion located within FPA, their continued conversion or degradation would reduce natural absorption capacity and exacerbate flood intensity in surrounding areas. Protecting these wetlands is therefore integral to long-term flood mitigation.
- Transport infrastructure, despite occupying a modest share of land, is strategically critical. Approximately 41% of its area falls within FPA, and 17.2 km of the total 145.53 km of LSGD roads are flood prone. Even temporary inundation disrupts mobility, emergency response, evacuation processes, and supply chains, thereby amplifying the indirect impacts of flooding on economic stability and governance.
- Commercial and industrial uses, though limited in extent, experience disproportionate economic consequences when affected. Flood exposure disrupts trade, damages inventories, halts small-scale enterprises, and affects employment continuity. Short-duration flooding can thus have cascading impacts on the local economy.
- Public and semi-public institutions - including schools, health facilities, and administrative offices - face service disruption when exposed to flooding. Given their critical role during emergencies, even limited exposure undermines disaster response efficiency and community resilience.
- Other categories such as vacant lands, recreational areas, and sacred groves, though relatively small in area, carry ecological and social value. Vacant lands within FPA present opportunities for strategic conversion into flood retention basins or green buffers. Recreational lands and sacred groves contribute micro-level ecological services and biodiversity support, and their protection enhances environmental resilience.

The analysis reveals that flooding in Haripad is not merely a hazard event but a systemic risk influencing agricultural sustainability, housing security, infrastructure functionality, ecosystem integrity, and economic stability. A balanced approach integrating ecological conservation, resilient infrastructure planning, and risk-sensitive land-use regulation is therefore essential for sustainable urban development.

35.2.1 Dimensions of Vulnerability in Haripad

The land use–flood exposure and risk analysis highlight that Haripad's disaster vulnerabilities are concentrated in three interlinked dimensions: livelihoods, population, and services/infrastructure. Each dimension has distinct implications for the town's resilience and development trajectory.

35.2.1.1 Livelihood Risk

Agriculture, particularly paddy cultivation, is the backbone of Haripad's local economy and cultural identity. With over 83% of paddy lands located in flood-prone areas, the sector faces recurrent crop losses, reduced yields, and increasing uncertainty in farm incomes. Such exposure not only undermines household-level economic security but also weakens the broader agrarian economy on which allied sectors such as animal husbandry and fisheries depend. In the long term, this could accelerate the shift away from traditional cultivation towards less sustainable land uses, eroding the ecological functions of paddy fields as natural flood retention basins. The cumulative effect is a dual crisis - loss of livelihoods and weakening of natural flood management systems, which amplifies overall disaster vulnerability.

35.2.1.2 Population Risk

Residential land use constitutes the largest share of the municipality's land area, and with nearly one-fifth of it falling within flood-prone zones, a significant proportion of Haripad's population remains directly exposed to flooding. This translates into heightened risks to life, property, and well-being, particularly among socially and economically vulnerable groups. Low-income households, often located in high-risk zones, are less likely to invest in resilient housing or insurance, compounding their exposure. Recurrent flooding not only causes displacement and asset loss but also imposes long-term burdens through reduced productivity, health risks, and increased expenditure on recovery and rebuilding. Housing resilience, risk-informed settlement planning, and the regulation of construction in flood-prone areas thus emerge as critical priorities for the Master Plan.

35.2.1.3 Service and Infrastructure Risk

Although public/semi-public facilities, transport networks, and waterbodies occupy a relatively small proportion of Haripad's land, their strategic importance far outweighs their physical extent. Even limited flooding of health centres, schools, or administrative facilities can disrupt emergency response and essential services at the very time they are most needed. Similarly, flooding of road and railway infrastructure can hinder evacuation, delay relief operations, and disrupt local trade and mobility. Furthermore, with nearly 79% of waterbodies and 48% of marshy lands located in flood-prone zones, the town's natural drainage and flood-buffering systems are themselves under stress, reducing their ability to mitigate flood impacts. This creates a systemic vulnerability, where the impairment of even small portions of critical infrastructure and ecosystems cascades into widespread disruption of governance, service delivery, and economic continuity. Taken together, these three dimensions demonstrate that Haripad's vulnerabilities are multifaceted and interconnected. Loss of livelihoods in agriculture reduces household resilience; exposed housing stock places entire communities at risk; and the

fragility of infrastructure and natural systems undermines the town's capacity to respond and recover. It is therefore important to adopt a comprehensive risk reduction strategy that addresses these dimensions simultaneously, aligning sectoral interventions (agriculture, housing, infrastructure, water management) with climate adaptation and sustainable land use practices.

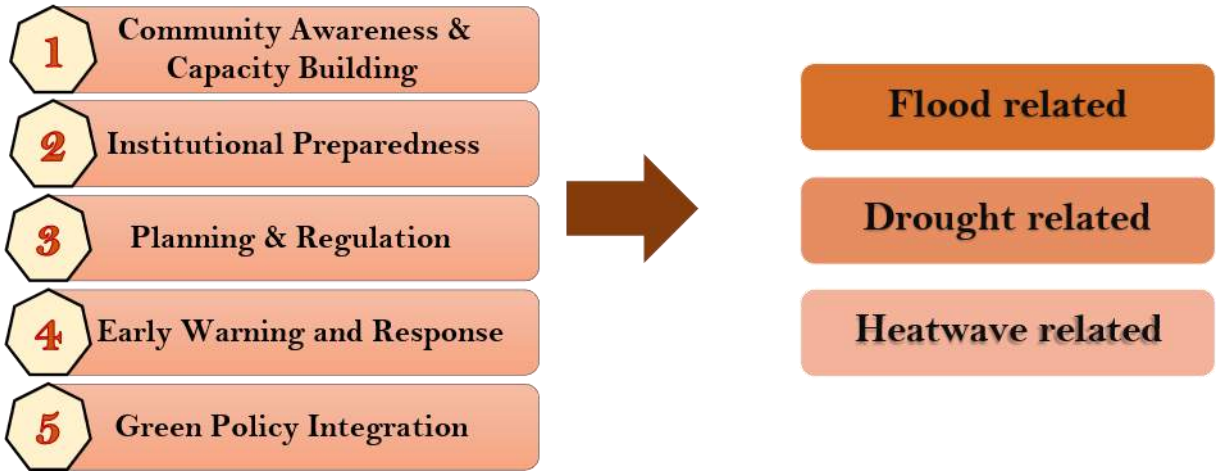
35.3 Priority Focus Areas for DRR and Mitigation Planning

The Haripad Municipality Disaster Management Plan (DMP), prepared by the Municipality under the 'Nammal Namukkai' initiative, forms the backbone of the municipality's DRR framework. This plan integrates hazard analysis, community engagement, institutional coordination, and both short-term and long-term risk mitigation measures. DRR efforts are guided by local disaster risk assessments, with an emphasis on proactive planning and preparedness. The land use and flood exposure profile of Haripad underscores the need for a multi-sectoral, risk-informed planning approach**.** Priority must be placed on safeguarding livelihoods, protecting people and housing, and ensuring the continuity of essential services, while simultaneously restoring natural systems that mitigate hazard impacts. Based on the land use flood risk analysis, the following areas will be prioritized in the DRR and mitigation framework for Haripad to make it a resilient, adaptive, and climate-ready urban settlement:

- **Agriculture and Irrigation:** Promote flood-resilient crop varieties, incentivize diversification, expand crop insurance, and protect paddy lands as natural buffers.
- **Residential and Housing:** Regulate development in high-risk areas, promote retrofitting, and develop relocation strategies where necessary.
- **Water Systems and Ecosystems:** Rejuvenate canals, ponds, and marshes; prevent encroachments; and integrate ecosystem-based approaches such as green buffers and wetlands.
- **Public Infrastructure and Services:** Flood-proof health, education, and administrative facilities and ensure contingency planning for uninterrupted functioning.
- **Transportation:** Safeguard critical road and railway links and establish redundancy in networks to support evacuation and relief.
- **Commerce and Industry:** Protect small businesses and local industries through continuity planning and rapid recovery measures.
- **Vacant and Marginal Lands**: Use strategically for retention ponds, green spaces, and emergency shelters to reduce overall flood vulnerability.

35.4 Non-Structural Measures

Non-structural interventions play a critical role in disaster risk reduction by addressing vulnerabilities through policy frameworks, planning mechanisms, institutional strengthening, public awareness, and behavioural change rather than physical infrastructure alone. These measures aim to minimize potential losses by enhancing preparedness, improving risk-informed decision-making, promoting community participation, and integrating disaster resilience into development planning. Some of the key actions include:



35.4.1 Community Awareness & Capacity Building

Community awareness and capacity building measures focus on strengthening the ability of residents and local institutions to understand risks, respond effectively during emergencies, and adopt practices that reduce long-term vulnerability. In Haripad, these initiatives emphasize regular public awareness programmes such as "Know Your Risk" campaigns on floods and heat-related illnesses in coordination with the District Disaster Management Authority (DDMA), disaster preparedness training for ward-level volunteers, first responders, and school children, and the promotion of green building practices, including the use of reflective and climate-responsive construction materials. Collectively, these measures aim to build an informed, prepared, and resilient community.

A) Flood:

a) Conduct community awareness and training programmes focused on flood preparedness, early warning response, and safe evacuation practices.

b) Organize regular mock drills and capacity-building exercises involving schools, institutions, and local residents to strengthen coordinated flood response and emergency preparedness.



As a part of this, *the Haripad Flood Resilience Program - Community Awareness & Capacity Building Initiative* has been conceived as capacity building programme. According to this programme A community-focused flood preparedness and resilience initiative is proposed for flood-prone areas of Haripad to enhance awareness, response capacity, and long-term resilience. The initiative includes the development of user-friendly flood preparedness booklets and digital resources outlining clear dos and don'ts, evacuation procedures, and emergency response guidelines. It also involves mapping and disseminating information on relief shelters, safe access routes, and key emergency contacts such as hospitals and first responders. Active participation of

Ward Councilors, along with capacity-building and training programs for officials, students, youth groups, SHGs, and volunteers, will strengthen community ownership and institutional readiness, thereby fostering a culture of preparedness and risk reduction.

B) Drought:

a) Conduct awareness campaigns to promote water conservation and responsible water use at the household and community levels.
b) Encourage the adoption of water-efficient irrigation techniques such as drip and sprinkler systems to reduce water stress in agriculture.
c) Promote crop diversification and the use of drought-resilient crop varieties to enhance agricultural sustainability.
d) Introduce community-level water budgeting practices to optimize water allocation during dry periods.
e) Prepare and disseminate contingency crop plans to minimize agricultural losses during drought conditions.
f) Support the revival and maintenance of traditional and community-based water harvesting systems to strengthen local water security.

C) Heat wave:

a) Conduct public awareness programs on heat-related risks and appropriate preventive and protective measures.
b) Identify and designate community cooling centres and safe shelters for use during extreme heat events.
c) Provide training to health workers and community volunteers on the identification and management of heat-related illnesses.
d) Issue guidelines for outdoor workers emphasizing adequate hydration, rest breaks, and safe working practices during heat wave conditions.

35.4.2 Institutional Preparedness

Institutional preparedness forms a critical component of non-structural disaster risk reduction measures, focusing on strengthening the capacity of institutions to respond effectively during emergencies. This involves regular updating and capacity building of Emergency Response Teams (ERTs), Shelter Management Units, and First Aid groups to ensure readiness and coordinated action. In addition, maintaining an updated inventory of critical resources - such as medical supplies, transportation facilities, heavy machinery, and emergency shelters - is essential for enabling timely and efficient response during the events of disasters.

A) Flood

a) Identification and mapping of designated safe shelters and community assembly points.
b) Preparation of comprehensive evacuation routes and shelter management plans.
c) Strengthening flood forecasting and early warning systems through digital platforms, local broadcasting, and community-based alert mechanisms.
d) Preparation and periodic updating of ward- and community-level disaster action plans.
e) Promotion and facilitation of flood insurance coverage for households and assets.
f) Mainstreaming flood risk considerations into infrastructure development and urban planning processes.

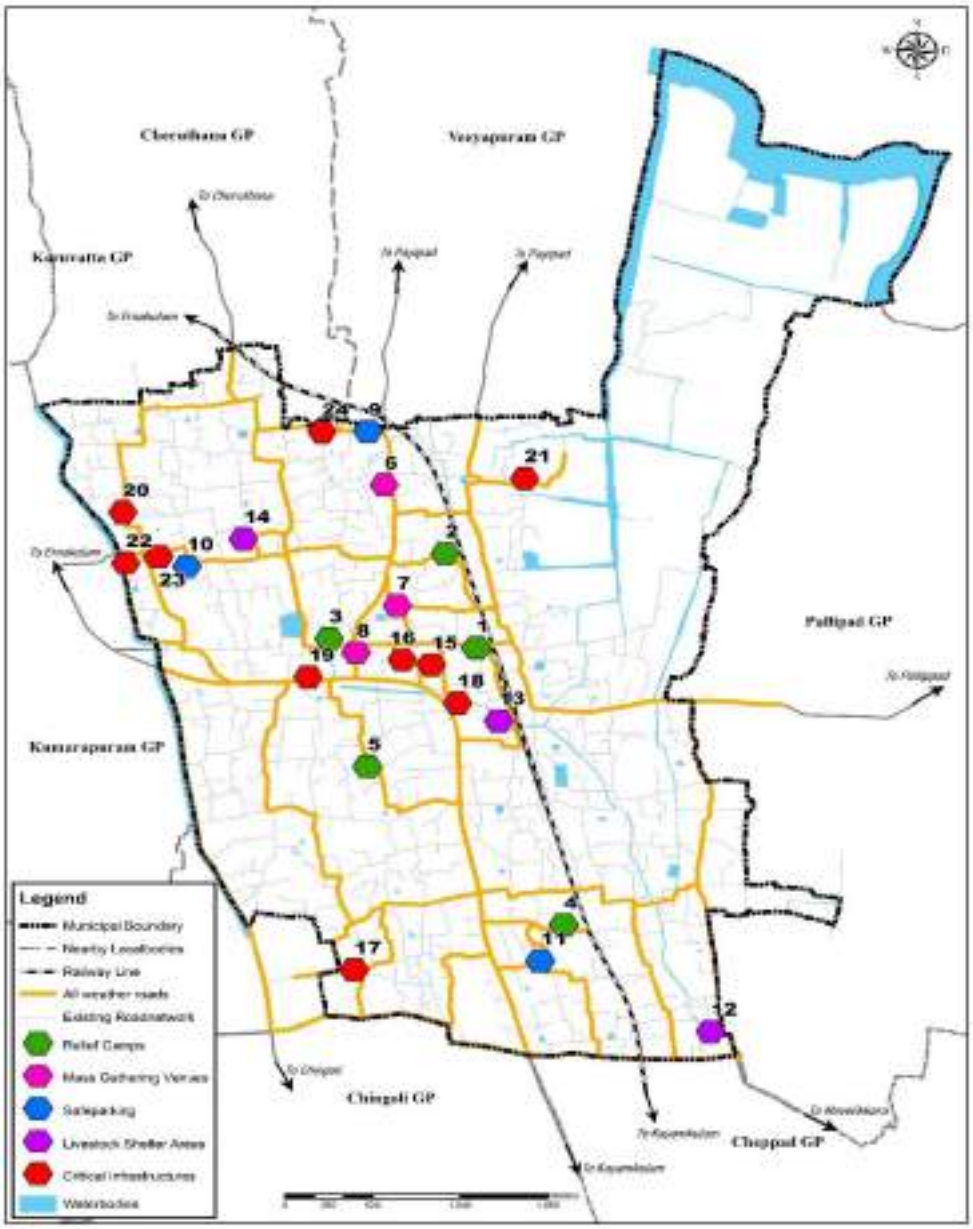


Figure 35.3 : Identified Evacuation Routes and other DRR facilities in the town

Table 35.1 : List of DRR facilities and Infrastructures identified in Haripad town

Symbol	Type	Identified Institution
	Relief Camps	1. Govt. UPS 2. Aroor LPS Haripad 3. Govt. GHS 4. SNT HS 5. DKNM LPS
	Mass Gathering Venues	6. Sabaris Convention Centre 7. S and S Auditorium 8. Taluk Central Library
	Safe parking	9. School Ground, Amrita Vidyalayam 10. School Ground, Mannarassala UPS 11. College Ground, TK Madhava Memorial College

	Livestock Shelter Areas	12. Ground (near Manimala Junction) 13. Ground (near Haripad railway station) 14. Ground (near Goshaala Cattle farm at Mannarassala)
	Critical Infrastructures	15. Fire and Rescue Station 16. Haripad Police Station 17. Veterinary Hospital 18. Taluk Head Quarters Hospital 19. Sreehari Ayurveda Hospital 20. Haripad Government Homoeo Dispensary 21. Primary Health Centre, Pilappuzha 22. Homeocare Homoeo Clinic 23. Government Veterinary Hospital 24. KMM Homoeo Clinic

The list of institutions and facilities that are identified as part of disaster risk reduction are given in Table 35.1. Figure 35.3 illustrates the evacuation routes, emergency facilities, and critical infrastructures identified within the town to ensure effective preparedness and response during disaster events. A well-distributed network of all-weather roads and existing road infrastructure forms the backbone of the evacuation system, ensuring safe and uninterrupted movement during emergencies. These routes are strategically aligned to connect residential areas with identified relief camps, mass gathering venues, safe parking areas, and livestock shelter zones, thereby facilitating orderly evacuation of people, vehicles, and animals.

Relief camps are evenly located across the town to provide accessible shelter and basic services to affected populations, while mass gathering venues act as temporary assembly points during evacuation and emergency coordination. Safe parking zones are identified along major corridors to prevent congestion and allow emergency vehicle movement. Dedicated livestock shelter areas reflect inclusive disaster planning by addressing the safety of animals, which is particularly important in a semi-urban and agrarian context like Haripad.

B) Drought:

a) Regular monitoring and systematic dissemination of data on rainfall, groundwater levels, and soil conditions.
b) Capacity-building programs for farmers focused on drought-resilient agricultural practices.
c) Establishment and strengthening of institutional mechanisms to ensure equitable and efficient water distribution.

C) Heat wave:

a) Identification and provision of drinking water supply points at strategic public locations.
b) Implementation of administrative measures such as flexible school and work timings during extreme heat conditions.
c) Formulation and operationalization of Heat Action Plans to guide coordinated preparedness and response actions.

35.4.3 Land Use Planning & Regulation

The non-structural measures focus on reducing disaster risk by embedding resilience principles into land use planning and the built environment. Through appropriate regulatory frameworks, development controls, and incentives, this approach aims to minimize exposure to hazards such as flooding and climate-related risks. Emphasis is placed on promoting resilient construction practices, guiding safe redevelopment in vulnerable areas, and integrating hazard risk information into statutory spatial planning processes to ensure long-term safety and sustainability of urban development in Haripad town.

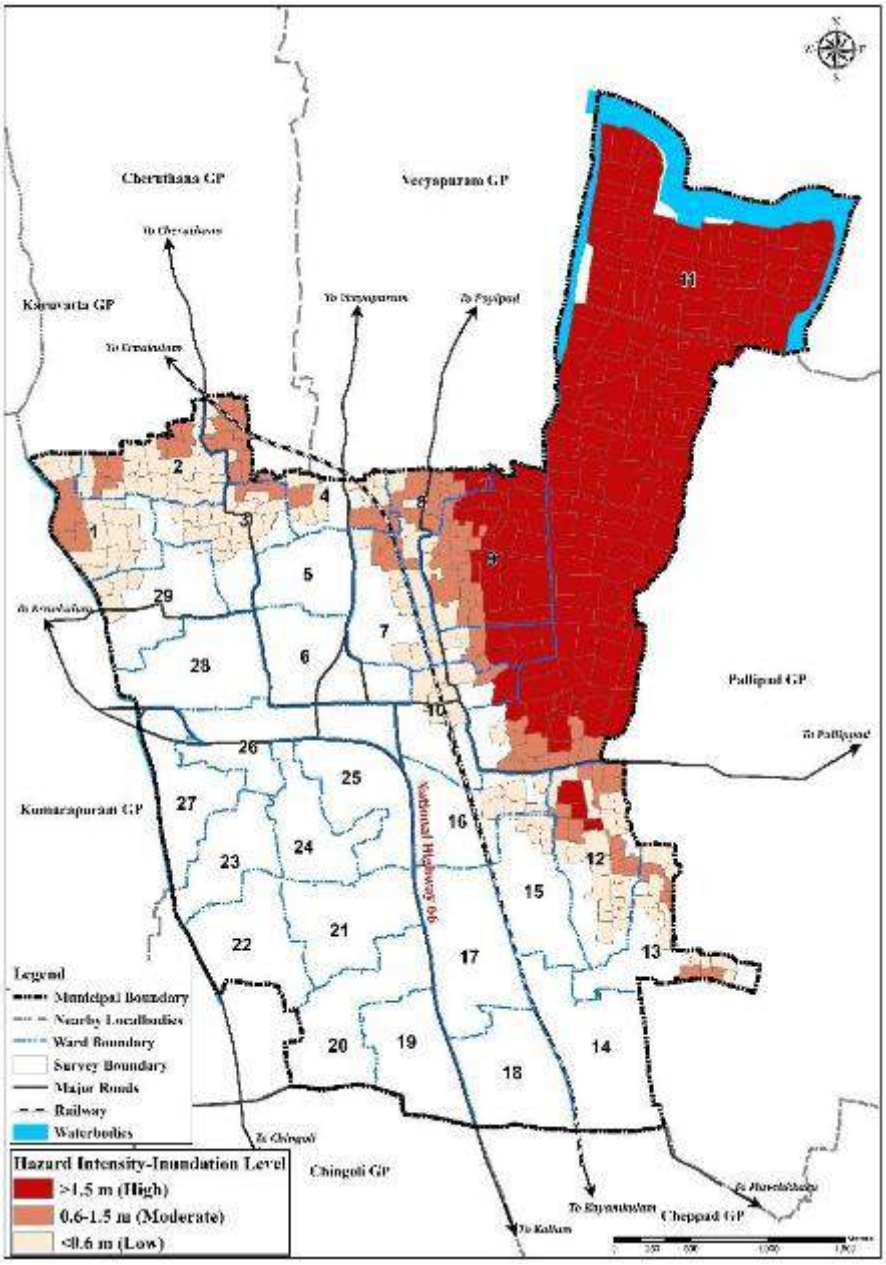


Figure 35.4 : Hazard (Flood) Intensity Map

A) Flood:

a) Implementation of floodplain zoning regulations to limit and control construction activities in flood-prone and low-lying areas.

b) Hazard Zoning: - Based on the Hazard Impact and Risk Assessment detailed in chapter 6 Hazard Profile and Climate Change, the entire Flood Prone Area in the town is categorized into three and is clearly demarcated as an overlay in the Proposed Land Use map for Haripad Town. The details are provided below:

1) Flood Prone Area I (inundation depth < 60cm) – These are areas expected to have inundation level below 60cm. These areas may have regulated human interventions. Permitted and restricted activities in these areas are detailed in zoning regulations.

2) Flood Prone Area II (inundation depth between 60cm and 1.5m) – These areas are expected to have inundation level above 60cm and below 1.5m. These areas also have regulated

human interventions. Permitted and restricted activities in these areas are described in zoning regulations.

3) Flood Prone Area III (inundation depth > 1.5m) – These areas are expected to have inundation depth greater than 1.5m. These are areas with limited human interventions and no new developments are allowed here. Permitted and restricted activities in these areas are described in zoning regulations. These zones are depicted in Figure 35.4.

B) Drought:

a) Incorporation of water-sensitive land use planning to safeguard recharge areas, wetlands, and traditional water bodies.

C) Heat wave:

a) Adoption of urban planning controls that promote heat-resilient development, including mandatory green cover, open spaces, and ventilation corridors.

b) Regulation of building design and materials to reduce heat absorption and mitigate urban heat island effects.

35.4.4 Early Warning and Response

Early Warning and Response measures focus on strengthening the timely dissemination of hazard-related information and ensuring prompt community-level action. In Haripad town, this involves the deployment of ward-level Early Warning Dissemination Systems (EWDS) to effectively relay alerts and advisories issued by the Kerala State Disaster Management Authority (KSDMA), thereby ensuring that critical warnings reach the most vulnerable and last-mile populations in a clear and timely manner. In response to this, the Local Disaster Management Plan prepared by the Haripad Municipality in 2023-24 has come up with training activities namely the Provision of Disaster Preparedness Training for the ERTS.

- **Provision of Disaster Preparedness Training for the Emergency Response Teams (ERTS):**

Systematic and periodic training of Emergency Response Team (ERT) volunteers is proposed to strengthen community-level disaster preparedness in Haripad. The training will focus on early warning dissemination, search and rescue, evacuation procedures, and basic first aid, enabling ERTs to function effectively as the first line of response during floods and other emergencies. This initiative will facilitate timely communication of warnings, accurate ground-level assessments, safe evacuation of vulnerable groups, and immediate life-saving assistance prior to the arrival of external agencies. Improved coordination among local authorities, first responders, and community members will enhance response efficiency, reduce loss of life and property, and strengthen the overall disaster resilience of the town.



Figure 35.5 : Emergency Response

35.4.5 Green Policy Integration

Alignment with the Kerala State Action Plan on Climate Change (KSAPCC) is essential to promote low-emission development pathways and ensure long-term environmental sustainability through climate-resilient and resource-efficient planning. The policies adopted under the Green Policy will help mitigate heat stress and ensure that its impacts are effectively managed. The Table *35.3* shows the various Non Structural measures for Disaster risk Reduction in Haripad.

Table 35.2 : Non-Structural Measures for Haripad town

Hazard	Measure	Priority	Key Implementing Agency
FLOOD	Mapping & identification of safe shelters & assembly points	Short-term	Municipality, DDMA
	Evacuation & shelter management planning	Short-term	Municipality, Police, DDMA
	Flood forecasting & early warning (SMS, FM, social media)	Short-term	IMD, KSDMA, Municipality
	Community awareness & training on flood preparedness	Short-term	Municipality, NGOs, Residents' Associations
	Mock drills & capacity-building exercises	Short-term	Schools, Colleges, Municipality, DDMA
	Preparation of Local Disaster Action Plans (ward/community level)	Medium-term	Municipality, Ward Committees
	Flood insurance promotion	Medium-term	Insurance Agencies, Banks, Municipality
	Floodplain zoning & regulation	Medium-term	Municipality, Revenue Dept., Town Planning Dept.
	Integration of flood risk in infrastructure & urban planning	Long-term	Municipality, PWD, Town Planning Dept.
DROUGHT	Awareness campaigns on water conservation	Short-term	Municipality, Krishibhavan, NGOs
	Promotion of water-efficient irrigation (drip/sprinkler)	Short-term	Agriculture Dept., Krishibhavan
	Crop diversification & drought-resilient varieties	Short-term	Agriculture Dept., Farmer Cooperatives
	Monitoring & dissemination of rainfall, groundwater & soil data	Short-term	IMD, Agriculture Dept.
	Training farmers on drought-resilient agriculture	Medium-term	Agriculture Dept., Research Institutions
	Community water budgeting practices	Medium-term	Krishibhavan, Local Water Committees
	Preparation of contingency crop plans	Medium-term	Agriculture Dept., Krishibhavan
	Institutional arrangements for equitable water distribution	Medium-term	Municipality, Irrigation Dept.
	Revival of traditional/community water harvesting practices	Long-term	Municipality, NGOs, Farmer Groups

HEAT WAVE	Public awareness on heat risks & protective measures	Short-term	Health Dept., Municipality, NGOs
	Dissemination of early warning & health advisories (heat alerts)	Short-term	IMD, Health Dept., KSDMA
	Drinking water availability & distribution points in public areas	Short-term	Municipality, Water Authority
	Identification of community cooling centres/safe shelters	Short-term	Municipality, Health Dept.
	Training health workers & volunteers on heat-related illness	Medium-term	Health Dept., Red Cross, NGOs
	Administrative adjustments in school/work timings	Medium-term	Education Dept., Labour Dept., Municipality
	Guidance to outdoor workers on hydration & rest breaks	Medium-term	Labour Dept., NGOs
	Development of Heat Action Plans	Medium-term	Municipality, Health Dept., KSDMA
	Awareness on cool roofing, tree planting & shading	Long-term	Municipality, Forest Dept., Residents' Associations

35.5 Structural Measures

Structural measures under Disaster Risk Reduction refer to physical and engineering interventions aimed at minimizing hazard exposure and safeguarding life, property, and critical infrastructure. These measures focus on modifying the built and natural environment to reduce the intensity and impact of disasters such as floods, droughts, and heat waves affecting Haripad town. Proposed structural measures are described in the following sections.

35.5.1 Flood Mitigation

a. **Strengthening of bunds and riverbank protection along the Achankovil River and other vulnerable water bodies**: - adopt measures to prevent flood probability and streamflow of the water bodies.
b. **Desilting of irrigation channels and maintain its depth**: - This measure involves the periodic removal of silt, sediment deposits, and obstructions from irrigation canals and drainage channels to restore and maintain their original carrying capacity. In the context of flood mitigation in Haripad town, regular desilting ensures unobstructed storm water flow, prevents water stagnation and backflow during heavy rainfall, and reduces the risk of localized flooding in low-lying areas.
c. **Rejuvenation and desilting of Pillathodu to increase its capacity**: - Pillathodu is an artificial canal traversing the core area of Haripad Municipality. It originates near Haripad Temple Road, passes through key locations such as NH-66, Taluk Hospital Junction, and RJ Road, and extends further eastward towards the paddy fields. Rejuvenation and systematic desilting of this canal are proposed to restore its original flow capacity and improve storm water drainage.
d. **Promote riverbank afforestation and bamboo**: - Based bioengineering to prevent erosion - This measure involves strengthening riverbanks through plantation of native tree species and the use of bamboo-based bioengineering techniques to stabilize soil and reduce erosion. Vegetative cover enhances root binding of the soil, minimizes bank

scouring during high flows, and improves the natural absorption capacity of the river margins.

e. **Mangrove edging/ fringe for agricultural fields and Achankovil river edge**: - The establishment of mangrove fringes along agricultural fields and the banks of the Achankovil River is proposed as a nature-based flood mitigation measure. Mangroves act as natural bio-shields by reducing flow velocity, stabilizing soil, and minimizing erosion during periods of high discharge. The establishment of scientifically planned mangrove buffer zones along riverbanks of Achankovil River and paddy field boundaries is proposed to enhance flood resilience and protect agricultural lands, particularly along the Achankovil stretch, from saline intrusion and seasonal flooding. The initiative includes the plantation of native mangrove species such as *Rhizophora mucronata*, *Rhizophora apiculata*, *Avicennia officinalis*, and *Acanthus ilicifolius*, with buffer width, planting density, and spatial patterns determined through detailed scientific and hydrological assessments to ensure ecological effectiveness and long-term sustainability. The details of this project is mentioned in chapter 36.

f. **Strengthening the drainage network**: - Strengthening the drainage network involves upgrading existing storm water drains, improving outfall conditions, removing bottlenecks, and ensuring proper connectivity between natural and man-made drainage channels.

g. **Retention or Detention Basins**: - Detention and retention basins are natural depressions or excavations, which can be used for temporarily storing flood water to reduce peak floods downstream. A Detention/Retention Basins are proposed in Haripad town as a special zone to manage storm water and mitigate flooding. The basin will temporarily store excess runoff during heavy rainfall and release it in a controlled manner, thereby reducing peak flows and downstream flood risk. It will function as permanent water bodies that aid groundwater recharge and improve water quality. The Retention/Detention zones is depicted as a main component of the project proposal for Wetland parks which is detailed in chapter 36.

35.5.2 Storm Water and Drainage Management

a. **Drainage Plan:** Upgradation of storm water drainage systems, regular cleaning and maintenance of drainage lines, desilting canals, constructing new channels and drains etc are vital actions that has to be undertaken for effective storm water and drainage management. The various drainage stretches in Haripad that requires repairs, proposals for new drains, repair and upkeep of thodus, proposals for new thodu stretches etc are discussed in detail in Chapter 33. Drainage Plan of this Master Plan.

b. **Waterbody Revival:** Revival and conservation of traditional water bodies, temple ponds etc. to function as decentralized flood buffers during extreme rainfall events is a critical step. Systematic desiltation, removal of encroachments, restoration of feeder channels, and strengthening of bunds can significantly enhance their storage and percolation capacity. Protecting catchment areas from contamination and unregulated development is equally critical to sustaining their ecological health. When integrated into the broader drainage strategy of the municipality, these restored water bodies can operate as distributed "sponges," reducing peak flood intensity, mitigating urban waterlogging, improving water security during dry periods, and reinforcing overall climate resilience.

c. **Artificial Recharge Pits:** Create artificial recharge pits and trenches along roads and open spaces in public as well as private fallow land.
d. **Pilla Thodu – Canal Front Redevelopment:** The ecological restoration of Pilla Thodu covering a total stretch between Haripad Temple Road, NH-66, RJ Road, and Taluk Hospital Junction is proposed to improve its hydraulic performance, environmental quality, and neighbourhood integration. The project includes comprehensive desilting, removal of weeds and solid waste, and restoration of natural water flow to enhance drainage efficiency and reduce flood risk. Structural strengthening of the canal bed and sidewalls, along with pitching and erosion control in vulnerable sections, will ensure long-term stability. Context-sensitive canal edge redevelopment is proposed based on available right-of-way and adjoining land use, incorporating neighbourhood-scale public spaces with walkways, seating, shaded pavilions, landscaping, and essential amenities where feasible. Safety, sanitation, and limited land acquisition (if required) will support infrastructure continuity, improve public health conditions, and enhance the overall liveability and visual character of the surrounding areas. The details of this project are described in chapter 36. Priority Action Plan.
e. **Padasekharam Revitalization & Smart Irrigation Network:** A comprehensive revitalisation of major and minor padasekharams across Haripad is proposed to enhance agricultural productivity and climate resilience. The initiative includes the introduction of smart, sensor-based shutter control systems for bunds and regulators to ensure precise and timely water management. Automated or semi-automated operation of key bunds at Danapady and Pulinkuzhi is recommended to improve irrigation reliability and reduce manual dependency. Additionally, strengthening and repair of bunds (muttu) will be undertaken to enhance structural stability and provide improved flood protection to agricultural lands. These interventions are to be focused on the 3 Padasekharams within the municipal limits according to the data provided by the Agriculture Department. The details regarding this project is described in chapter 36.

35.5.3 Protection of Critical Infrastructure

a. Flood-proofing of public institutions, including schools and healthcare facilities in flood prone area. A number of public buildings including 2 health care facilities and 8 *Anganwadis* are in flood prone area. This should be either relocated or retrofitted.
b. Three schools which are acting as relief camps during distress are recommended for renovation by the local area DM plan. They should be evaluated for their present status and may be taken up accordingly. (Govt. Boys High School, Govt. Girls High School and Govt. UP School)
c. The scope for a dedicated multipurpose relief camp cum community centre may be evaluated.



35.5.4 Mitigation of Heat Effects

Based on the analysis of Urban Heat Island effect as explained in Chapter 6 of this Master Plan, the major hotspots identified in Haripad Town are:

i. Open spaces,
ii. Dense built-up areas and road stretches,
iii. Mixed open areas and built-up spaces, and
iv. Road stretches

To effectively mitigate Urban Heat Island effects in these zones, an integrated strategy that combines nature-based solutions, smart infrastructure, and climate-responsive urban design is essential. The following are targeted proposals to address each hotspot category, thereby enhancing resilience and improving overall urban liveability.



Figure 35.6 : An Illustration of Urban Heat Island Mitigation measures in Haripad

- In **open spaces**, afforestation and re-vegetation with native, drought-resistant species can provide shading and cooling through evapotranspiration. Introducing water-based cooling systems such as ponds, wetlands, or rainwater harvesting structures will help regulate microclimates.
- In **dense built-up areas and road stretches**, the priority should be reducing heat retention from concrete and asphalt. Measures such as installing cool roofs, reflective pavements, and permeable surfaces can significantly lower surface temperatures. At the same time, roadside tree planting, vertical greenery, and rooftop gardens can introduce

shade and evapotranspiration-based cooling. Managing traffic emissions and promoting energy-efficient cooling systems will further reduce anthropogenic heat contributions in these zones.

- In **areas that combine open land and built-up spaces**, integrated blue–green infrastructure is essential for mitigating UHI effects. Bioswales, rain gardens, and vegetated buffers can break up heat accumulation zones while improving storm water management. Promote the planting of shade trees along roads and buildings, establish community gardens and green patches, and use native, drought tolerant plant species to increase vegetative cover and enhance cooling. Pocket parks and community gardens can be introduced into fragmented spaces to enhance cooling and create microclimates that improve urban liveability. Climate-responsive zoning policies should ensure that built-up expansion is balanced with mandatory green cover, preventing further fragmentation of cooling assets.
- To mitigate hotspots along **road stretches**, integrating blue–green infrastructure such as bioswales and rain gardens beside roadways can deliver localized cooling while also enhancing storm water management. The use of cool pavements with high-albedo or reflective materials helps reduce heat absorption, while permeable pavements allow water infiltration and contribute to lowering surface temperatures. In addition, planting shade trees along corridors, integrating median strips with vegetation, and encouraging climber plants on nearby structures can create shading, reduce radiant heat, and improve pedestrian comfort.

35.6 Proposals for Vulnerability Reduction

Vulnerability in the context of Haripad refers to the degree of potential loss and disruption resulting from the occurrence of climate- or hazard-induced events. The level of disaster risk in the town is determined not only by the intensity and frequency of hazards - such as floods, droughts, or heatwaves - but also by the exposure and susceptibility of people, infrastructure, and ecosystems to such impacts. Even within Haripad, areas experiencing similar hazard conditions may exhibit varying degrees of vulnerability due to differences in population density, socio-economic status, land-use patterns, and access to essential services and infrastructure.

In particular, low-lying residential clusters, aging infrastructure networks, and ecologically sensitive areas such as paddy fields and wetlands face compounded risks when development pressures intersect with natural hazard zones. Informal settlements and economically weaker sections are often disproportionately affected due to limited coping capacity, inadequate housing quality, and restricted access to emergency resources. Furthermore, degradation of natural drainage channels and waterbodies reduces the town's inherent adaptive capacity, amplifying the scale and duration of impacts.

Reducing vulnerability, therefore, requires addressing these underlying factors through targeted planning, capacity-building, and infrastructure interventions. The Haripad Master Plan emphasizes that effective vulnerability reduction measures - including risk-sensitive development, community preparedness, resilient infrastructure design, and ecosystem restoration - can significantly lower disaster impacts, minimize long-term socio-economic losses, and enhance the town's overall resilience to climate and environmental challenges.



35.6.1 Strengthening Livelihood Resilience

Haripad's economy is closely linked to its agrarian base, fisheries, small-scale industries, trade, and temple-centerd tourism. However, its low-lying geography, dependence on climate-sensitive sectors, and exposure to floods, droughts, and salinity intrusion make local livelihoods highly vulnerable. Strengthening livelihood resilience is, therefore, central to reducing disaster risk and ensuring sustainable economic growth. The Master Plan proposes a set of targeted interventions to diversify income sources, enhance adaptive capacity, and build climate-resilient economic systems tailored to Haripad's unique socio-ecological context.

35.6.1.1 Diversification of Local Economy and Sustainable Enterprises

a) Promote climate-resilient, small-scale agro-based industries, such as food processing, coir products, fish drying based value-added units.
b) Encourage eco-tourism and cultural tourism initiatives leveraging Haripad's religious and natural heritage such as the Subrahmanya Swamy Temple, temple ponds, and canal-side promenades.

c) Support handicrafts, small manufacturing, and digital service enterprises through training, incubation centres, and access to local markets.
d) Develop women-led micro-enterprises and youth entrepreneurship programs focused on green technologies, eco-products, and sustainable crafts.
e) Establish a Local Enterprise Facilitation Cell within the Municipality to support entrepreneurship, skill development, and financial linkages.

35.6.1.2 Climate-Resilient Agriculture and Fisheries

a) Promote integrated farming systems combining paddy cultivation, aquaculture, and livestock to reduce climate risks and increase income stability.
b) Introduce flood- and saline-tolerant crop varieties, raised-bed farming, and crop diversification in low-lying agricultural zones.
c) Expand sustainable inland fisheries and aquaculture, including paddy–fish farming, floating aquaculture systems, and cage fish culture in canal networks such as Pilla Thodu and Danapady Thodu.
d) Support organic farming and natural farming practices that improve soil resilience and reduce input costs.
e) Facilitate access to market linkages, cold storage, and processing facilities to minimize post-harvest losses and improve farmers' profitability.

35.6.1.3 Promotion of Alternative and Adaptive Livelihoods

a) Develop skill training and livelihood diversification programs in sectors such as eco-tourism, digital services, handicrafts, and repair-based trades.
b) Encourage green jobs in areas like renewable energy maintenance, waste management, and nature-based construction.
c) Promote community cooperatives for women and youth to engage in sustainable activities such as nursery cultivation, mangrove planting, and fish feed production.
d) Introduce skill-based vocational courses through local educational institutions and Skill Development Missions, focusing on trades relevant to the town's economy.
e) Support seasonal livelihood planning to reduce off-season unemployment in flood-prone agricultural regions.

35.6.1.4 Financial Inclusion and Social Protection Mechanisms

a) Expand access to microfinance, cooperative banking, and credit-linked insurance schemes for farmers, fishermen, and small traders.
b) Promote parametric crop insurance and climate risk insurance products to safeguard against losses from floods, pest attacks, or droughts.
c) Establish a Municipal Disaster Recovery Fund to provide immediate assistance to small enterprises and informal workers post-disaster.
d) Facilitate linkages between Self-Help Groups (SHGs), Kudumbashree units, and government livelihood missions to ensure last-mile financial inclusion.
e) Encourage digital financial literacy programs to help vulnerable groups access e-banking and government subsidies efficiently.

35.6.1.5 Institutional Support and Capacity Building

a) Form a Livelihood Resilience Task Force under the Municipality, with representation from agriculture, fisheries, industry, and social welfare departments.
b) Coordinate with Haripad Krishi Bhavan, Fisheries Department, and Skill Development Missions for convergence of livelihood schemes and climate adaptation initiatives.
c) Organize training and awareness programs for farmers, fishers, artisans, and informal workers on disaster preparedness, business continuity, and financial planning.
d) Establish community resource centres for information dissemination on government schemes, insurance products, and adaptive livelihood practices.
e) Encourage public–private partnerships (PPPs) for promoting sustainable local industries, renewable energy applications, and employment generation.

The proposed initiatives aim to build a diversified and shock-resistant local economy in Haripad, capable of sustaining income during climatic and economic disruptions. These measures will enhance livelihood security for vulnerable groups - including farmers, fishers, women, and informal workers - through adaptive practices and financial protection mechanisms. By promoting climate-resilient agriculture, fisheries, and small-scale industries, alongside improved institutional capacity for livelihood planning and risk management, the town will foster long-term stability. Collectively, these efforts will help establish Haripad as a resilient and inclusive local economy, grounded in sustainability, equity, and disaster preparedness.

35.6.2 Water Security & Drought Resilience

Despite being located in a water-rich region, Haripad experiences seasonal water scarcity, declining groundwater levels, and uneven water distribution - particularly during the dry months. The town's low-lying wetlands, canal networks, and paddy systems retain large quantities of water during monsoons, yet limited recharge infrastructure and contamination risks undermine year-round water availability. Strengthening water security and drought resilience is therefore critical to ensuring reliable supply, supporting livelihoods, and enhancing overall climate resilience.

35.6.2.1 Rainwater Harvesting and Groundwater Recharge

a) Mandate rainwater harvesting systems in all new residential, commercial, and institutional buildings through municipal bylaws.
b) Retrofit existing public buildings - such as schools, hospitals, and government offices - with rainwater collection tanks and recharge pits.
c) Construct community-level recharge wells, percolation trenches, and soak pits in dense urban areas to improve groundwater replenishment.
d) Integrate stormwater drains with recharge structures, particularly along Pilla Thodu and Danapady Thodu, to channel runoff into aquifers.
e) Promote rooftop rainwater harvesting awareness programs at ward level through resident's associations and educational institutions.

35.6.2.2 Establishing RO Plants in Every Ward

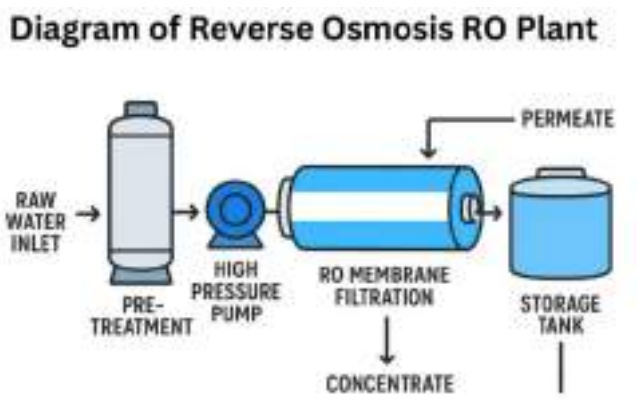


Figure 35.7 : Working of a RO Plant

Almost all wards in Haripad face acute drinking water shortages during the summer months, especially from March to May. Establishing decentralized Reverse Osmosis (RO) plants in every ward will ensure reliable access to safe and potable drinking water at the local level, reducing dependence on uncertain sources during peak shortages. By supplying treated water free from contaminants, salinity, and water-borne pathogens, the initiative will improve public health and ensure equitable distribution across vulnerable and low-income areas. Overall, ward-level RO facilities will strengthen community resilience to heat waves and dry spells while supporting long-term climate adaptation and water security.

35.6.2.3 Creation of Water Retention Ponds and Efficient Irrigation Systems

a) Develop multi-functional water retention ponds in strategic low-lying and agricultural zones to store monsoon runoff for use during dry periods.
b) Revive and interconnect traditional ponds and wetland areas across Haripad Municipality to create a distributed storage network supporting groundwater recharge.
c) Promote micro-irrigation systems such as drip and root-zone irrigation in peri-urban agriculture zones like Danapady and Pallippad, improving water-use efficiency and reducing evaporation losses.
d) Introduce solar-powered irrigation pumps and automated water distribution systems to enhance irrigation efficiency and minimize energy consumption.
e) Encourage farmers to adopt moisture retention techniques such as mulching, contour bunding, and crop scheduling aligned with rainfall variability.

35.6.2.4 Expansion and Strengthening of Water Supply Infrastructure

a) Expand the piped water supply network to underserved and economically fragile wards, ensuring equitable access to safe and reliable water.
b) Provide elevated storage tanks and distribution reservoirs in flood-prone areas to maintain water availability during inundation events.
c) Strengthen linkages between municipal water supply systems and local sources (ponds, canals, and wells) to ensure redundancy and reduce dependence on external supply.
d) Introduce water quality monitoring stations to prevent contamination, particularly in areas where open wells are primary sources.
e) Ensure water-efficient plumbing fixtures and promote dual plumbing systems in large buildings for optimal use of potable and non-potable water.

35.6.2.5 Policy Measures and Community Participation

a) Develop a Municipal Water Security Action Plan integrating drought preparedness, water conservation, and recharge initiatives under the Haripad Municipality.
b) Encourage community-led pond maintenance and desilting programs, involving local residents, youth groups, and Kudumbashree units.
c) Introduce incentive schemes for households and institutions adopting rainwater harvesting and efficient irrigation practices.
d) Conduct awareness campaigns on water conservation and drought management through schools, religious institutions, and public forums.
e) Coordinate with Kerala Water Authority (KWA) and Groundwater Department to monitor aquifer conditions and design location-specific recharge interventions. The proposed interventions will ensure improved water availability and equitable access through enhanced storage, supply, and recharge systems, while reducing drought vulnerability in peri-urban and agricultural zones through efficient irrigation and retention measures. By strengthening municipal and community capacities for water conservation and promoting the sustainable use of local hydrological assets, Haripad can achieve long-term water security and climate resilience. Collectively, these measures aim to position Haripad as a model for integrated urban water management within Kerala's coastal belt.
f) Maintaining Water Budget - Promoting water budgeting at household and farm levels will encourage the judicious use of available water resources, particularly during summer and drought periods. By assessing water demand against availability, residents and farmers can make informed decisions on domestic consumption and crop planning. The Local Self-Government (LSG) can facilitate this process by preparing ward-level water budgets based on data on groundwater levels, surface water availability, and seasonal rainfall. Such an approach enables regulated and equitable water distribution, supports efficient irrigation and crop diversification, and fosters community participation in conservation efforts. Overall, water budgeting reduces stress on groundwater sources and strengthens long-term water security and sustainability.

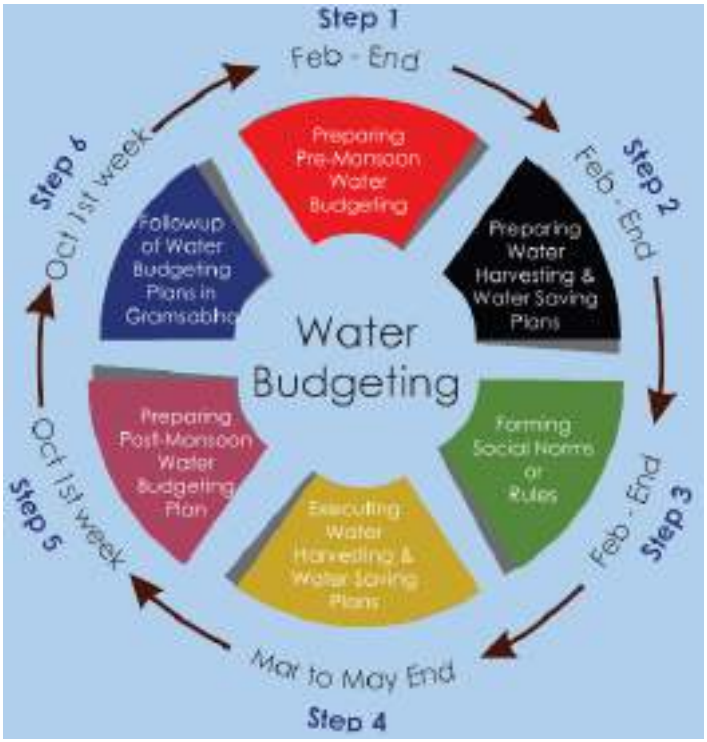


Figure 35.8 : Steps in Water Budgeting

35.6.3 Inclusive Disaster Planning

Haripad's diverse population - comprising coastal and inland communities, farmers, fisher folk, informal workers, women, children, the elderly, and persons with disabilities - faces varying levels of risk and exposure during disasters. Floods, heat waves, and lightning incidents disproportionately affect these vulnerable groups due to limitations in access to resources, infrastructure, and early warning mechanisms. To ensure equitable resilience, disaster management in Haripad must integrate social inclusion, accessibility, and participatory governance across all stages - preparedness, response, recovery, and rehabilitation. The following strategies are proposed to strengthen inclusivity in Haripad's disaster planning framework.

35.6.3.1 Inclusive Risk Assessment and Preparedness Planning

a) Conduct community-level vulnerability mapping that identifies and profiles at-risk populations such as women-headed households, the elderly, children, and persons with disabilities.
b) Integrate inclusive disaster preparedness protocols into the Haripad Municipality's Disaster Management Plan, ensuring that all emergency shelters, evacuation routes, and relief centres are barrier-free and accessible.
c) Develop accessible early warning systems using multilingual communication, visual alerts, and audible signals suitable for all user groups, including the hearing and visually impaired.
d) Ensure gender-sensitive resource allocation in disaster response budgets, prioritizing women's sanitation, childcare, and health needs in relief operations.
e) Establish neighbourhood-level emergency coordination committees to identify vulnerable individuals and ensure timely evacuation and support during disasters.

35.6.3.2 Empowering Vulnerable and Marginalized Groups

a) Promote active participation of women, elderly citizens, and persons with disabilities in local disaster risk reduction (DRR) committees and decision-making forums.
b) Provide training and capacity-building programs for vulnerable groups on emergency preparedness, first aid, and post-disaster recovery.
c) Create inclusive livelihood restoration programs post-disaster, focusing on women-led self-help groups (SHGs), informal sector workers, and small traders
d) Partner with Kudumbashree units, resident associations, and NGOs to facilitate targeted outreach and ensure representation in resilience planning
e) Incorporate psychosocial support and trauma counselling as a key component of recovery programs, particularly for children and elderly survivors.

35.6.3.3 Strengthening Community-Based Preparedness and Response

a) Establish Community-Based Disaster Response Teams (CBDRTs) in each ward, trained in first response, evacuation, and coordination with municipal authorities.
b) Conduct regular mock drills and awareness programs in schools, public institutions, and residential clusters to build disaster readiness.

c) Promote participatory hazard mapping and community risk profiling, integrating local knowledge and experiences into official planning documents.
d) Introduce volunteer-based rapid response networks involving youth and local organizations for early warning dissemination, resource mobilization, and relief distribution.
e) Encourage school-based disaster education programs and integrate disaster preparedness modules into the local curriculum to build long-term awareness.

35.6.3.4 Institutional Mechanisms and Policy Integration

a) Establish an Inclusive Disaster Management Cell under the Haripad Municipality, ensuring representation from social welfare, health, women and child development, and differently-abled departments.
b) Develop standard operating procedures (SOPs) for inclusive evacuation, shelter management, and post-disaster rehabilitation.
c) Implement data-driven decision-making systems, maintaining updated registries of vulnerable households for targeted communication and assistance.
d) Strengthen partnerships with Kerala State Disaster Management Authority (KSDMA), National Disaster Response Force (NDRF), and local NGOs for capacity building and resource sharing.
e) Institutionalize gender and social inclusion audits in all DRR and climate adaptation projects implemented under the Master Plan.

The proposed initiatives aim to establish equitable and accessible disaster management systems that address the needs of all sections of society while fostering community participation in planning, preparedness, and recovery. By promoting inclusive infrastructure, accessible communication systems, and gender-sensitive governance, Haripad can significantly reduce disaster-related mortality and displacement among vulnerable populations. Strengthened municipal capacity and socially responsive planning will collectively position Haripad as a model for inclusive, community-driven disaster resilience within Kerala's coastal region.

35.6.4 Safe and Resilient Infrastructure and services

Developing safe and resilient infrastructure is vital to reducing vulnerability in Haripad, where recurring floods and extreme weather events pose significant risks. Strengthening roads, bridges, buildings, drainage, water supply, and power networks to withstand such hazards will ensure the continuity of essential services, minimize disruptions, and reduce the socio-economic impacts of disasters

35.6.4.1 Hazard-Resistant Building Design

Given Haripad's exposure to flooding, lightning, and heat stress, all new and retrofitted structures must adopt hazard-resistant design principles to minimize vulnerability and enhance safety. Buildings in flood-prone areas should incorporate elevated plinth levels, flood-resistant materials, and site-level drainage provisions to prevent water intrusion and structural damage. In low-lying and waterlogged zones, permeable paving, raised platforms, and reinforced foundations should be prioritized. To address rising temperatures, structures must integrate passive cooling strategies, reflective roofing, adequate cross-ventilation, and green

roofs to reduce heat absorption and energy use. The Municipality should enforce revised building codes and design guidelines aligned with local hazard profiles to ensure that future development in Haripad is both structurally resilient and climate-responsive.

35.6.4.2 Climate Resilient Transport and Mobility Infrastructure

In Haripad, where seasonal flooding and waterlogging frequently disrupt mobility, developing climate-resilient transport infrastructure is critical for ensuring accessibility and continuity during emergencies. Key road corridors, particularly those adjoining Pilla Thodu, Danapady Thodu, and the Achankovil River, should be elevated and equipped with efficient side drains and cross-drainage structures to prevent inundation. Bridges and culverts must be designed with enhanced load capacity and flood-resistant foundations to withstand extreme rainfall events. Incorporating permeable shoulders, bioswales, and reinforced embankments using bioengineering methods will strengthen roads against erosion and slope failure. Additionally, improving pedestrian connectivity and evacuation routes through all-weather access paths will ensure safe, reliable mobility and strengthen Haripad's overall resilience to climate-induced disruptions.

35.6.4.3 Sustainable Water and Sanitation System

To strengthen resilience against flooding and seasonal water scarcity, Haripad's water supply and sanitation systems must be designed for sustainability and disaster resistance. The municipality should implement flood-protected wells, decentralized rainwater harvesting systems, and climate-resilient water distribution networks to ensure uninterrupted access during emergencies. Wastewater treatment units and septic systems must adopt flood-resistant designs to prevent contamination of surface and groundwater sources. In drought-prone areas, groundwater recharge structures, greywater reuse, and drought-tolerant landscaping should be promoted to enhance long-term water security. Collectively, these measures will safeguard public health and support a sustainable, climate-resilient urban water cycle for Haripad.

35.6.4.4 Strengthening Energy and Communication Systems

Ensuring a resilient power and communication network is vital for Haripad's disaster preparedness and emergency response. The Municipality should prioritize underground cabling in flood-prone areas and promote decentralized renewable energy systems, particularly solar-powered streetlights, water pumps, and public facilities, to maintain essential services during disruptions. All critical infrastructure, including hospitals, emergency shelters, and municipal offices, must be equipped with backup power systems and solar hybrid solutions to ensure continuity during outages. Strengthening telecommunication networks with disaster-resilient towers and integrated early warning systems will enhance real-time communication, coordination, and community safety during emergencies, ensuring Haripad remains operational and connected even under adverse conditions.

35.6.4.5 Critical Public Services and Emergency Infrastructure

In Haripad, ensuring the resilience of essential public infrastructure is vital for effective disaster response and recovery. Key facilities such as hospitals, schools, police stations, fire and rescue centres, and municipal offices must be designed and retrofitted to withstand floods, heatwaves, and other extreme events, ensuring uninterrupted operation during emergencies. Multi-purpose community centres and public halls should be equipped to function as

temporary relief shelters with provisions for safe water, sanitation, and backup power. Integrating disaster risk reduction principles into urban planning and public building design will help maintain accessibility, safety, and service continuity, enabling Haripad's critical infrastructure to serve as the backbone of its emergency response framework.

35.6.4.6 Sustainable Urban Planning and Green Infrastructure

To enhance environmental resilience and mitigate urban heat, Haripad's urban planning framework must prioritize green infrastructure and climate-responsive design. Expanding urban tree cover, linear green corridors, and public parks, particularly along Pilla Thodu, Danapady Thodu, and canal networks, will help regulate microclimates and reduce heat stress. Promoting compact and mixed-use development with adequate open spaces, green buffers around water bodies, and permeable surfaces will improve flood management and urban livability. Integrating transit-oriented and low-carbon development principles into planning will reduce emissions, enhance accessibility, and support Haripad's transition toward a sustainable, climate-resilient urban environment.

35.6.4.7 Carbon Neutral Local Self-Government Institution

The main objective is to measure the amount of carbon dioxide produced within the local self-government institution and its absorption capacity through a scientific study, and if the carbon dioxide emission is greater than the absorption capacity, reduce the difference between them to make it net-zero carbon. The concept of net-zero carbon can be implemented for each local self-government institution by reducing carbon dioxide emissions and increasing absorption capacity. Some of the activities that the local self-government institution should take the initiative to achieve this are given below:

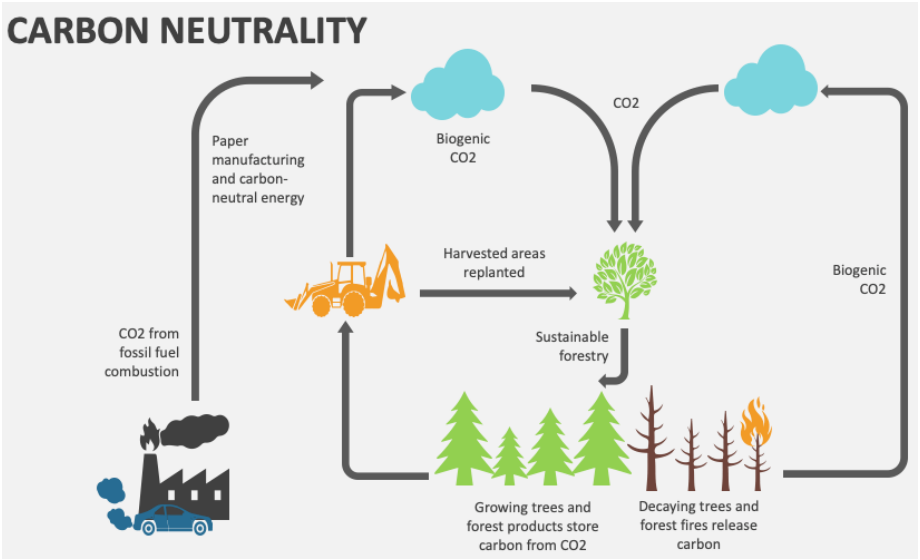


Figure 35.9 : Carbon Neutrality

- Reduce excessive use of vehicles
- Strengthen the public transport system
- Promote scientific waste management instead of burning garbage
- Ensure scientific management and processing of plastic waste and other wastes.
- Plant trees
- Promote methods of carbon nourishment in the soil
- Rely on non-conventional energy sources
- Cultivate barren land
- Protect the water in ponds, lakes, and other water sources from pollution

35.6.5 Capacity Building and Community Awareness

Building community capacity and awareness is central to reducing vulnerability and enhancing disaster resilience in Haripad, which frequently faces flooding, waterlogging, lightning, and heat stress. Empowering residents with knowledge, skills, and preparedness mechanisms will enable them to respond effectively during emergencies and safeguard their lives and assets. The Municipality should implement community-based disaster risk reduction (CBDRR) programs, including awareness campaigns, ward-level training workshops, and participatory risk mapping. Regular mock drills, early warning dissemination exercises, and school-based disaster education programs should be organized to build a culture of preparedness across all age groups. Integrating traditional coping practices with scientific disaster management tools can strengthen community ownership and enhance local relevance.

At the institutional level, first responders, municipal staff, and elected representatives should undergo specialized training in incident management, evacuation coordination, and relief operations to improve response efficiency. Public access to risk maps, hazard assessments, and safety guidelines must be ensured through digital platforms and local information centres, enabling residents to make informed decisions regarding construction, insurance, and relocation from high-risk zones. Transparent communication, supported by strong community networks and participatory governance, will help cultivate a well-informed, proactive, and resilient citizenry, ensuring that Haripad remains better prepared to withstand and recover from future climate and disaster challenges.

35.6.6 Insurance and Risk Transfer

Haripad's exposure to recurrent floods, lightning, heat waves, and waterlogging poses significant risks to households, businesses, and critical infrastructure. These hazards often result in economic disruptions, property damage, and livelihood losses, particularly affecting low-income and marginalized populations. To mitigate financial vulnerability and enhance recovery capacity, the Master Plan emphasizes the integration of comprehensive insurance and risk transfer mechanisms into the town's disaster management and climate adaptation framework. A structured risk transfer system ensures that disaster-related losses are equitably distributed, reducing direct financial burdens on affected individuals while promoting long-term economic stability and resilience.

Ensuring universal insurance coverage in hazard-prone areas is a key priority. The Municipality, in collaboration with insurance agencies and financial institutions, should promote multi-hazard insurance products tailored to Haripad's specific risks - such as flood, lightning, and heat-related damages. For economically weaker households, premium subsidies or integration of insurance within existing social protection and welfare schemes should be introduced. Furthermore, insurance providers should be encouraged to offer incentive-based policies, offering lower premiums or rebates for adopting flood-resistant construction techniques, raised plinths, lightning protection systems, and resilient roofing. This approach aligns financial benefits with proactive risk reduction.

In addition, financial institutions and credit agencies should integrate hazard and vulnerability mapping into their lending policies, encouraging safer investments through preferential loan terms for disaster-resilient construction. Collaboration between the Haripad Municipality, Kerala State Disaster Management Authority (KSDMA), insurance companies, and local banks

will be critical to institutionalizing these mechanisms. By embedding insurance and risk transfer strategies into local governance and development planning, Haripad can evolve into a financially secure, disaster-ready community, capable of absorbing and recovering swiftly from future climate-induced shocks.

35.6.7 Institutional Support and Governance

A robust institutional framework and effective governance structure are critical for building disaster resilience and reducing vulnerability in Haripad, which faces recurring floods, lightning incidents, and heat stress. Integrating disaster risk reduction (DRR) and climate adaptation into local governance, land-use planning, and infrastructure development is essential to ensure systematic preparedness and recovery. The Haripad Municipality, in coordination with the Kerala State Disaster Management Authority (KSDMA), should establish a dedicated Disaster Management and Climate Resilience Cell responsible for risk assessment, policy implementation, and inter-departmental coordination. Strengthening municipal departments through capacity-building programs, technical training, and resource support will enable effective enforcement of hazard-resistant building codes, emergency response mechanisms, and sustainable urban management practices. Collaboration with academic institutions, NGOs, and the private sector will further enhance technical expertise, knowledge sharing, and innovation in local disaster governance.

Transparency, accountability, and citizen participation form the backbone of effective resilience governance. The Municipality should promote participatory decision-making, ensuring that risk information, hazard maps, and safety guidelines are accessible to all residents through digital platforms, community notice systems, and awareness campaigns. Establishing Ward Disaster Management Committees will improve coordination during emergencies and ensure local-level preparedness. Regular public consultations, early warning dissemination, and disaster simulation exercises will strengthen public trust and response readiness. By embedding risk-informed governance principles across all municipal operations, Haripad can ensure safer urban growth, minimize disaster impacts, and foster a resilient, well-prepared, and inclusive local administration capable of responding effectively to future climate and disaster challenges.

35.7 Proposals for Climate Change Adaptation

Adapting to climate change demands proactive and strategic measures to minimize adverse impacts while harnessing potential benefits through planned adjustments. The adaptation process focuses on enhancing resilience, reducing vulnerability, and protecting communities from climate-induced hazards such as floods, droughts, heat waves, and extreme weather events. Although adaptation does not directly address the root causes of climate change, it seeks to mitigate its consequences by integrating climate-responsive strategies into urban planning, agriculture, water management, and infrastructure development. By prioritizing climate adaptation, municipalities and communities can safeguard lives, livelihoods, and essential resources.

Key strategies include strengthening disaster preparedness, promoting climate-smart agriculture, advancing water conservation, and investing in nature-based solutions, thereby fostering long-term sustainability and resilience across all sectors.

PROPOSALS FOR CLIMATE CHANGE ADAPTATION- HARIPAD

ENERGY-EFFICIENT AND LOW-CARBON STRATEGIES FOR CLIMATE RESILIENCE

1. *Transition to Renewable and Decentralized Energy Systems*
2. *Sustainable and Low-Carbon Mobility*
3. *Green and Energy-Efficient Built Environment*
4. *Cleaner Industrial and Waste-to-Energy Initiatives*
5. *Policy and Institutional Intervention*

CLIMATE-RESILIENT INFRASTRUCTURE AND SUSTAINABLE TRANSPORT SYSTEM

1. *Climate-Resilient Urban and Public Infrastructure*
2. *Road Network Upgradation and Climate Adaptation*
3. *Disaster-Resilient Transport and Public Spaces*



CLIMATE-RESILIENT AGRICULTURE

1. *Promotion of Climate-Resilient and Adaptive Farming Systems*
2. *Efficient Water and Soil Resource Management*
3. *Strengthening Disaster Preparedness in Agriculture*
4. *Sustainable Livestock and Fisheries Management*
5. *Institutional Support, Capacity Building, and Policy Measures*

ECOSYSTEM BASED ADAPTATION AND NATURE BASED SOLUTIONS

1. *Restoration and Conservation of Natural Water Systems*
2. *Floodplain and Wetland Rejuvenation for Flood Mitigation*
3. *Slope, Soil, and Ecosystem Stabilization*
4. *Urban Green Infrastructure and Heat Mitigation*
5. *Integration of EbA and NbS into Urban Planning and Infrastructure*
6. *Community Engagement and Institutional Strengthening*

INTEGRATED WATER RESOURCE MANAGEMENT

1. *Conservation and Efficient Utilization of Water Resources*
2. *Restoration and Protection of Traditional Water Systems*
3. *Urban Flood Management and Climate Adaptation Measures*
4. *Water Security and Sustainable Supply Systems*
5. *Pollution Control and Water Quality Management*
6. *Institutional Mechanisms and Community Participation*

35.7.1 Energy-Efficient and Low-Carbon Strategies for Climate Resilience

As Haripad continues to grow as a prominent urban and cultural centre in Alappuzha District, it faces increasing challenges from rising energy demands, vehicular emissions, and inefficient infrastructure, all contributing to a growing carbon footprint. To address these concerns and align with the broader objectives of climate resilience and sustainable urban development, the Master Plan proposes a comprehensive framework for energy-efficient and low-carbon development, tailored to Haripad's local context, geography, and economic structure.

35.7.1.1 Transition to Renewable and Decentralized Energy Systems

Given Haripad's favourable solar potential and dispersed settlement pattern, the adoption of renewable energy solutions- particularly solar energy is both feasible and impactful. The plan promotes:

a) Widespread rooftop solar installations on households, commercial establishments, and public buildings, including schools, temples, and government offices.
b) Community-level solar projects and decentralized solar farms to strengthen local energy independence and reduce electricity costs.
c) Solar-powered public infrastructure, such as street lighting, traffic signals, and water pumping stations, to lower operational costs and improve reliability.
d) Integration of smart energy systems, including automated lighting controls and energy-efficient appliances in public facilities, to optimize energy consumption.
e) Solar Rooftop Subsidy Drive (One Ward–One Solar Model)-A ward-wise, decentralized rollout of rooftop solar systems across the municipality will maximize adoption among residential, commercial, institutional, and public buildings. By facilitating MNRE, KSEB, and state renewable energy subsidies, along with net-metering support, the initiative will reduce upfront costs and enable households to offset electricity expenses. Demonstration projects on public buildings will build awareness and confidence, with special emphasis on inclusivity for low-income households, apartments, and small businesses. Overall, the initiative will enhance energy security during floods and extreme weather events, reduce carbon emissions, and strengthen Haripad's long-term transition toward clean and resilient energy systems.
f) Low Carbon Development Pathway- We have been pursuing a development path that exploits limited and high-carbon resources, which has led to increased greenhouse gas emissions, adversely affecting nature and climate, and increasing water scarcity. In contrast, the Low Carbon Development Pathway aims to provide a sustainable development path that reduces greenhouse gas emissions and adapts to a changing climate.
g) Green Protocol- Reduce the use of single-use and disposable plastics in the area falling within the local government area, thereby preventing the generation of plastic waste. Take steps to implement it under the leadership of local authorities. For example, make public events, such as weddings, etc., completely plastic-free and use banana leaves, steel, glass, steel utensils, etc. in public places such as schools, hospitals, etc. implement this idea through places, houses, shops and protect the environment and climate.

35.7.1.2 Sustainable and Low-Carbon Mobility

The transport sector remains a key contributor to urban emissions in Haripad due to increasing vehicular dependency. The Master Plan envisions a transition toward sustainable mobility systems that emphasize accessibility, safety, and environmental performance through

a) Introduction of electric public transport such as e-autos, minibuses, and shared e-mobility options to reduce vehicular pollution.
b) Establishment of EV charging stations at strategic nodes including bus stands, public parking areas, and major institutions.
c) Development of pedestrian-friendly and cycling infrastructure, especially along the town's key corridors and around educational and commercial areas.
d) Promotion of water-based transport options along Haripad's canal network, integrating low-emission ferries for both mobility and tourism.

35.7.1.3 Green and Energy-Efficient Built Environment

Building design and construction practices in Haripad have significant potential for reducing energy demand. The plan proposes:

a) Implementation of green building guidelines and incentives for energy-efficient design across residential, institutional, and commercial developments.
b) Incorporation of passive cooling techniques, natural ventilation, shading devices, and reflective materials to reduce heat gain and mitigate urban heat island effects.
c) Promotion of green roofs and vertical gardens to enhance thermal comfort and biodiversity.
d) Retrofitting of existing buildings with LED lighting, efficient HVAC systems, and improved insulation to lower operational energy use.
e) Encouragement of local construction materials with low embodied energy, supporting both sustainability and local economies.
f) Installation of solar panels in government buildings and promotion of decentralized renewable energy sources.
g) Increased tree cover through urban forestry and road-side plantation drives.
h) Green Building-Green building is an environmentally friendly building construction method that incorporates renewable materials and sustainable energy sources such as solar biogas. This building construction method is energy efficient.

35.7.1.4 Cleaner Industrial and Waste-to-Energy Initiatives

Although Haripad's industrial base is modest, it includes small-scale units and traditional industries that contribute to localized emissions. Recommendations include:

a) Adoption of cleaner production technologies and circular economy practices to minimize waste and enhance resource efficiency.
b) Introduction of small-scale waste-to-energy systems using organic waste from markets and households.
c) Encouragement of bioenergy applications, particularly biogas plants for community kitchens, markets, and institutions.

35.7.1.5 Policy and Institutional Intervention

The successful implementation of these strategies depends on strong policy support, institutional collaboration, and community participation. Recommended measures include:

a) Formulating local energy efficiency guidelines and incentive frameworks in coordination with the Kerala State Energy Management Centre (EMC).
b) Establishing a Municipal Energy Cell within Haripad Municipality to monitor energy use, promote awareness, and coordinate renewable energy projects.
c) Adopting carbon offset programs and green procurement policies to ensure sustainability in municipal operations.
d) Encouraging public-private partnerships (PPP) for investment in renewable energy infrastructure and smart technologies.

By embracing these energy-efficient and low-carbon strategies, Haripad can achieve multiple benefits - reducing emissions, lowering energy costs, improving air quality, and enhancing urban livability. Moreover, the initiatives will strengthen Haripad's position as a climate-smart town, demonstrating how smaller urban centres can contribute meaningfully to Kerala's climate goals while improving quality of life for their residents.

35.7.2 Climate-Resilient Agriculture

Haripad's agrarian landscape - characterized by its vast paddy fields, canal networks, and interconnected wetlands - forms the backbone of its local economy and ecological stability. However, increasing climate variability, frequent floods, droughts, salinity intrusion, and soil degradation have intensified the vulnerability of its farming communities. To address these challenges, the Haripad Master Plan proposes a comprehensive framework for climate-resilient agriculture, integrating adaptive farming practices, ecosystem restoration, and disaster preparedness to safeguard livelihoods and ensure long-term sustainability.

35.7.2.1 Promotion of Climate-Resilient and Adaptive Farming Systems

a) Introduce and promote flood-tolerant and drought-resistant crop varieties suited to Haripad's mixed hydrological conditions.
b) Encourage diversified cropping systems, including mixed cropping, multi-cropping, and crop rotation, to reduce dependency on single-crop cycles and stabilize farm income.
c) Promote integrated farming systems (crop–livestock–fisheries–horticulture) to optimize resource use, improve soil fertility, and diversify livelihood opportunities.
d) Revitalize traditional paddy cultivation systems through ecosystem-based practices like controlled flooding, seasonal fallowing, and paddy–fish integration.
e) Introduce saline-tolerant crop varieties and raised-bed farming techniques in flood-prone and waterlogged areas.
f) Promote organic and agro ecological farming practices, including the use of compost, green manure, and bio-fertilizers, to restore soil health and reduce chemical dependency.

35.7.2.2 Efficient Water and Soil Resource Management

a) Expand micro-irrigation techniques such as drip and sprinkler irrigation to enhance water-use efficiency and ensure crop survival during dry spells.
b) Construct rainwater harvesting ponds, percolation tanks, and recharge wells within agricultural areas to improve groundwater recharge and reduce irrigation dependency.
c) Implement soil moisture conservation measures, including contour bunding, mulching, vegetative barriers, and cover cropping, to prevent erosion and maintain soil structure.
d) Promote canal rejuvenation and bund strengthening to enhance floodwater management and ensure equitable distribution of irrigation water.
e) Encourage rain-fed farming practices in upper catchment zones with proper soil and water conservation techniques.

35.7.2.3 Strengthening Disaster Preparedness in Agriculture

a) Establish localized early warning systems for floods, droughts, pest outbreaks, and extreme weather events, integrated with real-time monitoring.
b) Develop digital agro-advisory platforms and mobile-based weather information systems to provide farmers with timely and actionable climate data.
c) Strengthen and expand crop insurance coverage for small and marginal farmers to minimize financial losses from climate-induced disasters.
d) Conduct farmer training and capacity-building programs on disaster risk management, sustainable farming, and adaptive practices.
e) Establish disaster-resilient storage and distribution systems for agricultural inputs and produce to ensure food and income security post-disaster.

35.7.2.4 Sustainable Livestock and Fisheries Management

a) Promote climate-smart animal husbandry through the introduction of heat-tolerant livestock breeds, improved housing designs, and enhanced fodder management practices.
b) Establish fodder banks and promote fodder cultivation zones to ensure continuous feed supply during droughts or floods.
c) Encourage waste-to-fodder and bio-digester technologies for sustainable livestock management and biogas production.
d) Develop sustainable inland fisheries using scientific stocking practices and improved water management techniques to enhance productivity and maintain ecological balance.
e) Promote paddy–fish integrated systems and brackish water aquaculture in suitable zones, combining food production with environmental resilience.
f) Establishment of Silage Units-To strengthen climate-resilient livestock management in Haripad town, it is proposed to establish silage units under the supervision of the Local Self-Government as part of the Sustainable Livestock and Fisheries Management strategy. These units will ensure a reliable and continuous supply of fodder, particularly during the summer months when green fodder availability is severely constrained. The initiative can be implemented with the active participation of

Kudumbashree units, enabling community-based fodder production, storage, and distribution. This project will help reduce seasonal fodder shortages, stabilize livestock productivity, support the livelihoods of cattle-rearing households, and enhance the overall resilience of the livestock sector to climate variability.



Figure 35.10 : Stages of Silage Production

35.7.2.5 Institutional Support, Capacity Building, and Policy Measures

a) Establish a Climate-Resilient Agriculture Task Force under Haripad Municipality in coordination with the Department of Agriculture, Krishi Vigyan Kendras (KVKs), and local self-government institutions.
b) Formulate Climate-Smart Agriculture Action Plans at the municipal level to integrate adaptation strategies into local planning and budgeting processes.
c) Promote collective farming models and strengthen farmer cooperatives for shared irrigation infrastructure, marketing, and technology dissemination.
d) Introduce incentives and subsidies for organic certification, renewable energy use (solar-powered pumps and dryers), and sustainable land management practices.
e) Foster public–private partnerships (PPP) and community participation in implementing climate-resilient agricultural projects.
f) Support research and innovation in adaptive farming techniques through collaboration with academic and agricultural research institutions.

The proposed measures will enhance agricultural productivity and livelihood security through diversification and risk reduction while improving soil health, water efficiency, and ecosystem stability across Haripad's rural landscape. Strengthened institutional and community capacity will enable better response to climate risks, and the promotion of low-carbon, sustainable farming practices will support long-term resilience. Together, these initiatives aim to establish Haripad as a model for climate-adaptive agriculture in Kerala's coastal regions.

35.7.3 Integrated Water Resource Management

Located within the low-lying Kuttanad region, Haripad is characterized by its dense network of canals, ponds, paddy fields, and wetlands, which form an intricate and sensitive hydrological

system. However, climate variability, rapid urbanization, and declining water quality have severely affected this natural balance. The town faces recurring floods, prolonged dry spells, salinity intrusion, and surface water contamination, all of which threaten water security and ecological stability. To build resilience against these challenges, the Master Plan proposes an Integrated Water Resource Management (IWRM) framework for Haripad - combining conservation, restoration, efficient utilization, and participatory governance to ensure the sustainable management of both surface and groundwater resources.

35.7.3.1 Conservation and Efficient Utilization of Water Resources

a) Promote judicious and efficient use of surface and groundwater through demand management and water budgeting at the ward and municipal levels.
b) Implement dual water systems for segregating potable and non-potable water use, reducing stress on freshwater sources.
c) Encourage rainwater harvesting systems in residential, institutional, and commercial buildings through municipal bylaws and incentives.
d) Introduce micro-irrigation systems such as drip and sprinkler irrigation in peri-urban agricultural zones to optimize irrigation efficiency.
e) Promote reuse and recycling of treated wastewater for landscape irrigation, cleaning, and non-potable uses in public spaces and institutions.
f) Develop a municipal water audit mechanism to monitor usage, losses, and efficiency improvements across sectors.
g) Decentralized Wastewater Reuse Gardens-The establishment of decentralized, small-scale wastewater treatment and reuse systems integrated with local drainage networks will enable the safe reuse of treated grey water for gardening, landscaping, parks, green buffers, and floriculture. By promoting circular water-use practices, the initiative will reduce freshwater demand and minimize wastewater discharge into canals and water bodies, thereby improving water quality. It will also lower the load on drainage infrastructure, reducing flooding and waterlogging risks, while supporting organic farming and greening of underutilized land. Overall, this climate-resilient approach - well suited for towns without centralized sewerage systems - will transform wastewater into a resource, strengthening environmental sustainability and long-term water security in Haripad.



Figure 35.11 : Representative image of a Decentralised wastewater treatment system (at Aravind Eye Hospital, Pondicherry)

h) Remove Moss from the Canals and Use This Moss in a Biogas Plant, For Mulching, Or for Composting Purposes -Algae grow and spread very quickly in water bodies. They do not allow sunlight to pass through the water where they grow, thus posing a threat to underwater life. African algae are a threat to agriculture and biodiversity in areas like Kerala. They drain nutrients from the water and grow in large numbers on the water surface, blocking sunlight. Therefore, steps should be taken to protect aquatic plants and aquatic animals by removing them from water bodies and restoring the natural flow of water.



Figure 35.12 : Removing Moss (Pola) from the canals

35.7.3.2 Restoration and Protection of Traditional Water Systems

a) Identify, map, and restore traditional ponds, tanks, canals, and wetlands as vital components of the town's blue infrastructure.
b) Prevent encroachments on water bodies and their buffer zones through strict land-use enforcement and community surveillance.
c) Undertake desilting and rejuvenation of canal networks, ensuring improved connectivity between ponds, drains, and paddy fields for better flood management.
d) Promote pond rejuvenation projects with peripheral walkways, vegetative buffers, and native landscaping to enhance ecological function.
e) Rehabilitate temple ponds and heritage water structures as part of both water management and cultural preservation efforts.
f) Integrate community-based water stewardship programs, empowering local residents and youth groups to monitor water body health and prevent illegal dumping.
g) Well Recharging- This is a method of collecting rainwater from the roof in trays during the rainy season and discharging it into holes dug above the well or directly into the well through a filter. This method will help in increasing the availability of water during the summer and also strengthen the springs leading to the well. Unused wells and tube wells can be used to transport rainwater to the groundwater in this way. Over time, springs will start reaching these too.
h) Rainwater harvesting, rainwater harvesting, and the Jaljeevan Mission can be implemented.
i) Introduce Mazhapolima scheme, a rainwater harvesting project that filters rainwater from the rooftop and directs it to the well.

35.7.3.3 Urban Flood Management and Climate Adaptation Measures

a) Adopt sponge city principles to enhance infiltration and reduce surface runoff through permeable pavements, bioswales, and vegetated drainage channels.

b) Develop urban wetlands and storm water detention ponds in strategic low-lying areas to absorb excess rainfall and mitigate flash flooding.
c) Promote green infrastructure, including paddy field restoration, urban forests, and open green spaces, to improve rainwater absorption and reduce heat island effects.
d) Strengthen and maintain the primary and secondary drainage network, ensuring proper gradient, silt traps, and outflow regulation mechanisms.
e) Integrate storm water management systems with existing irrigation canals for dual use and efficient flow regulation during monsoon peaks.
f) Implement flood-resilient infrastructure, including raised roads, culverts, and embankments with vegetative stabilization.

35.7.3.4 Water Security and Sustainable Supply Systems

a) Establish flood-protected and elevated wells, ensuring clean and safe water access during flood events.
b) Promote decentralized rainwater harvesting and recharge systems at household, community, and institutional levels.
c) Upgrade drinking water supply systems with resilient pipelines, storage tanks, and purification units capable of operating during extreme events.
d) Introduce groundwater recharge structures such as recharge pits, trenches, and percolation ponds in suitable areas.
e) Promote solar-powered water supply systems for energy-efficient operation of pumping and distribution networks.
f) In drought-prone wards, encourage the adoption of grey water reuse, moisture retention landscaping, and small-scale desalination units where feasible.

35.7.3.5 Pollution Control and Water Quality Management

a) Strengthen wastewater treatment infrastructure, including decentralized treatment plants (DEWATS) for clusters and institutions.
b) Enforce strict pollution control norms for industrial discharges, commercial activities, and septic systems.
c) Promote eco-friendly sanitation systems and bio-digesters to minimize groundwater contamination in densely populated wards.
d) Conduct regular water quality monitoring of canals, ponds, and groundwater to track pollution trends and identify hotspots.
e) Develop buffer vegetation zones along canals and ponds to filter pollutants, stabilize embankments, and enhance biodiversity.

35.7.3.6 Institutional Mechanisms and Community Participation

a) Establish a Haripad Water Resource Management Cell within the Municipality to coordinate planning, implementation, and monitoring of water-related initiatives.
b) Develop a comprehensive Water Resource Management Plan integrating flood control, water supply, irrigation, and ecosystem conservation.
c) Strengthen coordination among municipal departments, irrigation authorities, and environmental agencies for joint planning and data sharing.

d) Encourage community participation through water-user associations, resident groups, and school-level awareness programs.
e) Conduct capacity-building and training programs on climate-resilient water management, targeting local officials and community leaders.
f) Promote citizen science initiatives, enabling local monitoring of rainfall, water quality, and groundwater levels.

The proposed interventions aim to ensure improved water availability and quality in Haripad through efficient utilization, groundwater recharge, and pollution control measures. By restoring natural drainage systems and adopting sponge city principles, the town will enhance its resilience to both floods and droughts. Strengthening institutional mechanisms and community participation will foster sustainable and inclusive water governance. These measures will collectively help reduce urban water stress and disaster risks, securing long-term climate adaptation and resilience. Ultimately, the initiative envisions positioning Haripad as a model town for integrated water resource management within Kerala's coastal and low-lying regions.

35.7.4 Climate-Resilient Infrastructure and Sustainable Transport System

The town's linear growth pattern along major transport corridors, coupled with unplanned drainage and increasing vehicular use, intensifies its vulnerability to climate impacts. To ensure long-term resilience and sustainable urban development, the Haripad Master Plan emphasizes a dual approach - strengthening climate-resilient infrastructure and developing sustainable, low-carbon transport systems that enhance adaptability, reduce emissions, and improve urban liveability.

35.7.4.1 Climate-Resilient Urban and Public Infrastructure

a) Design and retrofit critical public buildings - including hospitals, schools, government offices, and disaster management centres - to withstand floods, storms, and extreme heat conditions.
b) Adopt hazard-resistant construction practices such as elevated plinth levels in flood-prone zones, reinforced foundations, corrosion-resistant materials, and natural ventilation systems.
c) Ensure that new infrastructure projects - including municipal buildings, public halls, and commercial complexes - incorporate climate-responsive design principles and energy-efficient materials.
d) Promote green infrastructure elements like green roofs, shaded corridors, and vertical gardens to reduce heat island effects and improve air quality.
e) Introduce solar-powered lighting systems, water-efficient fixtures, and rainwater harvesting systems in all public facilities to minimize operational energy and water use.
f) Upgrade storm water drainage networks using nature-based solutions such as bioswales, rain gardens, retention ponds, and vegetated channels to reduce urban flooding and enhance groundwater recharge.
g) Strengthen critical utilities and infrastructure networks (power, water, communication) to ensure continued functionality during floods and other climate events.

h) Renovation and Relocation of Anganwadis (Flood-Resilient Facilities)- The proposal involves relocating flood-prone Anganwadis in Wards 4, 22, and 26 to safer and more accessible locations to ensure uninterrupted early childhood care, nutrition, and health services during monsoon and flood events. The initiative includes constructing structurally safe, flood-resilient buildings with adequate indoor and outdoor activity spaces, secure play areas, and upgraded electrical and utility systems. Implemented in coordination with the ICDS department, ward councillors, and local communities, the project will strengthen neighbourhood-level disaster preparedness, enhance social infrastructure, and ensure the safety and well-being of children, pregnant women, and Anganwadi staff. The projects regarding the renovation and relocation of Anganwadis and introduction of smart Anganwadis and digital classrooms has been discussed in chapter 36. Priority Action Plan.



i) Flood Resilient Housing Scheme -The initiative focuses on reducing housing vulnerability in flood-prone areas of Haripad, with targeted support for economically vulnerable households. It promotes flood-resilient construction and retrofitting practices, including raised plinth levels, improved foundation design, use of flood-resistant materials, dampness control measures, better plot-level drainage, and safe electrical system placement. The program will provide standard design templates, technical guidance, and capacity-building support for homeowners, masons, and contractors, while converging with existing government housing and disaster mitigation schemes. Overall, it aims to minimize flood-related structural damage and reduce displacement risks. More details about this project is specified in chapter 36 Priority Action Plan.



j) Haripad Vidhya Vanam & School Agro-Forestry Initiative - The initiative proposes the creation of miniature forests and agro-forestry learning spaces in schools under the Kerala Forest Department's Vidyavanam scheme, implemented on land parcels of 5 cents or more using indigenous species. Inspired by the Miyawaki method, it promotes high-density, multi-layered planting to rapidly enhance green cover while developing living outdoor classrooms for experiential learning in biodiversity, climate change, and sustainable land practices. With active



student involvement through Forestry Clubs and integration of agro-forestry concepts, the program emphasizes native species, organic methods, and low-maintenance ecological design, contributing to improved urban green cover, better micro-climates, reduced heat-island effects, and long-term climate resilience and environmental awareness. The details of this project are given in chapter 36 Priority Action Plan.

35.7.4.2 Road Network Upgradation and Climate Adaptation

a) Redesign critical road corridors to include improved drainage systems, cross-drains, and raised carriageways in flood-prone stretches.
b) Strengthen embankments and retaining structures using bioengineering techniques, gabion walls, and vegetated slopes to prevent erosion and road damage during floods.
c) Introduce climate-resilient materials and cool pavements to reduce heat absorption and extend the lifespan of road surfaces.
d) Enhance connectivity to evacuation routes and emergency facilities, ensuring all-weather accessibility during disasters.
e) Provide green buffers and shaded avenues along roads to enhance comfort for pedestrians and cyclists while mitigating urban heat.

35.7.4.3 Disaster-Resilient Transport and Public Spaces

a) Design transport hubs, bus terminals, and public spaces with flood-proof flooring, elevated utilities, and robust drainage systems to ensure usability during extreme events.
b) Implement solar-powered lighting and digital information systems in public transport infrastructure to maintain functionality during power disruptions.
c) Create safe assembly and evacuation zones in strategic locations connected by all-weather access routes.
d) Introduce rain shelters, shaded seating areas, and cooling zones along key pedestrian corridors and public gathering spaces to reduce heat stress impacts.

35.7.5 Ecosystem Based Adaptation and Nature Based Solutions

Haripad, located within the ecologically sensitive Kuttanad–Kayamkulam corridor, is endowed with a rich network of canals, wetlands, ponds, and paddy fields that form the foundation of its environmental identity and local livelihoods. However, rapid urbanization, encroachments, and unregulated land-use changes have significantly degraded these natural systems, increasing the town's vulnerability to floods, droughts, salinity intrusion, and extreme heat. To address these challenges, the Haripad Master Plan promotes an Ecosystem-Based Adaptation (EbA) approach, integrating Nature-Based Solutions (NbS) into planning and development. This approach emphasizes working with natural systems to strengthen resilience, reduce disaster risks, and enhance environmental quality while providing socio-economic co-benefits.

35.7.5.1 Restoration and Conservation of Natural Water Systems

a) Undertake comprehensive mapping, rejuvenation, and interlinking of Haripad's natural waterways, including Achankovil River, Pilla Thodu, Danapady Thodu, and the secondary canal network.
b) Implement desiltation and dredging of blocked canals and temple ponds to restore hydraulic connectivity and enhance flood-carrying capacity.
c) Rejuvenate traditional ponds - especially smaller temple ponds and community ponds within dense residential areas - to improve groundwater recharge and serve as micro-climate stabilizers.
d) Establish buffer vegetation belts with native wetland plants (such as vetiver, reeds, and canna) along canals and pond margins to reduce erosion, filter pollutants, and enhance biodiversity.
e) Integrate constructed wetlands and bioswales into drainage systems to treat runoff naturally and reduce urban water pollution.
f) Protect and conserve wetland areas within the municipality by designating them as eco-sensitive zones under municipal development regulations.

35.7.5.2 Floodplain and Wetland Rejuvenation for Flood Mitigation

a) Restore and protect the floodplains of the Achankovil River and adjoining thodu networks to function as natural retention zones during peak monsoon flows.
b) Undertake wetland afforestation and riparian plantation using native species to stabilize embankments and enhance water retention.
c) Develop eco-parks and wetland reserves in degraded floodplain stretches that can serve dual purposes - flood control and biodiversity conservation.
d) Promote the Sponge City approach by integrating rain gardens, retention ponds, green corridors, and vegetated swales throughout the urban area to absorb excess runoff.
e) Reconnect urban water channels with traditional paddy fields to regulate seasonal water storage and prevent flooding in low-lying areas.
f) Wetland Parks- A Wetland Park is proposed at the southern part of the Padasekharams, adjacent to the Agro-Tourism Zone, as a designated special zone in Haripad town. Envisioned as a flood-adaptive landscape, the park will function as a natural buffer during periods of high rainfall while simultaneously providing an open recreational space for the local community. The proposal emphasizes conservation-oriented development, with no permanent built structures permitted, thereby preserving the ecological character of the wetland. In addition to supporting flood regulation, biodiversity conservation, and micro-climatic regulation, the Wetland Park will enhance the visual quality and environmental aesthetics of the town, offering opportunities for nature-based



recreation and environmental awareness. The details of the project proposal for wetland parks are discussed in Chapter 36 of this Master Plan..

35.7.5.3 Slope, Soil, and Ecosystem Stabilization

a) Stabilize vulnerable canal embankments and reclaimed paddy margins using bioengineering techniques, such as vetiver grass planting and soil bio-binders.
b) Promote agroforestry and mixed cropping in peri-urban agricultural lands to improve soil fertility, carbon sequestration, and resilience against extreme weather events.
c) Undertake eco-restoration of degraded lands and abandoned quarry areas through native tree plantations and grass cover.
d) Encourage community-based soil and water conservation programs using local labour and traditional techniques for embankment repair and canal rehabilitation.
e) Biodiversity Conservation:
   - **Strengthening local biodiversity governance:** Update and operationalize the Biodiversity Management Register (BMR) in line with KSAPCC objectives to systematically document local flora and fauna, including scientific classification, ecosystem services, and economic and medicinal value, thereby supporting evidence-based conservation planning.
   - **Promotion of native and medicinal plant conservation at household level:** Encourage the cultivation of indigenous shrubs and medicinal plants in homesteads to enhance urban biodiversity, preserve traditional knowledge systems, and contribute to climate-resilient green cover as envisaged under the State Green Policy.

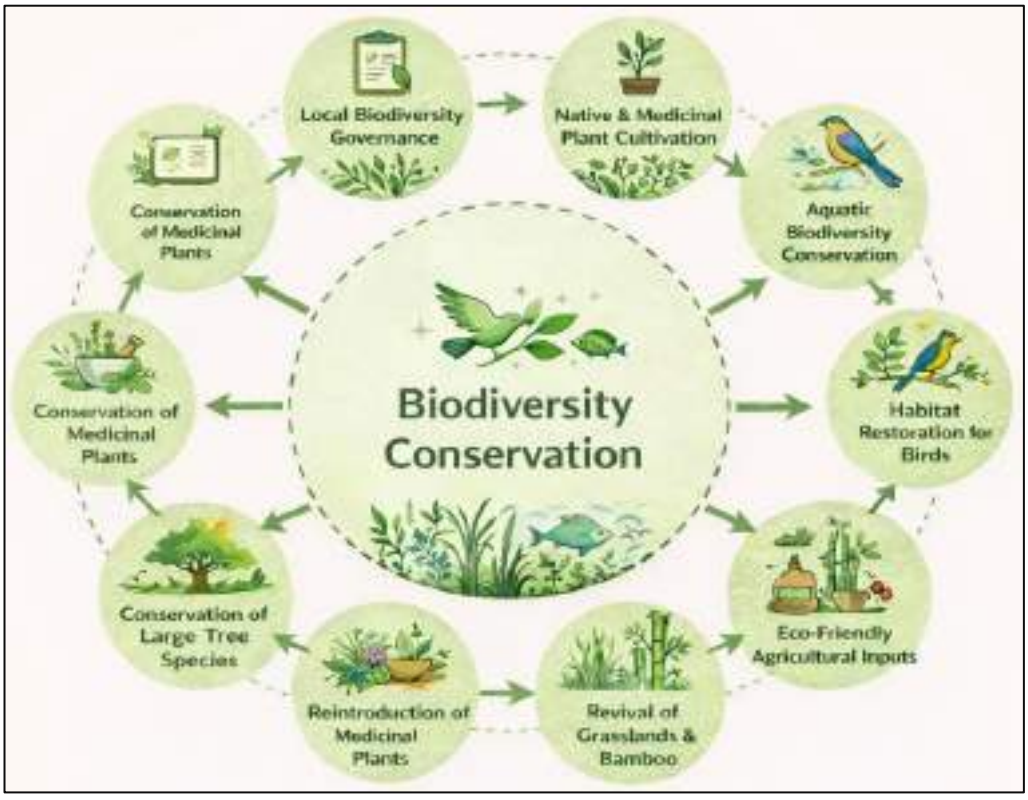


Figure 35.13 : Measures for Biodiversity Conservation

- **Conservation of aquatic biodiversity through indigenous practices:** Promote indigenous and sustainable fish farming practices to protect native fish species, maintain aquatic ecosystem health, and strengthen livelihood resilience in accordance with climate-smart agriculture principles.
- **Habitat restoration for declining bird species:** Implement habitat restoration and tree-based interventions to address the decline of native bird populations, such as parrots and jays, thereby enhancing urban ecological balance and biodiversity connectivity.
- **Transition towards eco-friendly agricultural inputs:** Reduce dependence on chemical fertilizers and pesticides and promote organic and bio-input-based practices to protect pollinators and beneficial insects, aligning with KSAPCC goals for low-emission and environmentally sustainable agriculture.
- **Revival of native grasslands and bamboo resources:** Restore declining native grasses and bamboo species in vacant municipal lands to improve carbon sequestration, soil stability, and urban ecological resilience, while reintroducing locally extinct species wherever feasible.
- **Reintroduction of indigenous large tree species:** Promote the planting of large native tree species in public institutions, educational campuses, and open spaces to enhance urban tree cover, mitigate heat stress, and improve microclimatic conditions as part of climate adaptation strategies.
- **Conservation and propagation of rare medicinal plant species:** Encourage community-level propagation of declining medicinal plant species to strengthen ecosystem services, support traditional healthcare systems, and advance the State's green development and biodiversity conservation objectives.

35.7.5.4 Urban Green Infrastructure and Heat Mitigation

a) Establish urban forests, linear green corridors, and shaded greenways along canals such as Pilla Thodu and Danapady Thodu, enhancing aesthetics and providing micro-climatic regulation.
b) Promote rooftop gardens, terrace vegetation, and vertical greening in public and private buildings to mitigate heat and improve urban air quality.
c) Develop permeable pavements and bio-retentive surfaces in parking lots, walkways, and public spaces to reduce surface runoff and promote infiltration.
d) Create rain gardens and bioswales in median strips and open spaces to naturally manage stormwater and support pollinator-friendly vegetation.
e) Increase urban tree canopy cover with species suited to Haripad's coastal climate - such as rain trees, banyan, neem, and bamboo- prioritizing areas with high heat vulnerability and pedestrian activity.
f) Pachathuruthu – Miyawaki Urban Forest Initiative -The proposal focuses on creating dense mini-forests on vacant and underutilized urban plots using the Miyawaki method, with indigenous trees, shrubs, and ground-cover species planted at



high density to ensure rapid forest establishment. These green pockets help reduce the urban heat island effect, improve environmental quality, and support flood mitigation by enhancing soil infiltration and reducing surface runoff. Implemented through active community participation - including residents, schools, youth groups, and Kudumbashree units - the initiative promotes the development of informal neighbourhood green spaces while strengthening local ecological resilience. The details regarding this project is detailed in chapter 36 Priority Action Plan.

g) Tree Museum - As part of strengthening urban green infrastructure and mitigating rising heat stress, it is proposed to introduce a Tree Museum model in Haripad town, inspired by the 'Pachathuruth' Tree Museum established within the Kannur Central Jail premises. This initiative will focus on the conservation, propagation, and public display of indigenous and endangered tree species that are facing decline within the municipal limits. Vacant lands in schools, colleges, Ayurveda hospitals, and other municipally owned properties shall be identified for establishing such tree museums. The initiative will contribute to increasing urban tree cover, conserving biodiversity, creating climate-resilient public spaces, and reducing urban heat island effects. Additionally, it will serve as an educational and awareness platform, promoting ecological stewardship while enhancing the town's resilience to climate-induced risks.

h) Tree Banking System -It is proposed to introduce a Tree Banking System in Haripad town, modelled on the successful implementation of this initiative at Meenangadi in Kerala. This system aims to discourage indiscriminate tree felling while incentivizing long-term tree conservation. Under the scheme, trees planted by farmers and landowners will be geotagged, monitored, and maintained for a minimum period of ten years. A dedicated fund allocated by the State Government shall be deposited in a designated cooperative bank, and annual maintenance incentives shall be disbursed to participants from the interest accrued, based on the number of trees conserved. In cases where tree removal becomes unavoidable, the incentive amount shall be refunded and compensatory plantation of new saplings will be mandatory.

35.7.5.5 Integration of EbA and NbS into Urban Planning and Infrastructure

a) Integrate Ecosystem-Based Adaptation principles into all stages of Haripad's urban planning - land use zoning, building codes, and infrastructure design.
b) Ensure all new developments and road projects include provisions for green buffers, water infiltration features, and natural drainage connectivity.
c) Implement eco-restoration projects along the Achankovil River banks and canal networks, incorporating walking trails, riparian vegetation, and interpretive signage to promote public engagement.
d) Develop eco-sensitive zoning regulations to restrict construction along water bodies and floodplains, supported by mandatory buffer zones and green setbacks.
e) Encourage public-private partnerships (PPPs) and CSR-funded projects for wetland restoration, canal rejuvenation, and park maintenance.

35.7.5.6 Community Engagement and Institutional Strengthening

a) Establish River and Canal Monitoring Committees comprising local residents, environmental groups, and ward representatives to oversee water body maintenance.
b) Organize community-led afforestation drives, clean-up campaigns, and wetland restoration programs across Haripad's temple ponds, canals, and wetlands.
c) Conduct awareness and training programs for municipal engineers, builders, and students on the design, maintenance, and benefits of nature-based systems.
d) Integrate EbA and NbS education into local schools and institutions to build long-term stewardship among youth.
e) Collaborate with academic and research institutions for monitoring hydrological changes, biodiversity impacts, and ecosystem health indicator.The proposed initiatives aim to achieve enhanced flood resilience and reduced waterlogging through the restoration of wetlands, ponds, and canal systems, while ensuring improved groundwater recharge and water quality across urban and peri-urban areas. Expanding vegetation cover and green infrastructure will help mitigate heat stress and enhance the urban microclimate, complemented by the revitalization of ecosystems that support biodiversity, fisheries, and the cultural heritage of temple ponds and waterways. By fostering community participation and strengthening local institutions in ecosystem stewardship, Haripad is envisioned to emerge as a model for ecosystem-based climate adaptation and nature-integrated urban planning in Kerala's coastal and low-lying regions.
f) Haripad Haritha Samriddhi Clusters Project- The initiative envisions town-wide activation of underutilized and fragmented agricultural plots through collective organic farming, floriculture, and herbal cultivation, transforming fallow lands into productive, income-generating landscapes with high-value, low-water, climate-appropriate crops. Adopting a cluster-based model for shared planning, training, branding, and market access, it promotes strong participation from Kudumbashree units, women's groups, youth clubs, RWAs, and self-help groups to ensure social inclusion and diversified livelihoods. By reducing dependence on water-intensive paddy cultivation and aligning with schemes such as NAWO–DHAN and horticulture missions, the program enhances resilience to climate variability while enabling integration with agro-tourism, ultimately strengthening Haripad's identity as a green, health-oriented, and climate-responsive agriculture-led town. The details regarding this project is detailed in Chapter 34 of this Master Plan.



CHAPTER
36

PRIOIRTY ACTION PLAN



The Priority Action Plan for Haripad provides a strategic roadmap for implementing key sectoral projects through a phased, outcome-oriented approach. It defines the implementation strategy, project phasing and priority initiatives, outlining essential components to support the preparation of Detailed Project Reports (DPRs) and resource mobilization. Adopting a 20-year horizon divided into four 5-year phases, the strategy is guided by spatial and socio-economic assessments and infrastructure gap analysis. Projects delivering high public benefit, addressing critical urban service deficits, enhancing resilience and promoting inclusive growth are prioritized. This structured framework ensures that early-phase investments yield visible improvements while establishing a strong foundation for long-term, sustainable and planned urban development in Haripad.

- Development priorities
- Implementation strategy & Project Phasing
- Identification of Priority Projects
- Details of Priority Projects

36. PRIORITY ACTION PLAN

36.1 Development priorities

The development initiatives proposed for Haripad have been strategically organized under broad thematic umbrellas to ensure a holistic, sector-focused, and integrated approach to urban transformation. Each category addresses key developmental challenges while promoting sustainability, inclusivity, and resilience. The projects have been structured based on their alignment with major sectors such as agriculture, tourism, heritage, environment, fisheries, animal husbandry, drainage, water supply, solid waste management, education, health, commerce, traffic and transportation, recreation, social infrastructure, and housing. Accordingly, the projects are grouped under six overarching development programs that reflect Haripad's unique socio-cultural identity and urban aspirations:

Table 36.1 : Proposed Project Umbrellas in Haripad

	**Haripad Paithruka Veedhi** *(Culture Corridor)*	Focuses on heritage and cultural tourism enhancement through temple precinct redevelopment, palace restoration, pedestrian-friendly heritage corridors, temple pond rejuvenation, and the creation of culturally vibrant urban spaces that celebrate Haripad's rich traditions and religious legacy
	**Haripad Jalamrutham** *(Water & Resilience Program)*	Encompasses initiatives for integrated water management and climate resilience in Haripad, including drainage improvement, canal and pond rejuvenation, stormwater management, flood mitigation, and strengthening of water supply systems for long-term water security. The program also aims to revitalize Haripad's canal and waterbody network through canal-front development, eco-tourism, and heritage-linked waterfront projects, blending sustainability with cultural and economic renewal.
	**Haritham Haripad 2.0** *(Agro-Ecology & Livelihoods)*	Focuses on environmental sustainability and ecological conservation in Haripad through initiatives such as agriculture, farm tourism, fisheries, animal husbandry, community and floriculture farming, and farming experience trails. It also emphasizes green infrastructure and agro-based value addition enterprises to enhance climate resilience, sustainable livelihoods, and balanced rural - urban development

	**Haripad Nagaravanam** *(Green & Recreational Network)*	Focuses on enhancing green and recreational infrastructure in Haripad through the creation of urban parks, waterfront promenades, Miyawaki forests, children's play areas, and biodiversity zones to improve liveability and environmental quality. It also proposes bicycle trails linking floriculture and vegetable farms, sacred groves, urban wetlands promoting sustainable mobility and community engagement
	**Haripad Ullasam** *(Vibrant Tourism & Public Realm)*	Promotes tourism, recreation, and local economic vitality through initiatives such as recreation-based activities, food streets, organized vending zones, cultural festivals, guided heritage walks, and local cuisine experiences, fostering Haripad's identity as a vibrant and engaging destination
	**Ente Haripad Projects** *(Social & Civic Infrastructure)*	Encompasses social and community-oriented initiatives that strengthen education, healthcare, housing, and public infrastructure, ensuring equitable access to essential services and promoting inclusive, people-centric development. It also includes civic amenities, social infrastructure, youth engagement programs, and veterinary-related projects, supporting overall community well-being and sustainable urban growth.

Together, these project umbrellas form a comprehensive development roadmap for Haripad - one that integrates its cultural heritage, ecological assets, and urban needs to create a resilient, sustainable, and vibrant urban environment.

36.1.1 Liveability and Its Relevance to Haripad

Liveability represents the overall quality of life experienced by residents within a town, shaped by the harmony between its physical environment, social systems, economic vitality, and cultural richness. The liveability pillars form the foundation of sustainable urban development, encompassing accessibility, safety, environmental sustainability, economic resilience, inclusivity, and cultural identity. A truly liveable town ensures well-connected infrastructure, reliable public services, affordable housing, vibrant public spaces, green environments, and equitable access to education, healthcare, and livelihoods. Equally vital are participatory governance, civic engagement, and a strong sense of belonging that nurture social cohesion and community well-being.

In the context of Haripad, the liveability framework acquires a distinctive cultural and environmental dimension. As a traditional temple town interlaced with waterways, agrarian landscapes, and heritage landmarks, Haripad's liveability is defined not only by its ecological balance and community well-being but also by its deep-rooted cultural

legacy. The proposed development initiatives address multiple liveability pillars through targeted interventions in heritage and tourism, water management, agriculture, green infrastructure, recreation, and social development.

While enhancing the quality of life for residents remains the central goal, these initiatives are equally designed to elevate Haripad's tourism potential. The projects collectively aim to create a town that is both liveable for its citizens and welcoming for visitors - a place where heritage, hospitality, and sustainability converge. Through improved mobility, rejuvenated public spaces, and heritage-led urban regeneration, Haripad aspires to become a vibrant, people-centric, and tourist-friendly town, harmoniously blending traditional character with modern amenities, and establishing itself as a model of cultural and ecological liveability within Kerala.

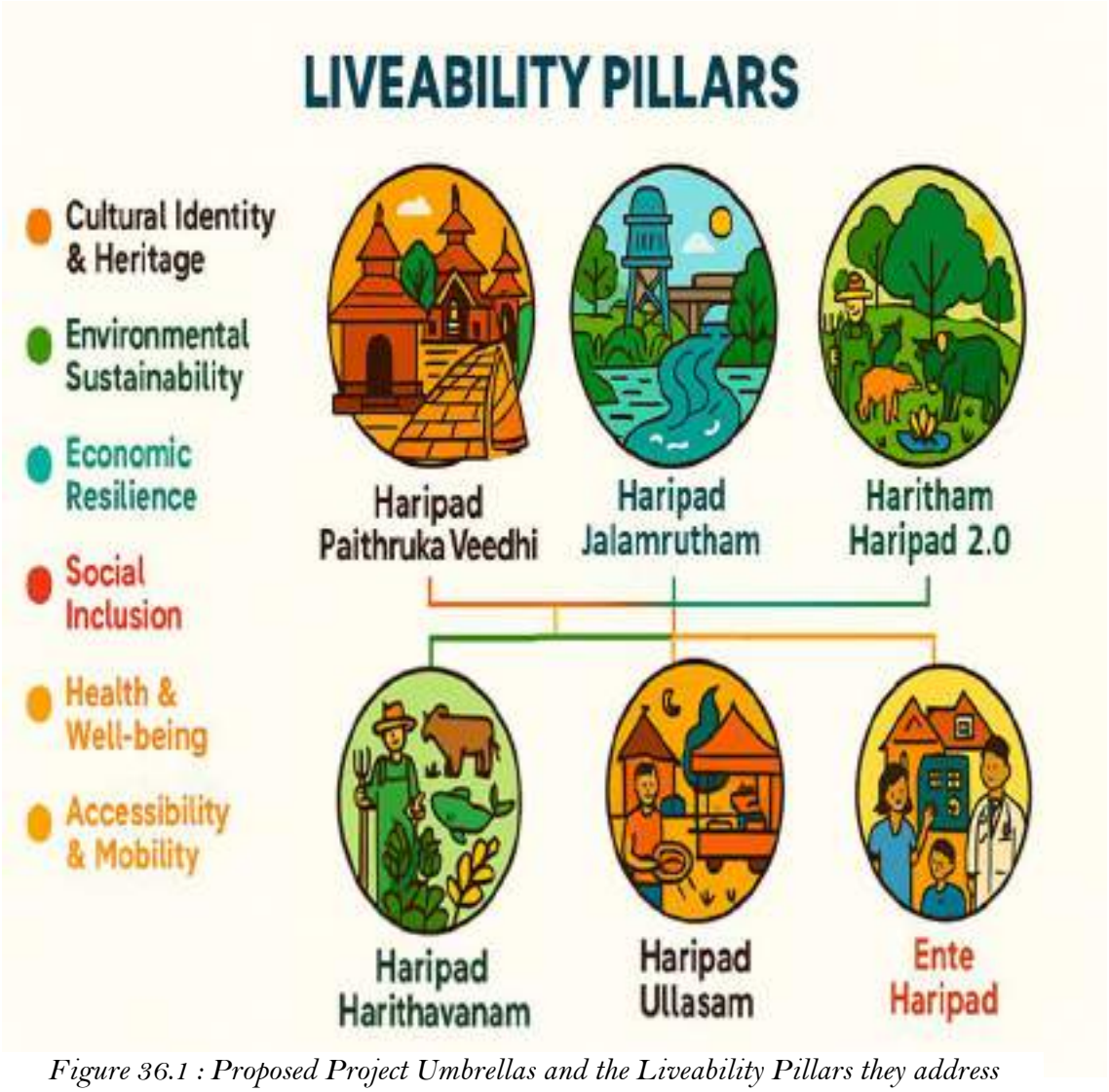


Figure 36.1 : Proposed Project Umbrellas and the Liveability Pillars they address

Together, these project umbrellas holistically address the major liveability pillars-environmental sustainability, economic resilience, cultural heritage, social inclusion, infrastructure reliability, and governance. By integrating these dimensions into spatial and policy interventions, the Haripad Risk-Informed Master Plan envisions a town that is resilient, inclusive, and culturally vibrant, ensuring long-term liveability and climate adaptability

Table 36.2 : Proposed Project Umbrellas and the Liveability Pillars they address

Project Umbrella	Primary Liveability Pillars Addressed	Key Focus Areas & Expected Outcomes
Haripad Paithruka Veedhi *(Culture Corridor)*	▪ Cultural Identity & Heritage Conservation ▪ Accessibility & Mobility ▪ Urban Design & Place-making	▪ Revitalization of heritage zones, temples, and palaces ▪ Creation of pedestrian-friendly heritage corridors and public spaces ▪ Strengthened temple tourism and local economy through cultural continuity
Haripad Jalamrutham *(Water & Resilience Program)*	▪ Environmental Sustainability ▪ Water Security & Infrastructure Resilience ▪ Climate Adaptation & Disaster Preparedness	▪ Canal and pond rejuvenation, drainage improvement, and stormwater management ▪ Flood mitigation and strengthened water supply systems ▪ Eco-tourism and canal-front public spaces promoting water-based identity.
Haritham Haripad *(Agro-Ecology & Livelihoods)*	▪ Economic Resilience & Employment ▪ Environmental Sustainability ▪ Rural - Urban Integration	▪ Promotion of sustainable agriculture, fisheries, and animal husbandry ▪ Development of agro-based enterprises and farm tourism ▪ Strengthened livelihoods through community farming and value addition.
Haripad Nagaravanam *(Green & Recreational Network)*	▪ Environment & Open Spaces ▪ Health & Well-being ▪ Sustainable Mobility	▪ Creation of parks, green corridors, Miyawaki forests, and biodiversity zones ▪ Bicycle trails connecting farms, wetlands, and temple precincts ▪ Improved air quality, aesthetics, and liveability through urban greening.
Haripad Ullasam *(Vibrant Tourism & Public Realm)*	▪ Economic Vitality & Tourism ▪ Recreation & Social Engagement ▪ Cultural Identity	▪ Development of food streets, vending zones, cultural events, and guided heritage walks ▪ Promotion of local cuisine and recreation-based tourism ▪ Strengthened sense of place and economic vibrancy.
Ente Haripad *(Social & Civic Infrastructure)*	▪ Social Inclusion & Equity ▪ Health, Education & Community Development ▪ Governance & Institutional Strengthening	▪ Upgrading education, health, and housing infrastructure ▪ Youth, women, and community-focused programs ▪ Strengthened civic amenities and social well-being through equitable service delivery.

1) Haripad Paithruka Veedhi



The Haripad Paithruka Veedhi, envisioned as the Cultural Corridor of Haripad, is a flagship initiative under the town's Risk-Informed and Sustainable Development Framework, designed to celebrate Haripad's rich cultural, architectural, and spiritual heritage while integrating principles of urban regeneration, placemaking, and sustainable mobility.

Extending from the Haripad Railway Station to the Mannarasala Nagaraja Temple, the corridor connects a series of key heritage and religious landmarks, including the Karimpalil Palace, RJ Road, Prathimukham Junction, Town Centre, Ezhikakath and Town Hall Junctions, Haripad Temple Road, the Subrahmanya Swamy Temple and its pond, the Haripad Kottaram, and finally the Mannarasala Temple via Haripad Vinoda Veedhi through Thulaparambu North (TPN) Junction. Together, these form an interconnected heritage and mobility spine reflecting the essence of Haripad's social, cultural, and spiritual identity.

Beyond connectivity, the project aims at regenerative placemaking - transforming streets and junctions into vibrant public spaces with shaded walkways, bicycle tracks, cultural plazas, and interactive nodes. These will feature traditional materials, temple-inspired architecture, vernacular street furniture, murals, and landscape features, ensuring both aesthetic harmony and functional resilience. Context-sensitive design and eco-friendly lighting systems will enhance safety and night-time appeal while conserving energy.

The revitalization of temple ponds and waterfronts, such as those near the Subrahmanya Swamy Temple, will create serene cultural and ecological hubs that blend spirituality, recreation, and community interaction. Interpretive trails, storytelling installations, and digital kiosks will allow visitors to engage with Haripad's heritage in immersive ways.

A key dimension of the project is heritage-led urban regeneration, focusing on adaptive reuse of historic assets such as Karimpalil Palace and Haripad Kottaram, which will be repurposed as cultural and craft centers, supporting local artisans, performers, and small enterprises. Surrounding market streets will be revitalized to foster a sustainable, culturally rooted local economy.

The inclusive and participatory approach of the project emphasizes community ownership, involving temple trusts, artisans, youth, and local residents in design and stewardship. Incorporation of green infrastructure - including tree-lined boulevards, rain gardens, and bioswales - further enhances environmental resilience and urban comfort.

Ultimately, the Haripad Paithruka Veedhi seeks to transform the town into a living heritage landscape, where the sacred and the civic coexist seamlessly. By integrating cultural continuity, regenerative urban design, and community engagement, the project aspires to position Haripad as a model for temple-town revitalization, where history, tradition, and urban life converge to create a vibrant, resilient, and culturally expressive urban environment

Table 36.3 : Haripad Paithruka Veedhi

HARIPAD PAITHRUKA VEEDHI *(Culture Corridor)*		
Sl No:	**Project**	**Sector**
1	Karimpalil Palace Renovation- Visitor Centre	Tourism/ Heritage
2	Road redevelopment from NH 66 to Haripad Railway Station	Transportation/ Tourism
3	Haripad Temple Town - Entry Gate	Tourism
4	RJ Road Redevelopment	Tourism/ Transportation
5	Prathimukham Junction redevelopment	Tourism/ Transportation
6	Haripad Hub- Town Centre Redevelopment	Tourism/ Trade & Commerce
7	Ezhikakath Junction redevelopment	Transportation
8	Town Hall Junction Redevelopment	Transportation
9	Haripad Kshetra Veedhi - Temple Road Redevelopment	Tourism/ Heritage
10	Street Vending Kiosks	Tourism/ Trade & Commerce
11	Piligrim Amenitites Centre	Tourism
12	Haripad Cultural Center - Haripad Kottaram Premise Redevelopment	Tourism/ Heritage
13	Haripad Vinoda Veedhi - Haripad Temple to Mannarasala Temple Road Redevelopment	Tourism/ Heritage
14	TPN Junction Redevelopment	Tourism/ Transportation
15	Mannarshala Temple Premise Redevelopment	Tourism/ Heritage
16	Mannarasala Heritage Interpretation Centre	Tourism/ Heritage
17	Mannarasala- Festival Infrastructure Upgrade Plan	Tourism/ Heritage
18	Road Development Around Subramanya Swamy Temple - Project 1 (Widening of existing roads)	Tourism/ Transportation
19	Road Development Around Subramanya Swamy Temple Pond	Tourism/ Transportation

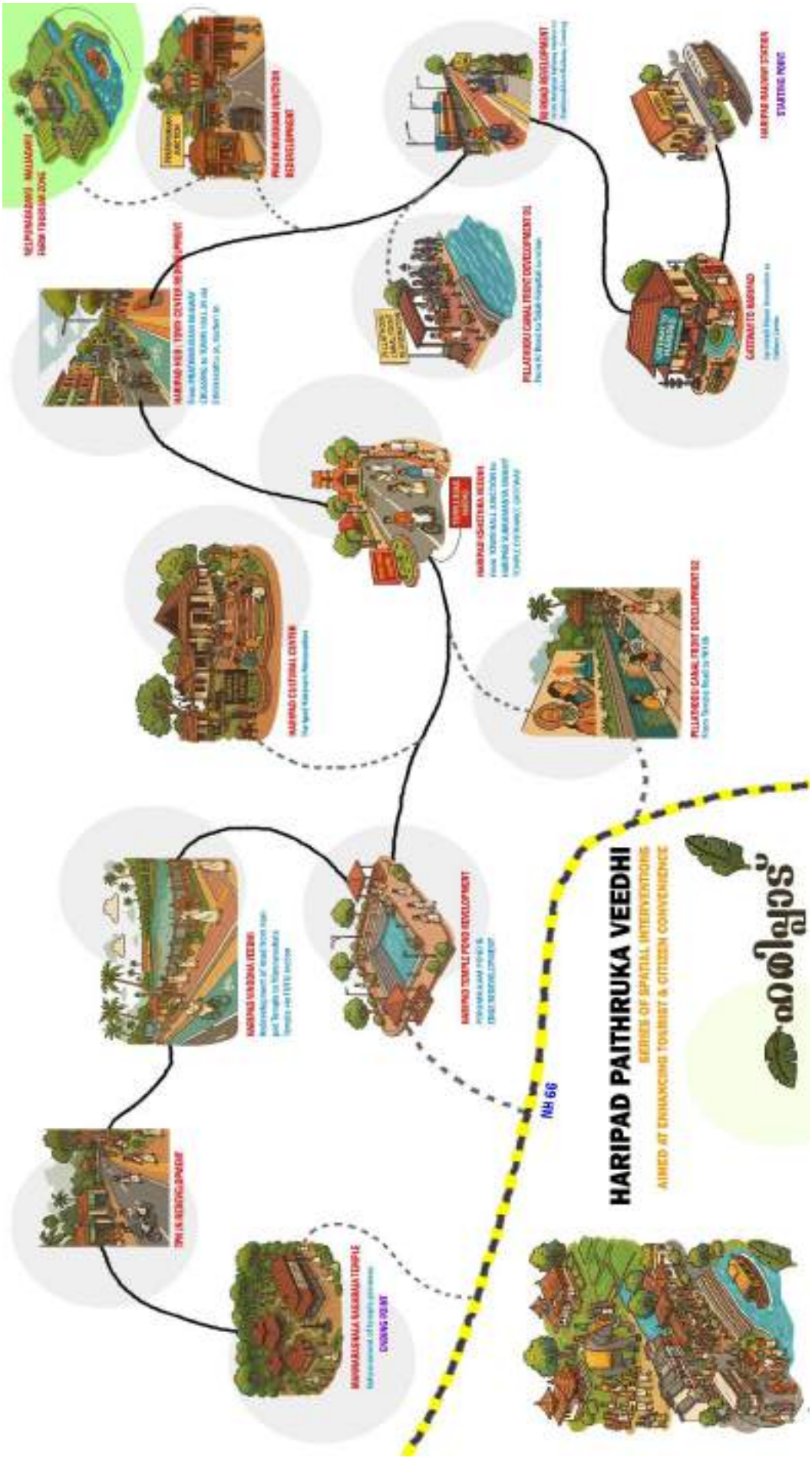


Figure 36.2 : Haripad Paithruka Veedhi - Project Illustration

2) Haripad Jalamrutham



Haripad Jalamrutham is a flagship initiative under the Haripad Master Plan that focuses on the revitalization, conservation, and sustainable management of the town's water systems, addressing one of its most critical challenges - flooding and water insecurity. The project adopts an integrated approach that combines drainage improvement, waterbody rejuvenation, agricultural enhancement, and water supply strengthening within a unified framework to build climate resilience, ecological balance, and long-term urban sustainability. Key interventions include the revitalization of Pilla Thodu and Danapady Thodu, restoration of temple ponds and community waterbodies, and the rehabilitation and upgrading of urban drains to ensure seamless stormwater conveyance and prevent chronic waterlogging. The project also proposes the construction of missing drainage links, rainwater harvesting systems, groundwater recharge structures, and improved stormwater management mechanisms to enhance water security and climate adaptability across the Municipality.

A major focus of Haripad Jalamrutham is the integration of water management with agricultural regeneration. The initiative promotes water lily cultivation and aquaculture in paddy fields during non-agricultural seasons, farm-based tourism, and the introduction of multi-cycle cropping systems to improve productivity and income resilience. These interventions will not only optimize the year-round use of agricultural land but also create new economic opportunities for farmers and local communities through agro-ecological diversification. Beyond its functional goals, Haripad Jalamrutham envisions a multi-benefit framework - reducing flood vulnerability, enhancing agricultural yield, promoting eco- and water-based tourism, and creating vibrant, people-friendly public spaces along Haripad's canal and pond networks. The integration of infrastructure renewal, ecological restoration, and community participation lies at the core of the project's vision, ensuring that water systems serve as both ecological assets and social spaces. Ultimately, Haripad Jalamrutham seeks to position the town as a model for integrated water resource management and disaster risk reduction in Kerala's coastal belt - where restored canals, resilient drainage, and productive landscapes collectively enhance Haripad's environmental sustainability, agricultural prosperity, and urban liveability.

Table 36.4 : Haripad Jalamrutham

HARIPAD JALAMRUTHAM *(Water & Resilience Program)*		
Sl No:	**Project**	**Sector**
1	Mangrove Fringe along Achankovil river, farm edges	Environment
2	Drainage Network Plan and Redevelopment - Phase 1	Drainage
3	Drainage Network Plan and Redevelopment - Phase 2 & 3	Drainage
4	Haripad Flood Resilience Program	Drainage

5	Subramanya Swamy Temple Perumkulkam Redevelpoment	Tourism
6	Pilla Thodu : Canal Front Redevelopment - Stretch 1 - Temple Road	Environment / Tourism/
7	Pilla Thodu : Canal Front Redevelopment & Wetland Park - Stretch 2 - RJ Road	Environment / Tourism/
8	Maliakadavu Ambal Padam	Environment / Tourism
9	Nelpurakadavu Farm Tourism	Environment / Tourism
10	Pond Rejuvenation & Pond Front Redevelopment- Kuttedath Jucntion	Environment/ Recreation
11	Pond Rejuvenation & Pond Front Redevelopment- Kuzhiyilikulangara	Environment/ Recreation
12	Pond Rejuvenation & Pond Front Redevelopment- Kolath Devi Temple	Environment/ Recreation
13	Heritage Waterway Trail (Pamba - Achankovil Link)	Transportation

3) Haritham Haripad



Haritham Haripad is a flagship initiative under the Haripad Master Plan aimed at revitalizing and modernizing the town's agricultural sector through an integrated approach encompassing agriculture, fisheries, animal husbandry, and agro-based industries. Building on Haripad's rich agrarian legacy - characterized by its extensive paddy fields, fertile lowlands, and scattered agricultural plots - the project envisions transforming the town into a regional hub for sustainable, organic, and value-driven agricultural production.

A key objective of Haritham Haripad is to position Haripad as the state's leading hub for organic vegetable farming, leveraging its proximity to the Kuttanad region - Kerala's renowned "Rice Bowl" - and its favorable agro-climatic conditions. By strengthening organic cultivation practices and developing market linkages, the project aims to make Haripad a flagbearer for organic and climate-smart agriculture in Kerala.

The initiative promotes organic vegetable and floriculture farming, aquaculture, integrated farming systems, and community-level cultivation, ensuring efficient land utilization even within mixed residential areas. Complementary interventions include the establishment of farm-produce collection centers, organic millet and vegetable shop networks, vermicomposting micro-units, and agritech incubation hubs to enhance productivity, processing, and supply chain efficiency. Haritham Haripad also emphasizes entrepreneurship, youth engagement, and women's empowerment through capacity-building programs, training initiatives, and partnerships with Kudumbashree, SHGs, and agricultural institutions. These efforts aim to foster a new generation of agri-entrepreneurs while ensuring equitable participation and inclusive growth. To enhance economic sustainability, the project focuses on value addition, processing, storage, logistics, and marketing of agricultural and fisheries

products. It also promotes farm tourism and experiential trails, allowing visitors to engage with Haripad's vibrant agricultural landscapes and community-based farming models.

By merging traditional knowledge with innovation, green infrastructure, and circular economy principles, Haritham Haripad envisions creating a resilient, climate-adaptive, and economically vibrant agricultural ecosystem. Ultimately, the project seeks to position Haripad as a model town for organic farming and agro-based entrepreneurship, driving sustainable rural - urban integration and reinforcing Kerala's identity as a leader in eco-conscious agricultural development

Table 36.5 : Haritham Haripad

HARITHAM HARIPAD 2.0 *(Agro-Ecology & Livelihoods)*		
Sl No:	**Project**	**Sector**
1	Organic Millets Outlet at Prathimukham Junction	Trade & Commerce/ Agriculture
2	Danapady Market Redevelopment	Trade & Commerce
3	Choorelakkal Village Tourism- Master Plan	Tourism
4	Haripad AgriSamriddhi Kendra – AgriTech, FPO & Cold Chain Resource Centre	Trade & Commerce / Agriculture
5	Agro-Produce Outlets (at multiple points)	Trade & Commerce/ Agriculture
6	Padasekharam Revitalization & Smart Irrigation Network	Agriculture
7	Haripad Green Basket - Local Food Security Network	Trade & Commerce/ Agriculture
8	Haripad Blue Harvest Initiative – Community Aquaculture Development Programme	Fisheries
9	Biofloc Aquaculture System	Fisheries
10	Freshwater Pearl Farming	Fisheries
11	Bio-Fertilizer & Vermicompost Micro Units	Agriculture
12	Farm to School Nutrition Link Program	Education/ Agriculture
13	Haripad Vidya Vanam & School Agro-Forestry Initiative	Agriculture
14	Women Entrepreneurship Park	Industry
15	Haripad Haritha Samriddhi Clusters Project	Agriculture

16	Bioenergy from Agro Waste Project	Energy
17	Decentralized Wastewater Reuse Gardens	Waste Water
18	Haripad Agro-Processing Park & Value Addition Centres	Industry
19	Cattle Feed Farming	Animal Husbandry

4) Haripad Nagaravanam



Haripad Nagaravanam is a key initiative under the Haripad Master Plan that focuses on strengthening the town's ecological fabric through social forestry, biodiversity conservation, and eco-recreational development. The project envisions a greener, healthier, and more climate-resilient Haripad by integrating afforestation, sacred grove preservation, and ecological tourism into the broader urban development framework.

The initiative seeks to enhance the town's green cover and biodiversity corridors through systematic afforestation drives, Miyawaki forests, and the rejuvenation of existing vegetative buffers along canals, roads, and public open spaces. It also emphasizes the conservation and restoration of sacred groves (Kaavus) which are integral to Haripad's cultural and ecological heritage - ensuring their protection as vital micro-ecosystems that support native flora and fauna.

A distinctive feature of Haripad Nagaravanam is the creation of eco-tourism and nature-based recreational experiences. The proposed Nagaravanam Trails will offer immersive bicycle and walking routes that connect forests, organic farming areas, floriculture plots, butterfly gardens, and other biodiversity zones, blending environmental awareness with leisure and learning. These green trails aim to provide residents and visitors an opportunity to engage closely with Haripad's natural landscapes while promoting sustainable mobility and low-impact tourism.

The project also focuses on community participation and environmental stewardship, encouraging local schools, youth clubs, and resident associations to take part in tree-planting initiatives, garden maintenance, and biodiversity monitoring. Through these collaborative efforts, Nagaravanam aspires to nurture a shared environmental consciousness and a sense of pride in local natural heritage.

By combining urban forestry, eco-recreation, and cultural ecology, Haripad Nagaravanam envisions transforming Haripad into a model green town where nature-based solutions enhance liveability, reduce carbon footprint, and create inclusive spaces that connect people with their environment. This initiative ultimately strengthens Haripad's position as a climate-resilient, biodiverse, and environmentally responsible urban center within Kerala's coastal landscape

Table 36.6 : Haripad Nagaravanam

HARIPAD NAGARAVANAM *(Green & Recreational Network)*		
Sl No:	**Project**	**Sector**
1	Pachathuruthu- Miyawaki forest	Environment
2	Nagaravanam Trails	Tourism
3	Butterfly Park and Organic Vegetable Farming Park Trail – Ward 22	Tourism

5) Harpad Ullasam



Haripad Ullasam is a flagship initiative under the Haripad Master Plan aimed at positioning the town as a vibrant tourism and cultural destination by leveraging its rich natural, religious, and cultural assets. The project focuses on creating a diverse and engaging visitor experience that celebrates Haripad's heritage, local flavors, and unique landscape, while simultaneously boosting the local economy through tourism-based livelihood opportunities.

The initiative envisions the development of sustainable, experience-based tourism activities that highlight Haripad's ecological and cultural character. Key projects include the development of a scenic green corridor along the Danapady Thodu, offering opportunities for kayaking, cycling, and waterfront recreation. The initiative also promotes culinary tourism through local cuisine experiences, food streets, and pop-up markets that showcase Haripad's traditional flavors and community-based gastronomy. In addition, Haripad Ullasam proposes guided heritage and farm walks, providing immersive experiences that connect visitors with the town's agricultural heritage, temple corridors, and rural landscapes. The introduction of an annual Haripad Heritage and River Festival will serve as a major cultural attraction - celebrating local art, music, crafts, and river-based activities while strengthening community participation and cultural pride.

The project also aims to enhance connectivity and accessibility to key religious and tourist destinations in and around Haripad, creating a cohesive tourism network that supports local entrepreneurs, artisans, and service providers. Public spaces along canals and heritage streets will be activated with recreational amenities, cultural performances, and thematic installations, enhancing the overall visitor experience. By combining culture, ecology, and recreation, Haripad Ullasam seeks to transform the town into a welcoming, lively, and inclusive destination that not only attracts visitors but also enriches the quality of life for residents. Through its focus on sustainable tourism and local economic revitalization, the initiative aspires to make Haripad a model for small-town cultural tourism and heritage-based urban regeneration in Kerala.

Table 36.7 : Haripad Ullasam

HARIPAD ULLASAM *(Vibrant Tourism & Public Realm)*		
Sl No:	**Project**	**Sector**

1	Ha Ha Yatra - Haripad Heritage and Harmony Yatra	Tourism
2	Choorelakkal Kayaking Terminal	Tourism
3	Danapady Thodu Green Corridor + Green Vending Zones and Street Food Parks near Danapady Thodu	Tourism
4	Danapady Kayaking Terminal	Tourism
5	Local Cuisine Experience Food Stretch - Maliakadavu-Nelpurakadavu	Tourism
6	Annual Haripad Heritage & River Festival	Tourism
7	Farm Experience & Guided Walks	Tourism
8	Haripad Visitor Passport	Tourism

6) Ente Haripad Projects



Ente Haripad represents a comprehensive portfolio of projects aimed at strengthening Haripad's social, civic, and community infrastructure, ensuring equitable access to essential services and enhancing the overall quality of life for its residents. The initiative focuses on creating an inclusive, people-centric urban environment that promotes well-being, accessibility, safety, and social cohesion through the development of modern amenities, resilient public facilities, and improved service delivery systems.

The projects under Ente Haripad encompass a wide range of interventions across key sectors, including healthcare, education, sanitation, mobility, recreation, and social welfare. Major components include the Gender Park near Arayakulangara Devi Temple Pond, Urban Park near Manimangalam Balamuruga Temple, and Janamandapam - an integrated Town Hall and Urban Library at Town Hall Junction, all designed to promote inclusivity, learning, and cultural engagement. To strengthen urban health and sanitation infrastructure, the initiative includes projects such as the Sewage Treatment Plant near Choorellackal, Municipal Crematorium, Flood-Resilient Taluk Hospital Upgradation, Municipal Slaughterhouse, Water ATMs, and Mobile Health Clinics for the elderly and women. These efforts aim to improve public health outcomes and ensure climate-resilient service delivery.

Mobility and accessibility improvements form another critical focus area, with projects such as Haripad Private Bus Stand and KSRTC Terminal Upgradation, Solar-Powered Bus Shelters, Public EV Charging Stations, Cycle-Friendly Haripad Initiative, and Smart Streetlight Management System - all contributing to a safer, sustainable, and future-ready transport ecosystem. In the social and community sector, Ente Haripad emphasizes education, youth engagement, and inclusivity through Smart Anganwadis, Digital Classrooms, Pakalveedus, Ward-Level Citizen Facilitation Centres, Urban Pulse Hub (Youth & Innovation Centre), and the Ravi Gandhi Library Enhancement Project. Initiatives such as Children's Parks, Fitness Centres, and Public Comfort Stations further enhance everyday liveability and urban comfort. Additionally, the program integrates flood-resilient housing schemes,

veterinary facility upgrades, and sports infrastructure development, including a Municipal Sports Centre and playground, promoting both community resilience and social well-being.

Through these interventions, Ente Haripad envisions transforming the town into a model of inclusive urban development, where social equity, modern amenities, environmental responsibility, and citizen participation together drive a higher standard of living and holistic urban growth.

Table 36.8 : Ente Haripad Projects

ENTE HARIPAD PROJECTS *(Social & Civic Infrastructure)*		
Sl No:	**Project**	**Sector**
1	Gender Park near Arayakulangara Devi Temple Pond	Recreation
2	Urban Park near Manimangalam Balamuruga Temple	Recreation
3	Sewage Treatment Plant near Choorellackal	Waste Water/ Solid Waste Disposal
4	Municipal Crematorium near Choorellackal	Other Civic Amenities
5	Janamandapam: Town hall and Urban Library at Town Hall Junction	Other Civic Amenities
6	Municipal Slaughterhouse	Animal Husbandry
7	Taluk Hospital : Flood-Resilient Health Centre Upgradation	Health
8	Haripad Private Bus stand	Other Civic Amenities/ Transportation
9	Haripad KSRTC Stand Amenities Enhancement	Other Civic Amenities/ Transportation
10	Bus Shelter at Danapady	Other Civic Amenities/ Transportation
11	Bus Shelter near Town Hall Junction	Other Civic Amenities/ Transportation
12	Vathukulangara Temple Premise amenities enhancement	Tourism
13	Mobile Health Clinics for Elderly & Women	Health
14	Solar Rooftop Subsidy Drive (One Ward One Solar Model)	Energy
15	Smart Streetlight Management System	Energy
16	Public EV Charging & Solar Bus Shelter Network - Install EV charging and solar bus shelters	Energy/ Transportation
17	Ward-Level Citizen Facilitation Centres - Local counters for decentralized service delivery & Pakalveedus	Other Civic Amenities
18	Inclusive Public Comfort Stations/ Take a break at Nelpurakadavu, Mannarasala Temple, Town Centre, Danapady Road	Other Civic Amenities/ Tourism

19	Bicycle-Friendly Haripad Initiative	Tourism
20	Smart Anganwadis & Digital Classrooms (Phase I)	Education
21	Renovation of Anganwadis	Education
22	Relocation of Anganwadis	Education
23	Flood resilient housing scheme	Housing
24	Children Park and Fitness Centre	Recreation
25	Swimming Classes for children and adults	Health/ Recreation
26	Urban Pulse Hub (Youth & Innovation Centre)	Employment
27	Upgradation of Govt Homeopathy Clinic	Health
28	Water ATMS	Water Supply
29	Veterinary Polyclinic Enhancement	Animal Husbandry
30	Municipal Sports Centre/ Playground	Recreation

36.2 Implementation strategy & Project Phasing

The implementation of all projects identified under Chapters 31, 32, and 33 of the Haripad Master Plan follows a structured, phased strategy to ensure systematic development, efficient investment, and adaptive planning. The 20-year horizon is divided into four five-year phases aligned with municipal budget cycles, institutional capacity, and developmental priorities. This approach allows for progressive implementation, beginning with critical infrastructure, disaster resilience, and service delivery improvements, followed by projects that enhance economic vitality, cultural identity, and environmental sustainability. Phased execution enables efficient budgeting, monitoring, and flexibility to respond to emerging urban needs. The various projects envisioned for Haripad and their implementation phase, is presented in Table 36.10, providing a clear roadmap for realizing Haripad's long-term vision of sustainable, resilient, and inclusive urban growth.

Table 36.9 : Phase-wise implementation strategy

Phase	Timeline	Focus Area	Key Objectives
Phase I	**Years 1 - 5**	Foundational & Priority Interventions	Implement high-impact, low-cost, and urgently needed projects; initiate pilot initiatives; establish institutional and monitoring frameworks.
Phase II	**Years 6 - 10**	Infrastructure Strengthening	Strengthen core infrastructure, scale up pilot initiatives, and integrate essential services such as mobility, water management, and public amenities.
Phase III	**Years 11 - 15**	System Integration & Regional Linkages	Integrate regional connectivity, adopt advanced systems and smart solutions, and align with broader state and regional development programs.

Phase IV	**Years 16 - 20**	Consolidation & Sustainability	Consolidate outcomes, ensure long-term sustainability, strengthen maintenance and governance frameworks, and fully operationalize the Master Plan vision.

Table 36.10 : Project phasing of all master plan project

PHASE I (Years 1-5)		
Sl. No.	**Project Name**	**Sector**
1	Karimpalil Palace- Haripad Visitors Center	Heritage Tourism
2	Road Redevelopment from NH 66 to Haripad Railway Station	Tourism
3	Haripad Temple Town – Entry Gate	Piligrim Tourism
4	RJ Road Redevelopment	Tourism
5	Haripad Kshetra Veedhi – Temple Road Redevelopmjent	Piligrim Tourism
6	Street Vending Kiosks	Trade & Commerce
7	Piligrim Amenitites Centre	Piligrim Tourism
8	Haripad Vinoda Veedhi – Haripad Temple to Mannarasala Temple Road Redevelopment	Tourism
9	Mangrove Fringe along Achankovil river, farm edges	DRR/ Environment
10	Drainage Network Plan and Redevelopment – Phase 1	DRR/ Drainage
11	Pilla Thodu : Canal Front Redevelopment – Stretch 1 - Temple Road	DRR/ Tourism
12	Maliakadavu Ambal Padam	Farm Tourism
13	Nelpurakadavu Farm Tourism	Farm Tourism
14	Haripad Blue Harvest Initiative – Community Aquaculture Development Programme	Fisheries
15	Bio-Fertilizer & Vermicompost Micro Units	Agriculture
16	Farm to School Nutrition Link Program	Agriculture
17	Haripad Vidya Vanam & School Agro-Forestry Initiative	Agriculture
18	Haripad Haritha Samriddhi Clusters Project	Agriculture
19	Ha Ha Yatra – Haripad Heritage and Harmony Yatra	Tourism
20	Urban Park near Manimangalam Balamuruga Temple	Recreation
21	Municipal Crematorium near Choorellackal	Other Civic Amentities
22	Haripad Private Bus stand	Transportation
23	Haripad KSRTC Stand Amentities Enhancement	Transportation

24	Bus Shelter at Danapady & Town Hall Jn	Transportation
25	Inclusive Public Comfort Stations/ Take a break at Nelpurakadavu, Mannarasala Temple, Town Centre, Danapady Road	Other Civic Amentities
26	Smart Anganwadis & Digital Classrooms (Phase I)	Education
27	Renovation of Anganwadis	Education
28	Swimming Classes for Children and Adults	Recreation
29	Veterninary Polyclinic Enhancement	Animal Husbandry

PHASE II (Years 6-10)

Sl. No.	Project Name	Sector
1	Prathimukham Junction redevelopment	Tourism
2	Ezhikakath Junction redevelopment	Transportation
3	Town Hall Junction Redevelopment	Transportation
4	Haripad Cultural Center – Haripad Kottaram Premise Redevelopment	Heritage Tourism
5	TPN Junction Redevelopment	Transportation
6	Mannarshala Temple Premise Redevelopment	Piligrim Tourism
7	Mannarasala- Festival Infrastructure Upgrade Plan	Piligrim Tourism
8	Road Development Around Subramanya swamy Temple – Project 1 (Widening of existing roads)	Piligrim Tourism
9	Haripad Flood Resilience Program	DRR/ Drainage
10	Subramanya Swamy Temple Perumkulkam Redevelpoment	Tourism
11	Narayanan Kulam - Pond rejuvenation & Pond Front Redevelopment	Recreation
12	Pond rejuvenation & Pond Front Redevelopment- Kuzhiyilikulangara	Recreation
13	Pond rejuvenation & Pond Front Redevelopment- Kolath Devi Temple	Recreation
14	Organic Millets Outlet at Prathimukham Junction	Trade & Commerce
15	Danapady Market Redevelopment	Trade & Commerce
16	Choorelakkal Village Tourism- Master Plan	Village Tourism
17	Haripad AgriSamriddhi Kendra – AgriTech, FPO & Cold Chain Resource Centre	Agriculture
18	Agro-Produce Outlets (at multiple points)	Agriculture
19	Padasekharam Revitalization & Smart Irrigation Network	Agriculture

20	Biofloc Aquaculture System	Fisheries
21	Freshwater Pearl Farming	Fisheries
22	Cattle Feed Farming	Animal Husbandry
23	Women Entrepreneurship Park	Industry
24	Bioenergy from Agro Waste Project	Energy
25	Haripad Agro-Processing Park & Value Addition Centres	Industry
26	Haripad Visitor Passport	Tourism
27	Annual Haripad Heritage & River Festival	Heritage Tourism
28	Farm Experience & Guided Walks	Farm Tourism
29	Gender Park near Arayakulangara Devi Temple Pond	Recreation
30	Sewage Treatment Plant near Choorellackal	Solid Waste Disposal
31	Vathukulangara Temple Premise amenities enhancement	Tourism
32	Mobile Health Clinics for Elderly & Women	Health
33	Solar Rooftop Subsidy Drive (One Ward One Solar Model)	Energy
34	Smart Streetlight Management System	Other Civic Amentities
35	Public EV Charging & Solar Bus Shelter Network	Energy
36	Relocation of Anganwadis	Education
37	Children's Park and Outdoor Fitness Centre	Recreation
38	Urban Pulse Hub (Youth & Innovation Centre)	Sepcial Concern areas
39	Upgradation of Govt Homeo Clinic	Health
40	Water ATMS	Water Supply
41	Municipal Sports Centre/ Playground	Recreation

PHASE III (Years 11-15)

Sl. No.	Project Name	Sector
1	Haripad Hub - Town Centre Redevelopment	Tourism
2	Mannarasala Heritage Interpretation Centre	Piligrim Tourism
3	Road Development Around Subramanya swamy Temple – Project 1 (Laying of new roads)	Piligrim Tourism
4	Drainage Network Plan and Redevelopment – Phase 2 & 3	DRR/ Drainage
5	Haripad Green Basket – Local Food Security Network	Trade & Commerce
6	Decentralized Wastewater Reuse Gardens	Waste Water
7	Nagaravanam Trails	

8	Danapady Thodu Green Corridor + Green Vending Zones and Street Food Parks near Danapady Thodu	Tourism
9	Choorelakkal Kayaking Terminal	Water Tourism
10	Local Cuisine Experience Food Stretch – Maliakadavu- Nelpurakadavu	Farm Tourism
11	Janamandapam: Town hall and Urban Library at Town Hall Junction	Other Civic Amentities
12	Bicycle-Friendly Haripad Initiative	Tourism
13	Flood resilient housing scheme	Housing
14	Butterfly Park and Organic Vegetable Farming Park Trail – Ward 22	Recreation

PHASE IV (Years 15-20)		
Sl. No.	**Project Name**	**Sector**
1	Pilla Thodu : Canal Front Redevelopment & Wetland Park – Stretch 2 - RJ Road	DRR/ Drainage
2	Heritage Waterway Trail (Pamba–Achankovil Link)	Transportation
3	Pachathuruthu- Miyawaki forest	Environment
4	Ward-Level Citizen Facilitation Centres - Local counters for decentralized service delivery & Pakalveedus	Other Civic Amentities

Haripad Municipality faces fiscal constraints in implementing the full range of Master Plan projects, as municipal revenues alone are insufficient to meet the required investments. Accordingly, a diversified resource mobilisation strategy will be adopted. The Municipality will leverage State and Central schemes—such as AMRUT, Smart Cities, Rebuild Kerala Initiative, and Jal Jeevan Mission—along with MP/MLA funds, CSR partnerships, and Public–Private Partnerships (PPPs). Land-based financing tools, improved tax collection, and community participation will also be explored. Through coordinated convergence of departmental investments, Haripad aims to ensure financially sustainable, phased, and resilient urban development aligned with the Master Plan vision..

36.3 Identification of Priority Projects

Priority projects for Haripad have been identified as strategic urban development initiatives that address the town's most pressing needs and offer the highest potential impact on infrastructure, public services, and overall quality of life. These projects have been selected based on their relevance to Haripad's unique urban context, focusing on key objectives such as economic revitalization, environmental resilience, and social inclusivity. The prioritization process involved a comprehensive assessment through technical studies, stakeholder consultations, and community participation, including feedback from public seminars and on-site evaluations conducted by the Master Plan Committee. The final list of priority projects (Table 36.11) has been discussed with the Haripad Municipal Council, ensuring alignment with both local aspirations and long-term sustainable development goals.

Table 36.11 : Priority Action Project in Haripad

PRIORITY ACTIONS PROJECTS for HARIPAD			
Sl. No.	**Project Name**	**Sector**	**Project Umbrella**
1	Karimpalil Palace- Haripad Visitors Cenre	Tourism/ Heritage	Haripad Paithruka Veedhi
2	Water ATMs	Other Physical Infrastructure	Ente Haripad Projects
3	Road Redevelopment from NH 66 to Haripad Railway Station	Transportation	Haripad Paithruka Veedhi
4	Haripad Temple Town - Entry Gate	Tourism	Haripad Paithruka Veedhi
5	RJ Road Redevelopment	Tourism/ Transportation	Haripad Paithruka Veedhi
6	Haripad Hub - Town Centre Redevelopment	Tourism/ Commerce	Haripad Paithruka Veedhi
7	Haripad Kshethra Veedhi - Temple Road Redevelopment	Tourism/ Heritage	Haripad Paithruka Veedhi
8	Pilgrim Amenities Centre	Tourism	Haripad Paithruka Veedhi
9	Haripad Cultural centre- Haripad Kottaram Premise Redevelopment	Tourism/ Heritage	Haripad Paithruka Veedhi
10	Haripad Vinoda Veedhi - Haripad Temple to Mannarasala Temple Road Redevelopment	Tourism/ Heritage	Haripad Paithruka Veedhi
11	Haripad Temple Pond (Perumkulam) Renovation	Environment/ Tourism	Haripad Jalamrutham
12	Mangrove Fringe along Canals and Agricultural Fields	Environment / DRR	Haripad Jalamrutham
13	Municipal Sports Centre and Playground	Recreation	Ente Haripad Projects
14	Padasekharam Revitalization & Smart Irrigation Network	Agriculture	Haritham Haripad
15	Pillathodu Canal Front Redevelopment – Stretch 01	Environment / Tourism/ DRR	Haripad Jalamrutham
16	Malikadavu Ambal Padam (Water Lily–Based Farm Tourism Initiative)	Environment / Tourism/ Agriculture	Haripad Jalamrutham
17	Nelpurakadavu Farm Tourism	Environment / Tourism/ Agriculture	Haripad Jalamrutham
18	Narayana Kulam- Pond rejuvenation & pond front redevelopment- near Kuttedath Junction	Environment / Tourism/ Recreation	Haripad Jalamrutham
19	Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment	Environment / Tourism/ Recreation	Haripad Jalamrutham

20	Rejuvenation of the Municipality pond near Kolath Devi Temple & pond front redevelopment	Environment / Tourism/ Recreation	Haripad Jalamrutham
21	Kilikke Kulam- Pond rejuvenation & pond front redevelopment	Environment / Tourism/ Recreation	Haripad Jalamrutham
22	Urban Bus Shelters at Danapady and Subramanya Swamy Temple Road	Other Civic Amenities/ Transportation	Ente Haripad Projects
23	Danapady Market Redevelopment	Trade and Commerce	Haritham Haripad
24	Kayaking Terminal, Choorellakkal	Recreation/ Tourism	Haripad Ullasam
25	Municipal Crematorium near Choorellackal	Other Civic Amenities	Ente Haripad Projects
26	Wetland Park in Ward 11	Environment/ DRR	Haripad Jalamrutham
27	KSRTC Bus Stand – Renovation	Tourism/ Transportation	Ente Haripad Projects

36.4 Details of Priority Projects

This section provides a comprehensive overview of the Priority Projects identified for Haripad, aimed at advancing urban development, improving resilience, and enhancing the overall quality of life within the town's built-up areas. It outlines essential project parameters, including the concept and objectives, precise location, land ownership details, key components, implementing and coordinating agencies, recommended implementation strategies, estimated financial requirements, and indicative timelines. These details are structured to guide the systematic preparation of Detailed Project Reports (DPRs) and streamline decision-making for effective execution. The information serves as a strategic tool for the Haripad Municipality and associated stakeholders to prioritize interventions, allocate resources efficiently, and ensure that urban transformation in Haripad is timely, sustainable, and community-centric.

36.4.1 Karimpalil Palace- Haripad Visitors Center

1) Project Brief



The Karimpalil Palace - Haripad Visitors' Centre project aims to transform one of Haripad's most culturally significant heritage precincts into a welcoming gateway for tourists and pilgrims. Located near the railway station, KSRTC bus stand, and NH-66, the site offers exceptional visibility and accessibility, making it ideal as the town's primary visitor interface. The initiative focuses on the conservation and adaptive reuse of the historic Karimpalil Palace, integrating it with modern visitor facilities such as information services, rest and cloak amenities, mobility support, and community spaces. By combining heritage restoration with high-quality public infrastructure, the project strengthens Haripad's identity as a temple town, enhances the overall tourism

experience, and positions the precinct as a vibrant cultural node within the broader urban regeneration framework.

Need for the Project

The renovation of Karimpalil Palace is essential to conserve its cultural, historical, and architectural significance while unlocking its potential as a key cultural and tourism hub in Haripad. Currently housing the Assistant Commissioner's Office of the Travancore Devaswom Board, the palace occupies a strategically important location near the Haripad Railway Station, KSRTC Bus Stand and NH 66, offering excellent accessibility.

Despite its heritage value and locational advantage, the palace precinct remains underutilized, with substantial open land offering scope for visitor facilities, interpretative spaces, and tourism-support amenities. As shown in Figure 34.3, the existing condition underscores the need for systematic conservation and adaptive reuse.

Revitalization of the palace precinct will ensure sensitive restoration of the historic structure while enabling adaptive reuse for cultural, administrative, and community-oriented functions. Integrating the site into the proposed Haripad Paithruka Veedhi will establish Karimpalil Palace as a key heritage node, strengthening heritage tourism, enhancing community engagement, and supporting local economic development through increased visitor activity.

Aim of the Project

The aim of the Karimpalil Palace Renovation Project is to transform the historic palace precinct into a Gateway to Haripad and a state-of-the-art Visitors' Centre, serving as the principal point of orientation for tourists arriving by rail, road, or highway. The project envisions adaptive reuse of the heritage structure and its surrounding open spaces to create a culturally engaging, visitor-friendly complex that reflects Haripad's identity as a temple town and heritage destination. The proposed Visitors' Centre will provide essential amenities such as an information desk,

0cloakroom facilities, rentable sleeping pods, an open-air amphitheatre for cultural performances, a mini library, EV charging stations, and bicycle rental points. Designed as an integrated tourism facilitation hub, the Gateway will function as a single-window centre offering guidance, services, and experiences that promote Haripad's religious, cultural, and ecological tourism potential while preserving the architectural legacy of the Karimpalil Palace



Figure 36.3 : Images showing existing condition of Karimpalil Palace, Haripad

Project Objectives

- **Heritage Conservation and Adaptive Reuse:** Restore and repurpose the historic Karimpalil Palace precinct into a functional heritage complex that preserves its architectural character while accommodating contemporary tourism and civic functions.
- **Tourism Facilitation and Orientation:** Develop an integrated Visitors' Centre serving as the primary point of orientation for tourists, equipped with information services, visitor amenities, and digital guidance systems to promote Haripad's religious, cultural, and ecological tourism circuits.
- **Urban Identity and Placemaking:** Establish the site as a symbolic Gateway to Haripad, creating a landmark urban node that reflects the town's cultural ethos through context-sensitive architecture, landscape design, and public realm enhancement.
- **Sustainable and Inclusive Design:** Incorporate environmentally responsive and barrier-free design principles, ensuring energy efficiency, universal accessibility, and the use of local, eco-friendly materials that align with Kerala's traditional architectural vocabulary.
- **Community Activation and Cultural Engagement:** Create multifunctional spaces such as amphitheatres, cultural courts, and public plazas that encourage community interaction, cultural performances, and social exchange - positioning the Gateway as both a civic and cultural nucleus of Haripad

2) Location and Ownership

The Gateway to Haripad project which focus on the renovating the Karimpalil Palace into a tourist centric Visitors center is proposed on the existing site of the palace. This has also been demarcated as a special zone in the Proposed Land Use map.

Land Ownership	Travancore Devaswom Board
Ward Number	16
Project Area	2.65 Acre
Survey Number	459/11

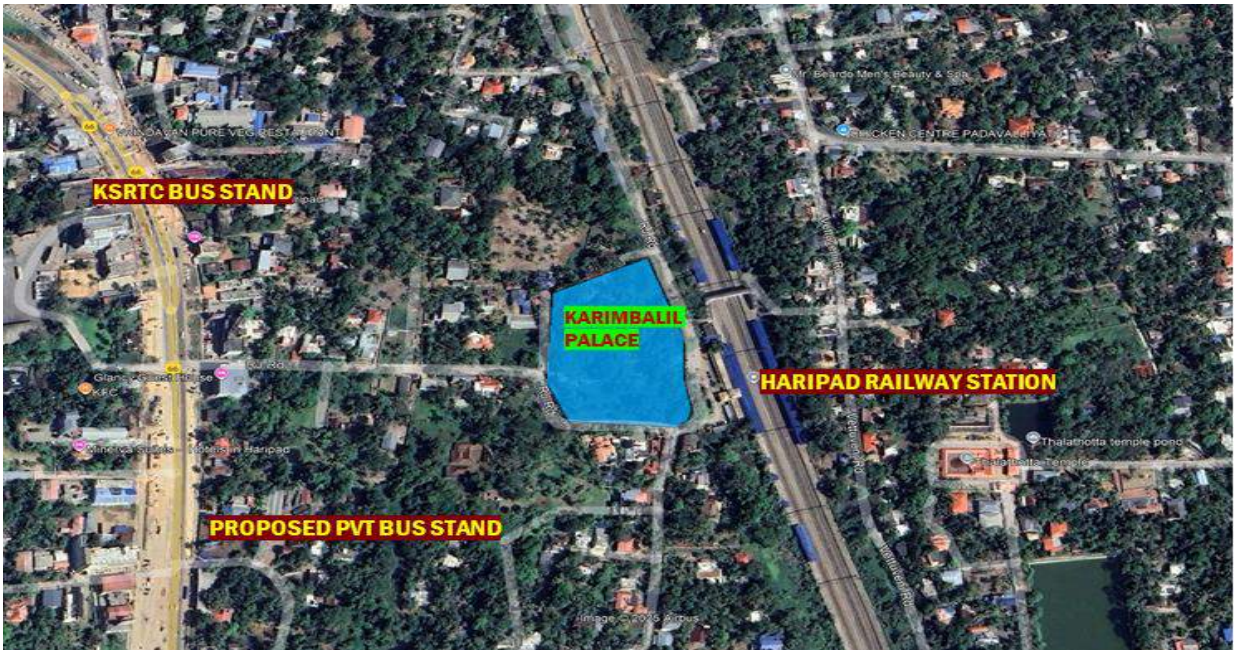


Figure 36.4 : Location of Karimbalil Palace

3) Project Components

1. **Restoration and Adaptive Reuse of Karimpalil Palace:** Conservation of the existing heritage building, structural strengthening, façade restoration, and adaptive interior redesign to accommodate tourism-related functions.
2. **Visitor Information and Facilitation Centre:** Centralized help desk, digital information kiosks, tourist helpline, interactive displays, and guided tour coordination counter.
3. **Cultural Plaza and Amphitheatre:** Open-air performance space for local art, music, and cultural events with stepped seating integrated into the landscape.
4. **Mini Library and Interpretation Gallery:** Reading lounge and exhibition space showcasing Haripad's history, temples, festivals, architecture, and heritage trails.
5. **Cloakroom and Baggage Storage Facility:** Secure, modern storage systems for travelers' convenience.
6. **Sleeping Pods / Transit Accommodation Zone:** Hourly rentable resting pods designed for short-term stays with modern amenities for tourists and pilgrims.
7. **Café and Retail Kiosk Zone:** Small-scale café, souvenir shop, and handicraft stalls promoting local artisans and cuisine.
8. **EV Charging Stations and Bicycle Rental Hub:** Provision for electric vehicle charging points, bicycle rental, and parking facilities promoting sustainable mobility.
9. **Landscaped Public Realm and Plaza:** Shaded pedestrian corridors, seating areas, native landscaping, and water features reflecting Kerala's traditional design aesthetics.
10. **Wayfinding and Signage System:** Contextually designed signage integrating Malayalam and English, with cultural motifs guiding visitors through the complex and toward major destinations.



Figure 36.5 : Gateway to Haripad |Haripad Visitors Center concept (Proposed)

11. **Parking and Access Infrastructure:** Designated vehicle and two-wheeler parking areas, bus lay-bys, and pedestrian-friendly access from nearby roads and transport hubs.
12. **Public Amenities Block:** Inclusive sanitation facilities, drinking water points, and rest areas ensuring universal accessibility and comfort.
13. **Solar Power and Sustainable Infrastructure:** Rooftop solar panels, rainwater harvesting system, and waste management facilities aligned with green building principles.
14. **Perimeter Landscaping and Lighting:** Architectural and ambient lighting emphasizing the traditional façade, enhancing safety, visibility, and night-time aesthetics

4) Agencies Responsible

Table 36.12 : Agencies responsible for Karimpalil Palace- Haripad Visitors Center

Agencies responsible for Karimpalil Palace- Haripad Visitors Center		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Project Coordination, Planning, and Governance	Haripad Municipality *(Nodal Implementing Agency)*; Urban Development Department (UDD)
2	Ownership and Cultural Oversight	Travancore Devaswom Board (TDB)
3	Heritage Conservation and Adaptive Reuse	Department of Archaeology; Kerala Heritage Commission; Department of Culture
4	Tourism Infrastructure Development and Promotion	Department of Tourism, Government of Kerala; District Tourism Promotion Council (DTPC - Alappuzha); Kerala Tourism Infrastructure Limited (KTIL)
5	Urban Design, Access, and Infrastructure Integration	Public Works Department (PWD); Haripad Municipality
6	Financial Planning and Project Funding	Kerala Infrastructure Investment Fund Board (KIIFB); Department of Finance; Potential PPP Partners
7	Sustainability and Climate Resilience Integration	Kerala State Disaster Management Authority (KSDMA); Energy Management Centre - Kerala (EMC)
8	Community Engagement and Capacity Building	Haripad Subrahmanya Swamy Temple Trust; Local Temple Committees; Kudumbashree Units; SHGs; Local Artisans and Cultural Organizations
9	Operations, Maintenance, and Facility Management	Haripad Municipality; PPP Operators for café, bicycle rental, and EV charging facilities
10	Promotion, Branding, and Awareness	Department of Tourism; DTPC - Alappuzha; Local Cultural Collectives and Tourism Associations

5) Suggested Implementation Mechanism

The Haripad Gateway & Karimpalil Palace Visitors' Centre will be implemented through a collaborative governance model, led by Haripad Municipality with strategic partnerships across tourism, heritage, infrastructure, and community sectors. This structure ensures that the project not only preserves Haripad's cultural legacy but also establishes it as a model for integrated, sustainable, and community-driven heritage tourism development in Kerala

6) Other Associated Issues to be addressed

As a heritage structure of architectural and cultural significance, the Karimpalil Palace requires a detailed conservation-focused study before any intervention. This includes structural assessment, documentation of heritage elements, and preparation of a conservation management plan to ensure sensitive and authentic restoration. During construction of the new Visitor Centre blocks, the existing palace building may be exposed to dust, debris, and vibration-related risks. Protective measures such as dust screens, vibration monitoring, controlled demolition, and phased works will be essential to prevent damage and preserve the integrity of the heritage structure. The site's close proximity to the Haripad Railway Station enhances its strategic importance but also increases risks such as vandalism, illegal parking, unregulated vending, and crowding. Continuous monitoring, proper surveillance systems, and clear circulation management will be necessary to ensure safety and order. Additional considerations include addressing traffic congestion, ensuring adequate stormwater drainage, maintaining universal accessibility, and managing stakeholder coordination among multiple agencies. Proactively addressing these issues will help ensure the smooth implementation of the project and the long-term protection of the heritage precinct.

7) Project Cost and Period

Table 36.13 : Project Cost Estimate - Karimpalil Palace- Haripad Visitors Center

Project Cost Estimate - Karimpalil Palace- Haripad Visitors Center			
Sl. No.	**Project Component**	**Cost (₹ Crore)**	**Remarks**
1	Heritage conservation works for Karimpalil Palace (structural strengthening, roof restoration, timber repairs, lime plastering, façade conservation)	2.50	Conservation per heritage norms
2	Renovation of outhouse block (adaptive reuse for administration / TDB coordination)	0.60	Minor structural & interior works
3	New Visitors' Centre complex (info desk, lounge, reception, cultural kiosks)	2.00	Contextual design with vernacular elements
4	Sleeping pods / transit accommodation block	1.20	10 - 14 pods with automated access
6	Mini amphitheatre / cultural court (outdoor, ~150 seats)	0.80	Landscape-integrated performance space

7	EV charging station & bicycle rental hub	0.45	4 charging bays + rental infrastructure
8	Public amenities block (toilets, drinking water, resting kiosks)	0.35	Universal access features
9	Wayfinding signage & digital tourist information kiosks	0.20	Touchscreen kiosks + QR-enabled panels
10	Landscaping & hardscaping (pathways, plaza, seating, lighting, green buffers)	1.10	Vernacular landscape treatment
11	Parking area development	0.90	Durable paving & markings
12	Heritage interpretation centre / museum galleries	1.50	Interactive displays and exhibits
13	Security systems (CCTV, access control, guards' cabin)	0.20	Includes control room
14	Stormwater & drainage upgrades	0.30	Protect heritage structures from runoff
15	Electrical, MEP & solar power system	0.65	Energy-efficient systems + solar
16	Contingencies (5%)	0.64	Standard DPR contingency provision
17	Consultancy, architectural & conservation fees (7%)	0.90	DPR preparation, PMC, conservation consultants
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors.*			

The overall expense for the project would be approximately INR 14.54 Crores

Table 36.14 : Project Duration - Karimpalil Palace- Haripad Visitors Center

Project Duration - Karimpalil Palace- Haripad Visitors Center			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Preparatory & Approvals	Surveys, heritage assessment, DPR, permissions, tendering	0 - 4 months
2	Conservation & Structural Stabilization	Structural strengthening, façade restoration, roof repair	4 - 12 months
3	Construction of Visitor Facilities	Visitor centre block, amenities, EV hub, landscape, access	12 - 24 months
4	Finishing & Commissioning	Interiors, exhibits, signage, lighting, testing, handover	24 - 30 months
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions.*			

The overall duration required for the project completion would be around 30 months

36.4.2 Water ATMs

1) Project Brief



The Water ATMs project aims to provide reliable, affordable, and safe drinking water access across Haripad by installing automated purified water dispensing units at key public locations. Designed to address seasonal shortages, water quality concerns, and the needs of commuters and vulnerable groups, the initiative strengthens the town's public health framework while promoting a refill culture that reduces plastic waste. By integrating smart monitoring, regular quality checks, and community-friendly operation models, the project enhances urban resilience and ensures equitable access to clean drinking water across Haripad.

Need for the Project

Haripad Municipality, with its dense residential clusters, temple-based tourism, commercial nodes, and floating population, requires reliable access to safe and affordable drinking water. Seasonal variations, intermittent supply in certain wards, dependence on private vendors, and contamination risks in select pockets create gaps in equitable water access. Water ATMs provide a decentralized, 24/7, low-cost, and quality-controlled solution, ensuring that residents, pilgrims, daily commuters, and visitors have access to purified drinking water across key locations in the town.

The project also supports public health resilience by reducing dependence on single-use plastic bottles, ensuring water safety during flood seasons, and strengthening emergency preparedness during disruptions in the centralized supply network the

Aim of the Project

To establish a decentralized, accessible, and safe drinking water distribution system across Haripad through automated Water ATMs that ensure affordability, convenience, and assured water quality for residents, commuters, and visitors.

Project Objectives

- To ensure round-the-clock availability of purified drinking water at strategic public locations.
- To provide affordable and quality-tested drinking water, reducing health risks associated with contaminated sources.
- To support tourism and mobility infrastructure by placing Water ATMs near transit nodes and heritage corridors.
- To reduce plastic waste by promoting refillable containers and discouraging disposable bottled water.
- To enhance disaster resilience by ensuring safe drinking water access during floods and supply disruptions

2) Location and Ownership

The proposed water ATMs shall be located in prominent wards where tourist footfall is higher and where prominent social infrastructure and institutions are located. Few of the suggested location include- Haripad KSRTC Bus Stand, proposed Visitors Center at Karimpalil Palace, proposed Private Bus Stand, Prathimukham Jucntion, Ezhikakath Junction, Haripad Subramanyaswamy Temple road, Proposed Haripad Cultural center at Haripad Kottaram premise, TPN Junction, Mannarasala Temple premise, proposed Danapady Market redevelopment area, Vathukullangara temple

premise, Manimangalam Balamuruga temple premise, Nangiarkulangara junction, prosed butterfly park area in Suresh Market ward, Taluk Hospital premise, Dnapady Karthikapally road etc.

3) Project Components

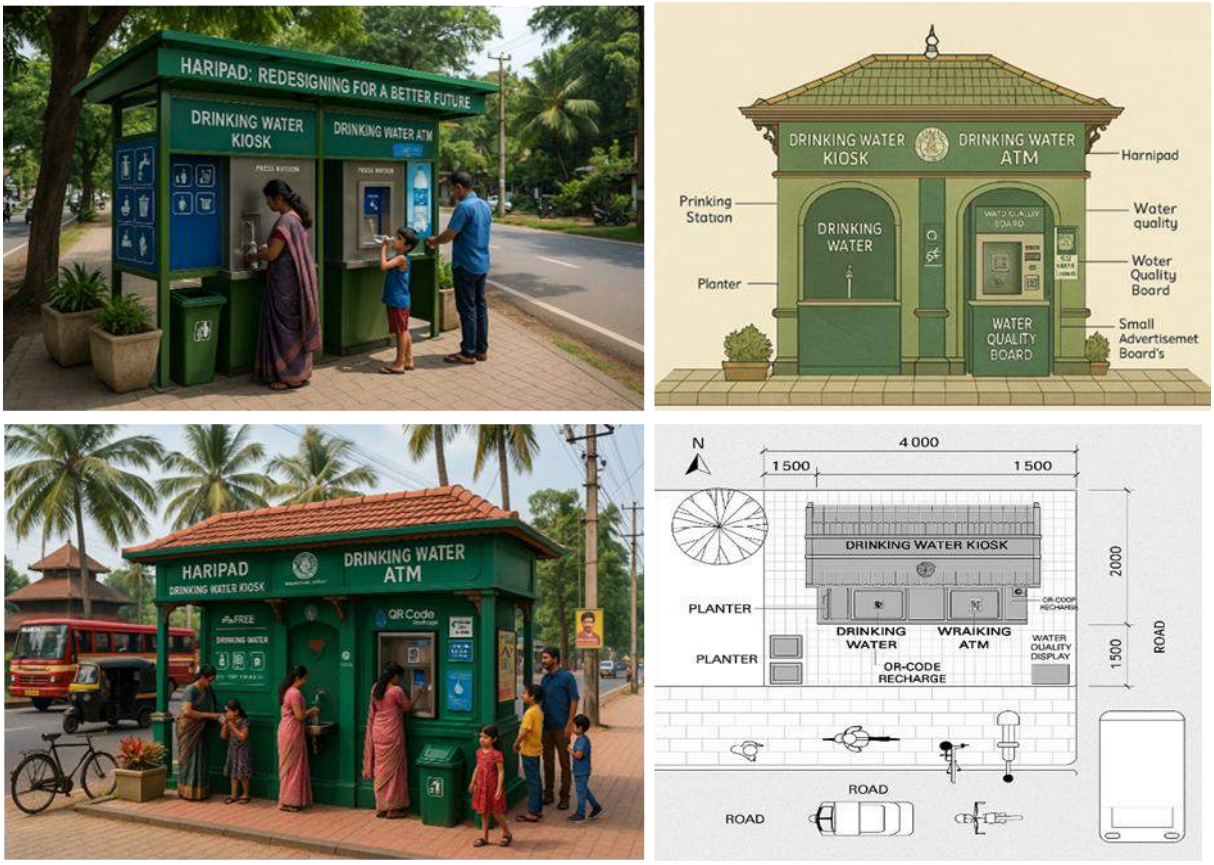


Figure 36.6 : Conceptual Views, Elevation and Plan of Proposed Water ATM

The various components that will form part of the project include:

1. Installation of Water ATMs (coin/card/mobile-payment enabled).
2. Integration with RO/UV purification units based on site conditions.
3. Water quality monitoring system (online or periodic testing).
4. Smart metering and automated dispensing mechanism.
5. Backup solar power systems where feasible.
6. User interface with multilingual instructions and digital payments.
7. Accessibility features such as differently abled-friendly dispensing height.
8. CCTV monitoring for security and vandalism prevention.
9. Branding and information signage under Haripad Municipality.

4) Agencies Responsible

Table 36.15 : Agencies responsible for Water ATMs

Agencies responsible for Water ATMs		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project implementation, coordination, monitoring, and public facilitation	Haripad Municipality

2	Water source connection, system integration, and water quality certification	Kerala Water Authority (KWA)
3	Supply, installation, commissioning, and technical maintenance of Water ATMs	Equipment Vendors / Technology Providers
4	Periodic water quality testing, certification, and compliance monitoring	Accredited Water Testing Laboratories
5	Day-to-day operation, cleaning, minor maintenance, and grievance handling	Kudumbashree Units / SHGs / Private Operators
6	Protection from vandalism, illegal parking, misuse, and ensuring public safety	Police Department / Municipal Enforcement Wing

5) Suggested Implementation Mechanism

The implementation of Water ATMs in Haripad should follow a phased approach, beginning with high-demand public nodes such as the railway station, bus stands, markets, hospitals, major temples, and parks to ensure maximum community benefit. Operations may be structured through a PPP-based model or a Municipality - SHG/Kudumbashree partnership for efficient day-to-day management. A long-term Annual Maintenance Contract (AMC) with the equipment vendor is essential to guarantee uninterrupted technical performance, alongside digital monitoring systems that track usage, revenue, and real-time water quality through a centralized dashboard. Additionally, a sustained public awareness campaign should be undertaken to promote a refill culture, reduce single-use plastic consumption, and encourage responsible use of the Water ATMs.

6) Other Associated Issues to be addressed

Other associated issues include ensuring consistent water quality through scheduled laboratory testing and providing strict protection against vandalism, misuse, and unauthorized parking through CCTV surveillance and municipal enforcement. Proper management of wastewater from RO units is essential to prevent environmental impacts, along with ensuring that all kiosks are accessible, well-lit, and barrier-free for users of all age groups and abilities. The units shall be integrated into disaster preparedness protocols to remain functional during floods or power outages through appropriate backup systems. Close coordination with KWA, PWD, and other utility agencies is required to avoid service disruptions during road works or pipeline repairs and to ensure uninterrupted operation across the Municipality.

7) Project Cost and Period

Table 36.16 : Project Cost Estimate - Water ATMs

Project Cost Estimate - Water ATMs		
Sl. No.	**Component**	**Unit Cost (INR Lakhs)**

1	Water ATM Kiosk (Stainless Steel, Fully Automated, RO System, Coin/Card/Tap Access)	2,50,000
2	Borewell / Water Source Strengthening	1,20,000
3	Electrical Connection, Wiring & Panel	40,000
4	Civil Platform, Paving & Shelter	60,000
5	Branding, Information Signage, Instruction Panels	10,000
6	Smart Monitoring System (IoT Sensors + Remote Dashboard)	35,000
7	Annual Maintenance Contract (AMC) for 5 Years	25,000
8	Safety Measures (CCTV, Lighting, Bollards)	30,000
9	Project Management, Supervision & Contingency (8%)	50,000
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 6.2 Lakhs per Water ATM unit

Table 36.17 : Project Duratione - Water ATMs

Project Duration - Water ATMs			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Site Preparation & Approvals	Location finalization, KWA link approval, electrical clearance	0 - 1 month
2	Procurement & Supply	Ordering RO + ATM unit, delivery, quality checks	1 - 2 months
3	Installation & Civil Works	Platform construction, plumbing & electrical connections	2 - 3 months
4	Testing & Commissioning	Water quality testing, calibration, digital setup	3 - 3.5 months
5	Handover & O&M Onboarding	Operator training, AMC activation, public rollout	3.5 - 4 months
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions.*			

The overall duration required for installation of one unit would be around 4 months

36.4.3 Road Redevelopment from NH 66 to Haripad Railway Station

1) Project Brief



The Road Redevelopment from Haripad KSRTC Bus Stand to Haripad Railway Station is an important urban mobility improvement initiative aimed at upgrading one of the most critical movement corridors in Haripad Municipality. This stretch of road forms the primary link between the KSRTC Bus Stand, the Private Bus Stand, Haripad Railway Station, NH 66, and the proposed Gateway to Haripad - Visitors Centre at Karimbilil Palace. Presently operating with an average width of about 8 metres, the corridor often experiences congestion, poor pedestrian conditions, and inadequate tourist-friendly features despite serving as the town's main arrival spine for regional visitors, pilgrims, and daily commuters. The

project proposes widening the road to 12 metres, strengthening the carriageway, improving walkability, and introducing modern street amenities to enhance safety, comfort, and aesthetics. The upgraded road is envisioned as the "Welcome Corridor" of Haripad, offering an efficient, attractive, and seamless travel experience for residents and visitors alike.

Need for the Project

The existing 8-metre road connecting Haripad KSRTC Bus Stand to the Railway Station is no longer adequate to handle the growing traffic volumes, especially during temple festivals and peak tourism seasons when thousands of visitors pass through the corridor. The absence of proper pedestrian facilities, lighting, signage, and essential safety measures further affects mobility, comfort, and overall visitor experience. As this stretch forms a critical mobility spine linking key transport nodes - including the KSRTC Bus Stand, Private Bus Stand, Railway Station, NH 66, and the proposed Gateway to Haripad Visitors Centre - it must function as a high-quality urban corridor. Upgrading and widening the road will significantly improve traffic flow, reduce congestion, enhance safety, and strengthen Haripad's image as an emerging regional hub for cultural and religious tourism. The project also aligns with the town's long-term vision of improving regional connectivity and supporting sustainable tourism-led development.



Figure 36.7 : Existing condition photo of Road from NH 66 to Haripad Railway Station

Aim of the Project

The aim of this project is to transform the NH 66 - Railway Station corridor into a safe, well-designed, and tourist-friendly urban spine that supports smooth mobility, enhances the town's visual appeal, and provides a comfortable travel experience for residents and visitors. By widening the road, improving lighting, adding signage, and strengthening pedestrian facilities, the project seeks to create a welcoming gateway to Haripad

Project Objectives

- Enhance mobility and safety by widening the road to 12 m, improving traffic flow, pedestrian pathways, signage, road markings, lighting, and night-time visibility.
- Strengthen connectivity and accessibility between major transport nodes and key tourist destinations through modern street design and wayfinding elements.

- Improve streetscape quality and arrival experience with urban design features such as landscaping, planters, wall art, tactile paving, reflector mirrors, and directional boards, reinforcing Haripad's image as a welcoming town.
- To create a high-quality arrival experience for visitors and enhance overall mobility standards in Haripad

2) Location and Ownership

The project is along the road connecting NH 66 to Haripad Railway Station for a stretch of distance approx. 420 metres

Land Ownership	Road owned by Municipality or PWD. Land on either sides of road are partly private land and partly owned by Travancore Devaswom Board
Ward Number	16
Project Area	1.8 Acre
Survey Number	463(p), 462(p), 459(p), 470(p), 471(p), 469(p), 468(p)



Figure 36.8: Location of proposed Road Redevelopment stretch from NH 66 to Haripad Railway Station

3) Project Components

The various components that will form part of the project include:

- Road and mobility upgrades: Road widening to 12 m with carriageway strengthening, improved stormwater drainage, thermoplastic road markings, reflector mirrors, and upgraded bus bays near KSRTC and private bus stands.
- Pedestrian safety and accessibility: Dedicated footpaths with tactile blocks, safe pedestrian crossings, safety islands, railings, and universal access features.
- Lighting and wayfinding: Energy-efficient LED street lighting, tourist-friendly signage, and an integrated wayfinding system to improve visibility and navigation.
- Urban design and streetscape enhancement: Planter boxes, linear landscaping, street furniture (benches, bollards), and façade/compound wall art to enhance visual quality.

- Public realm and safety measures: Traffic calming elements and corridor-level improvements to ensure safe, legible, and people-friendly street environment
- Pedestrian crossings and safety islands
- Bus bay improvements near KSRTC and private stand
- Utility shifting and underground cabling (where required)



Figure 36.9: Conceptual view of Road Redevelopment from NH 66 to Haripad Railway Station

4) Agencies Responsible

Table 36.18 : Agencies responsible for Road Redevelopment from NH 66 to Haripad Railway Station

Agencies responsible for Road Redevelopment from NH 66 to Haripad Railway Station		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, approvals, and monitoring	Haripad Municipality
2	Road design, widening plan preparation, geometric improvements	PWD (Roads Division), NATPAC (as technical advisor)
3	Traffic management planning, junction design, signage standards	NATPAC, Kerala Police (Traffic Wing)
4	Utility shifting (electric lines, water pipelines, telecom cables)	KSEB, Kerala Water Authority, BSNL/private telecom operators

5	Street lighting installation, high-mast lighting, smart poles	Haripad Municipality, KSEB
6	Footpath, pedestrian infrastructure, and accessibility improvements	Haripad Municipality, PWD
7	Landscaping, planter boxes, compound wall improvements, wall art	Haripad Municipality, Department of Tourism (for thematic elements)
8	Road marking, road signage, reflective devices, safety barriers	PWD, Kerala Police (Traffic), Transport Department
9	Construction execution, material procurement, field supervision	Selected Contractor(s), Haripad Municipality Engineering Wing
10	Environmental compliance, drainage integration, stormwater management	Haripad Municipality, Irrigation Department
11	Railway station interface coordination and access improvements	Southern Railway (Engineering Division), Haripad Municipality
12	Monitoring and quality control during construction	Haripad Municipality Engineering Wing, Third-party QC agency (if appointed)

5) Suggested Implementation Mechanism

The project shall be implemented through a structured, multi-agency coordination framework led by Haripad Municipality as the nodal planning and monitoring authority, in close partnership with the Public Works Department (PWD) as the primary technical and executing agency. The Municipality will be responsible for overall project coordination, stakeholder engagement, and ensuring alignment with Haripad's mobility, tourism, and urban design objectives, while PWD will handle detailed engineering design, road widening, construction execution, supervision, and quality assurance in accordance with applicable standards.

To ensure smooth and time-bound implementation, a Joint Working Group comprising representatives from PWD, Kerala State Electricity Board (KSEB), Kerala Water Authority (KWA), National Transportation Planning and Research Centre (NATPAC), Revenue Department, Motor Vehicles Department, and the Police should be constituted. This body will facilitate coordinated utility shifting, traffic management planning, road safety audits, statutory approvals, and land-related clearances, thereby minimizing implementation delays.

Project execution may be undertaken through a tendered EPC (Engineering, Procurement, and Construction) model, enabling integrated delivery of civil works, utilities, and streetscape elements under a single contract. Urban design components - such as landscaping, pedestrian amenities, signage, and public art - shall be developed in parallel through coordination with the District Tourism Promotion Council (DTPC) and relevant cultural stakeholders to ensure contextual and visitor-friendly outcomes. A dedicated Project Monitoring Committee, chaired by the Municipality, will conduct periodic reviews to track progress, resolve inter-agency issues, manage risks, and ensure timely, cost-effective, and high-quality completion of the road redevelopment project.

6) Other Associated Issues to be addressed

In addition to the physical widening and upgrading of the road corridor, several interconnected issues must be addressed to ensure the long-term effectiveness and sustainability of the redevelopment works. Existing utilities such as water lines, drainage channels, electricity

poles, and telecom cables will require careful relocation and coordination to avoid service disruptions. Encroachments along the road edges - including temporary structures, signage boards, and informal parking - must be managed through stakeholder consultations and appropriate enforcement measures. Proper stormwater management solutions, including side drains and culvert improvements, are necessary to prevent waterlogging during monsoon periods. Special attention must also be given to pedestrian safety, especially near temples, schools, and commercial stretches, where footfall remains high. Traffic management during the construction phase, dust suppression, noise control, and ensuring uninterrupted access for residents and businesses are equally important. A structured communication plan with the public, grievance redressal mechanisms, and coordination among multiple agencies will be essential to minimize inconvenience and ensure smooth and timely project implementation.

7) Project Cost and Period

Table 36.19 Project Cost Estimate for Road Redevelopment from NH 66 to Haripad Railway Station

Project Cost Estimate - Road Redevelopment from NH 66 to Haripad Railway Station		
Sl. No.	**Component**	**Estiamted Cost (INR Lakhs)**
1	Road widening & carriageway strengthening	220
2	Footpaths & pedestrian infrastructure	60
3	Street lighting (LED)	40
4	Road signage & markings	15
5	Drainage improvement	45
6	Landscaping & planter boxes	20
7	Wall art & façade improvements	25
8	Street furniture	10
9	Traffic safety elements	10
10	Contingencies (5%)	25
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 4.2 Crores

Table 36.20 : Project Duration for Road Redevelopment from NH 66 to Haripad Railway Station

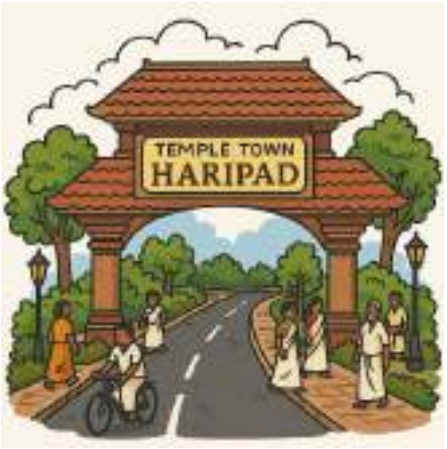
Project Duration - Road Redevelopment from NH 66 to Haripad Railway Station			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Project Preparation & Approvals	Detailed survey, traffic assessment, utility mapping, preliminary drawings, stakeholder consultations, DPR finalization, administrative sanction, and tender documentation	2 months
2	Land / ROW Clearance & Utility Shifting	Identification of required ROW, compensation processes where relevant, shifting of electric lines, water pipelines, drainage lines, communication cables, etc.	2 - 3 months
3	Road Widening & Earthwork	Cutting, filling, subgrade preparation, boundary demarcation, drainage alignment, relocation of	3 months

		encroachments, and formation of widened carriageway base.	
4	Drainage & Footpath Construction	Construction of side drains, covered drains, pedestrian footpaths, kerbs, tactile paving, and introduction of stormwater structures (inlets, chambers).	2 months
5	Carriageway Construction	Laying of GSB, WMM, binder course, asphaltic concrete, hot mix surfacing, and shoulder strengthening	2 months
6	Street Lighting, Signage & Safety Installations	LED streetlights, poles, smart controls, signage boards, road markings, zebra crossings, reflector mirrors, pedestrian rails, and barricades.	1 month
7	Urban Aesthetics & Landscaping Works	Planter boxes, median beautification, wall art, junction improvements, green buffers, and public realm enhancement.	1 month
8	Final Inspection & Commissioning	Safety audit, quality check, rectification works, commissioning, and handover to the Municipality.	0.5 month
		** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*	

The overall duration required for installation of one unit would be around 10-12 months

36.4.4 Haripad Temple Town - Entry Gate

1) Project Brief



The Haripad Temple Town - Entry Gateway project proposes the development of a signature welcoming structure at Madhava Junction, the primary approach to the Haripad Subrahmanya Swamy Temple from NH 66. Designed in traditional Kerala vernacular architecture, the gateway will reflect the cultural identity, heritage character, and spiritual significance of Haripad, serving as a prominent visual landmark for visitors arriving via the national highway and the upcoming flyover. The project will be implemented after the redevelopment of Madhava Junction and will integrate complementary public realm improvements, including pedestrian footpaths, road signage, safety railings, and enhanced street markings. Together, these interventions will create a dignified, safe, and memorable entry experience, reinforcing Haripad's identity as a historic temple town

Need for the Project

Madhava Junction is a high-visibility, high-traffic node and the first point of contact for a majority of visitors approaching the Haripad Subrahmanya Swamy Temple via NH 66. Despite its cultural importance, the junction currently lacks a defining landmark that signifies entry into a historic temple town. With the ongoing flyover construction and proposed junction redevelopment, this is a strategic opportunity to

establish a dignified, welcoming, and identity-shaping gateway. The project is needed to strengthen Haripad's tourism appeal, improve wayfinding for pilgrims, enhance urban aesthetics, and create a safe and coherent public realm through improved pedestrian facilities, signage, and road design.

Aim of the Project

The aim of the Haripad Temple Town - Entry Gateway project is to create a culturally significant, visually prominent, and architecturally authentic entrance feature that reflects the heritage, temple traditions, and identity of Haripad. Positioned at Madhava Junction - the primary entry point from NH 66 and the proposed flyover - the gateway intends to enhance the arrival experience for visitors and pilgrims, reinforce Haripad's temple-town character, and integrate with broader streetscape and junction improvement works

Project Objectives

- To establish a culturally rooted architectural gateway that symbolizes Haripad's temple-town heritage.
- To create a prominent visual landmark visible from NH 66 and the proposed flyover.
- To enhance the pedestrian and visitor experience through coordinated streetscape improvements.
- To support tourism and pilgrim movement with safe, accessible, and well-designed public realm features.
- To integrate the gateway with the Madhava Junction redevelopment for seamless mobility and improved urban character.



Figure 36.10 : Existing photo of Madhava Jucntion

2) Location and Ownership

Land Ownership	Private
Ward Number	25
Project Area	0.03 Acre
Survey Number	287(p), 288(p), 293(p)

The Entry gateway for Haripad Temple Town is proposed at Madhava Jucntion.



Figure 36.11: Proposed project location for Entry Gateway- Haripad Temple Town at Madhava Jucntion

3) Project Components

The various components that will form part of the project include:

- **Architectural Gateway Structure:** A traditional Kerala-style gateway with temple-inspired forms, sloping tiled roofs, and vernacular detailing reflecting the architectural character of Haripad Subramanya Swamy Temple, serving as a symbolic entry to the temple town.
- **Pedestrian Infrastructure & Universal Access :** High-quality pedestrian footpaths with granite/printed pavers, tactile tiles, kerb ramps, and barrier-free access for safe and inclusive movement.
- **Signage, Wayfinding & Information Systems :** Heritage-themed directional signage guiding visitors to NH-66, temple precincts, town centre, canal-front areas, and the Paithruka Veedhi corridor.
- **Safety & Traffic Management Measures :** Aesthetic safety railings, bollards, pedestrian barriers, and improved road markings to enhance pedestrian safety and lane discipline at the junction.
- **Street Lighting & Surveillance :** Energy-efficient, heritage-style LED street lighting and CCTV surveillance to improve night-time safety and deter vandalism.
- **Landscape & Streetscape Enhancements :** Native tree planting, low-height shrubs, planting strips, and shaded seating areas to improve microclimate and visual quality.
- **Street Furniture & Public Amenities :** Benches, litter bins, bollards, and information kiosks designed in harmony with the vernacular character of the gateway.
- **Future-Ready Integration :** Provision for integration with future wayfinding systems linked to the Visitors' Centre and Paithruka Veedhi Cultural Corridor.



Figure 36.12 : Conceptual view of proposed Entry gateway- Haripad Temple Town

4) Agencies Responsible

Table 36.21 : Agencies responsible for Haripad Temple Town - Entry Gate project

Agencies responsible for Haripad Temple Town - Entry Gate project		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, approvals, and monitoring	Haripad Municipality
2	Architectural design, structural design, and vetting	Town Planning Department / Accredited Architectural Consultant
3	Heritage integration and cultural design review	Travancore Devaswom Board / Temple Authorities
4	Road alignment, junction integration, and pedestrian safety design	PWD (Roads Division)
5	Utility shifting (electric, water, drainage) and service coordination	KSEB, KWA, BSNL / Utility Providers
6	Traffic management, safety compliance, and enforcement	Haripad Police Department / Traffic Wing
7	Landscape development, urban furniture, and lighting integration	Haripad Municipality / Accredited Landscape Consultant

8	Construction execution and quality control	Empanelled Contractor / Municipal Engineering Wing
9	CCTV, surveillance, and vandalism prevention	Haripad Municipality + Police Department
10	Post-construction maintenance and upkeep	Haripad Municipality (Health & Engineering Division)

5) Suggested Implementation Mechanism

The implementation of the Haripad Temple Town - Entry Gateway should follow a structured and phased approach aligned with the redevelopment of Madhava Junction. The project may begin with detailed architectural and structural design development, incorporating Kerala vernacular aesthetics and heritage elements endorsed by the Devaswom Board and temple authorities. Parallel coordination with PWD, the flyover contractors, and municipal engineering teams is essential to finalize road alignment, pedestrian movement, and utility integration. Construction should be executed through an empanelled contractor selected via a transparent tendering process, with periodic technical supervision by the Municipality and design consultants to ensure quality and heritage sensitivity. Utility shifting, street lighting installation, and streetscape works must be sequenced to avoid disruption to traffic and pilgrim flow. The final commissioning should include safety audits, lighting checks, and landscaping completion, followed by assignment of routine maintenance responsibilities to the municipal engineering and health wings

6) Other Associated Issues to be addressed

Several site- and context-specific issues require careful attention for successful project delivery. As a culturally significant structure situated near a major temple, the gateway's design and construction must respect heritage norms, demanding expert review and sensitive material selection. The proximity to NH 66 and the ongoing flyover construction increases risks of dust, vibration, and debris exposure, requiring protective measures for the gateway structure during and after construction.

The junction experiences heavy vehicular flow, pedestrian movement, and parking pressure, increasing the likelihood of accidental damage, encroachments, and vandalism. Continuous surveillance, regulated parking, and coordinated enforcement will be essential. Utility conflicts - particularly overhead electrical lines, drainage paths, and streetlighting - must be resolved early to prevent delays. Additionally, the completed gateway demands long-term maintenance planning to ensure lighting, paintwork, landscaping, and structural components remain intact despite weather exposure and high traffic intensity

7) Project Cost and Period

Table 36.22: Project Cost Estimate for Haripad Temple Town - Entry Gate

Project Cost Estimate - Haripad Temple Town - Entry Gate		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Main gateway structure (RCC frame + local finish/veneers, modest ornamental detailing)	60.0
2	Side pavilions / small wing structures (2 nos.)	18.0
3	Roofing (clay tiles / lightweight tiles, basic waterproofing)	10.0

4	Architectural & streetscape lighting	4.0
5	Soft landscaping, planters and basic irrigation	5.0
6	Footpaths, tactile paving & pedestrian safety railings	8.0
7	Signage / modest wayfinding	2.0
8	Minor utility shifting / local drainage adjustments	2.5
9	Traffic management & temporary works during construction	1.5
10	Contingency (approx. 7 - 8%)	7.5
	** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*	

Total Estimated Cost would be approx. 1.3 Crores

Table 36.23: Project Duration for Haripad Temple Town - Entry Gate

Project Duration - Haripad Temple Town - Entry Gate			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Pre-Construction Phase	Site survey, measurements, soil testing, utility mapping, design finalisation,	1.5
2	Site Preparation	Barricading, traffic diversions, clearing, minor utility shifting	0.5
3	Foundation & Structural Works	Excavation, footing, RCC framework for gateway & side pavilions	2.0
4	Superstructure & Roofing	Columns, beams, roof truss, tile installation, structural finishing	1.5
5	Architectural Finishing	Cladding, wood/veneer detailing, plastering, painting, signage	1.0
6	Streetscape & Pedestrian Works	Footpath construction, railings, road markings, landscaping	0.5
7	Electrical & Lighting Installation	Heritage lighting fixtures, wiring, testing	0.3
8	Final Inspection & Commissioning	Safety inspection, quality check, defect rectification, handover	0.2
	** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*		

The overall duration required for installation of one unit would be around 7-9 months

36.4.5 RJ Road Redevelopment

1) Project Brief



The RJ Road Redevelopment Project proposes a comprehensive transformation of the 700-metre road corridor connecting Haripad Railway Station to Haripad Town Junction - one of the most strategically important mobility links in the Municipality. This stretch serves as a principal approach to the town centre and is extensively used by residents, students, office-goers, pilgrims, and tourists arriving through the railway station and the proposed Karimpalil Palace Visitors' Centre. The project aims to redesign RJ Road as a safe, efficient, and visually

appealing complete street that supports multimodal mobility while enhancing the overall urban experience and reinforcing Haripad's identity as a welcoming temple town

Need for the Project

RJ Road currently suffers from uneven carriageways, the absence of proper footpaths, inadequate lighting, lack of cycle-friendly infrastructure, and minimal safety features despite running parallel to the railway track for a significant length. The corridor's suboptimal condition restricts smooth traffic flow and creates safety risks for pedestrians, cyclists, and schoolchildren. This road also connects directly to several high-density civic and institutional nodes, including two major schools, the Taluk Court, the Police Station, commercial areas, and the proposed Visitors' Centre-making capacity enhancement and safety interventions essential.

Furthermore, because of its linear visibility and high daily footfall, the corridor holds substantial potential for regulated advertisement placements, contributing to sustained municipal revenue generation. Redeveloping RJ Road will also encourage sustainable travel by offering a seamless pedestrian and bicycle-friendly link between the railway station and the town core.

Aim of the Project

The overarching aim of the RJ Road Redevelopment Project is to convert the existing corridor into a model urban mobility and public-realm space that enhances safety, accessibility, comfort, and convenience for all users. The project intends to establish this stretch as a signature entry corridor to the town centre - integrating mobility, aesthetics, safety, and revenue generation opportunities. Through improved infrastructure, dedicated bicycle tracks, pedestrian-oriented design, and streetscape enhancement, the project aspires to enable smooth last-mile connectivity for both residents and visitors, especially tourists accessing Haripad's heritage and cultural sites.

Project Objectives

- To ensure safe, barrier-free pedestrian movement through raised footpaths, tactile paving, and continuous walking paths.
- To promote non-motorized mobility by introducing a dedicated, well-marked cycle track connecting the railway station, Visitors' Centre, and Town Junction.
- To enhance traffic efficiency and road safety, reducing travel time and providing safer conditions along the railway-adjacent stretch through guardrails and warning signage.
- To improve the overall urban environment by integrating landscaping, street furniture, lighting, and organized waste collection systems.
- To leverage the corridor's visibility for revenue generation through structured advertisement boards without compromising safety or aesthetics.
- To strengthen tourist connectivity by providing a direct, comfortable access route from the railway station to the cultural heart of Haripad.

2) Location and Ownership

RJ Road stretches between Haripad Railway Station entrance to Haripad Town Junction.

Land Ownership	Indian Railways
Ward Number	10, 16
Project Area	0.03 Acre
Survey Number	319. 315(p)



Figure 36.13: Location fo RJ Road

3) Project Components

The various components that will form part of the project include:

1. Roadway & Mobility Infrastructure
   - Hot-mix tarred road surface (700 m, 12m width upgrade)
   - Lane marking, traffic calming elements, and junction improvements
   - Dedicated, well-segregated bicycle tracks
   - Safety railings along the railway edge throughout vulnerable sections
2. Pedestrian Infrastructure
   - Raised pedestrian footpaths with tactile guidance tiles
   - Ramp-enabled crossings for universal accessibility
   - Shaded resting nodes with street furniture
   - Designated pedestrian crossings at key points
3. Lighting, Safety & Signages
   - Solar-powered LED street lights at regular intervals
   - Smart streetlight management system
   - Directional, regulatory, and tourist information signages
   - CCTV at critical points for safety and monitoring
4. Streetscape Enhancement
   - Hardscaping, bollards, planters, green buffers
   - Organized vending spaces (where appropriate)
   - Consistent visual identity aligned with Haripad's cultural character
5. Waste Management & Public Convenience

- Waste receptacles placed at appropriate distances
- Provision for future integration of water ATMs or drinking water points

6. Revenue-Generating Elements
   - A structured advertisement board framework along the stretch
   - Digital advertisement panels at high-visibility nodes
   - Municipality-managed licensing and maintenance mechanism



Figure 36.14 : Existing condition and proposed conceptual view of stretches of RJ Road

4) Agencies Responsible

Table 36.24 : Agencies responsible for RJ Road Redevelopment

Agencies responsible for RJ Road Redevelopment

Sl. No.	Responsibility / Function	Agencies / Departments Involved
1	Overall project coordination, land management, stakeholder consultation	Haripad Municipality
2	Road design, pavement works, drainage alignment, safety engineering	Public Works Department (PWD)
3	Installation of solar streetlights and integration with smart lighting systems	Kerala State Electricity Board (KSEB) / Approved Solar Vendors
4	Railway-side safety approvals, design conformity along railway boundary	Indian Railways - Engineering Department
5	Bicycle track standards, pedestrian infrastructure design support	Department of Town & Country Planning (DTCP)
6	Landscape design, urban design elements, streetscape enhancements	Landscape Architects / Urban Design Consultants
7	Solid waste receptacle placement and routine maintenance	Haripad Municipality - Health & Sanitation Wing
8	Traffic regulation during construction, final traffic management plan approval	Traffic Police / Kerala Police Department
9	Advertisement framework approvals and revenue management for display boards	Haripad Municipality - Revenue Wing
10	Environmental safeguards, tree protection, green buffer certification	Kerala State Pollution Control Board (KSPCB) / Haripad Municipality

5) Suggested Implementation Mechanism

The RJ Road Redevelopment project should follow a phased and coordinated implementation approach to ensure safety, efficiency, and uninterrupted accessibility for commuters. Initial activities should include detailed engineering surveys, traffic management planning, and structural vetting of works proposed along the railway boundary. Construction may be executed in segmented stretches to minimize disruption, with temporary pedestrian pathways and regulated traffic flow throughout the execution period. Close coordination between the Haripad Municipality, PWD, and Indian Railways will be essential, particularly for works adjacent to the railway line such as safety railings and drainage. Procurement of materials and services should follow standard tendering procedures, with quality control and site supervision led by the engineering team. Installation of solar-powered streetlights, bicycle tracks, tactile footpaths, and urban furniture should be taken up after the completion of core road and drainage works. Post-completion, the Municipality should adopt a structured O&M plan covering streetscape upkeep, lighting maintenance, and waste management.

6) Other Associated Issues to be addressed

Several contextual concerns must be addressed to ensure the long-term functionality and safety of the RJ Road corridor. Given its proximity to the railway line, strict compliance with railway safety norms and construction buffer limits is essential to avoid accidents or structural

conflicts. The high pedestrian and student movement in the area requires enhanced safety measures during construction, including barricading, signage, and controlled working hours near school zones. Stormwater management must be designed carefully to prevent waterlogging along the railway boundary, especially during monsoons. Regular monitoring will be required to deter encroachments, illegal parking, and misuse of bicycle tracks. Maintenance challenges such as vandalism of signboards, damage to landscaping, or improper waste disposal must also be anticipated and mitigated through enforcement and community awareness. Coordination with utility agencies (KSEB, water supply, telecom) is crucial to avoid disruptions during underground works. Finally, advertisement board installations must follow regulated design standards to avoid visual clutter and ensure road safety.

7) Project Cost and Period

Table 36.25: Project Cost Estimate for RJ Road Redevelopment

Project Cost Estimate - RJ Road Revelopemnt		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Road reconstruction & surfacing (700 m, 15 m ROW)	1.80
2	Dedicated bicycle tracks (dual-side)	0.60
3	Raised pedestrian footpaths with tactile paving	0.75
4	Safety railings along railway boundary	0.35
5	Solar-powered streetlighting system	0.40
6	Street furniture - seating, waste bins, bollards	0.20
7	Signage, road markings & wayfinding systems	0.15
8	Landscaping & hardscaping (tree pits, planters, buffers)	0.30
9	Advertisement boards & mounting infrastructure	0.10
10	Drainage strengthening & shoulder reinstatement	0.45
11	Contingency (7 - 10%)	0.40
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 5.6 Crores

Table 36.26: Project Duration for RJ Road Redevelopment

Project Duration - Haripad Temple Town - Entry Gate			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Preparatory Works	Site surveys, utility mapping, stakeholder consultations, traffic management plan	1 month
2	Civil & Road Works	Road reconstruction, pavement strengthening, drainage upgrades, footpath works	3 months
3	Street Infrastructure	Installation of bicycle tracks, safety railings, street furniture, waste bins	1.5 months
4	Electrical Works	Solar-powered streetlights, signage, street marking, advertisement boards	1 month

5	Finishing & Handover	Landscaping, final inspections, commissioning, defect rectification	0.5 months
			** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*

The overall duration required for installation of one unit would be around 7-9 months

36.4.6 Haripad Hub - Town Centre Redevelopment

1) Project Brief



The Haripad Hub - Town Centre Redevelopment project aims to transform the 790-metre stretch from Haripad Town Junction to Town Hall Junction - passing through Ezhikkakath Junction and Kacheri Junction - into a vibrant, pedestrian-friendly urban core. As the commercial and institutional heart of Haripad, this corridor accommodates high daily footfall, major government offices, dense retail activity, and significant student movement. The project envisions creating a safe, accessible, and climate-responsive streetscape that enhances mobility, public safety, and the overall urban experience.

Need for the Project

The existing corridor lacks adequate pedestrian infrastructure, experiences heavy congestion due to on-street parking, and poses safety risks for schoolchildren, shoppers, and commuters. With major civic institutions and commercial establishments located along this stretch, improved walkability, organized mobility, and high-quality public amenities are essential to support urban life, reduce conflicts, and elevate Haripad's image as a growing sub-regional hub.

Aim of the Project

The primary aim of the project is to redesign Haripad's central spine into a modern, inclusive town centre that prioritizes pedestrians, ensures safe multi-modal mobility, and supports commercial vibrancy. The project seeks to create a cohesive, attractive, and accessible public realm that reflects the evolving needs of residents and visitors.

Project Objectives

- Enhance pedestrian safety and comfort through continuous, barrier-free footpaths and protective railings.
- Improve traffic flow by regulating one-way movement and relocating on-street parking to dedicated facilities.
- Promote sustainable and low-carbon mobility through dedicated bicycle lanes and cycle-sharing facilities.
- Strengthen commercial vibrancy by creating active, well-designed mixed-use public spaces.

- Enhance urban aesthetics and environmental quality through landscaping, shaded seating areas, and improved lighting



Figure 36.15 : Existing condition of road stretch from Haripad Town Jucntion to Town Hall Junction

2) Location and Ownership

The Haripad Hub stretches between Town Hall junction to Town Hall junction via the Exhikkakathu junction and Kacheri junction.

Land Ownership	Private and Municiplaity
Ward Number	6, 26
Project Area	2.12 Acres
Survey Number	303, 302, 295, 294



Figure 36.16 : Location of Haripad Hub- Town centre

3) Project Components

The various components that will form part of the project include:

1. Wider, Continuous Pedestrian Footpaths
   - Minimum 2.0 - 2.5 m width on both sides.
   - Tactile paving for the visually impaired.
   - Non-slippery, high-durability paving materials.
   - Protective guard railings along school zones and high pedestrian activity areas.
2. Dedicated Bicycle Lane
   - Physically segregated cycle track.
   - Integrated with town-wide cycle network and the Karimpalil Palace Visitors' Centre.
   - Provision of cycle stands, repair kiosks, and rent-a-cycle docking points.
3. Street Furniture & Shaded Resting Areas
   - Shaded pavilions with seating, especially near schools, courts, and bus stops.
   - Ergonomic street benches, bollards, and planters.
   - Designed using materials reflecting local identity.
4. Urban Greenery & Environmental Enhancements
   - Tree plantation along the corridor for thermal comfort.
   - Median planting where feasible.
   - Pocket green zones and micro-gardens at junctions.
   - Rain gardens or bio-swales for stormwater percolation.
5. Solar-Powered Smart Street Lighting
   - Energy-efficient LED fixtures.
   - Solar-integrated poles to ensure uninterrupted lighting.
   - Smart timers and remote monitoring capability.
6. Mobility Management & Safety Improvements
   - Retention of one-way vehicular movement for efficient flow.
   - Dedicated pick-up/drop-off zones near key institutions.
   - Speed-calming measures like raised pedestrian crossings.
   - Reflective road markings and regulated signage.
7. Removal & Regulation of Advertisement Hoardings
   - Elimination of unregulated hoardings that obstruct visibility.
   - Structurally safe and aesthetically consistent advertising panels.
   - Potential revenue generation through regulated display boards.
8. Waste Management Infrastructure
   - Strategically placed waste receptacles and segregated bins.
   - Periodic cleaning zones integrated into municipal route planning.
9. Public Amenities & Utility Infrastructure
   - Drinking water kiosks and water ATMs.
   - Public seating nodes integrated with shade structures.
   - Smart public convenience units where feasible.
10. Parking Reorganization
    - Removal of on-street parking along the corridor.
    - Linkage with proposed dedicated parking facilities in adjacent plots.
    - Clear signage directing vehicles to new parking locations.
11. Streetscape Aesthetic and Identity Enhancement
    - Uniform façade treatment guidelines for shops.

- Visual continuity in materials, colors, and signage.
- Street naming, heritage interpretation panels, and wayfinding systems.

12. Landscaping & Hardscaping Improvements
    - Durable and visually cohesive paving patterns.
    - Improved drainage channels integrated into footpath design.
    - Junction redesign with safer turning radii.

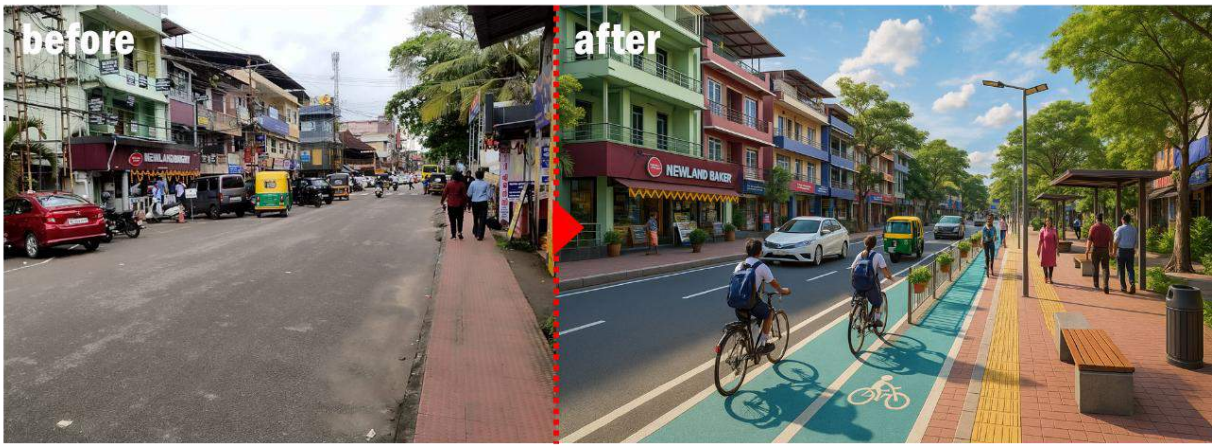


Figure 36.17: Existing and proposed conceptual view of Road stretch from Haripad Town Jn to Town Hall

4) Agencies Responsible

Table 36.27 : Agencies responsible for Haripad Hub - Town Centre Redevelopment

Agencies responsible for Haripad Hub - Town Centre Redevelopment		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, approvals, stakeholder consultations, land-related decisions	Haripad Municipality
2	Detailed engineering design, road and footpath redevelopment, drainage upgrades, junction improvements	PWD (Roads Division), Municipal Engineering Wing
3	Electrical works, installation of solar-powered smart streetlights	KSEB, Accredited Solar Vendors
4	Cycle-track design, cycle stands, rent-a-cycle network integration	Haripad Municipality, Dept. of Urban Affairs, Approved Mobility Operators
5	Tree plantation, landscaping, shaded pavilions, streetscape beautification	Haripad Municipality, Social Forestry Division, Local NGOs/SHGs
6	Traffic regulation, signage enforcement, safety railing approval	Kerala Police (Traffic Wing), Motor Vehicles Department
7	Utility shifting (water supply lines, drainage, utilities)	Kerala Water Authority (KWA), Municipality, KSEB

8	Waste receptacle installation, daily waste collection & O&M	Haripad Municipality - Health Section
9	Removal / regulation of advertisement hoardings	Haripad Municipality - Revenue Section, Town Planning Wing
10	Monitoring accessibility standards, barrier-free infrastructure	Dept. of Social Justice, Municipality Engineering Section
11	Vendor management, shop façade regulation, commercial activity coordination	Haripad Municipality, Town Planning Wing, Local Merchant Associations

5) Suggested Implementation Mechanism

The Haripad Hub - Town Centre Redevelopment shall be implemented through a phased and coordinated execution framework led by Haripad Municipality in collaboration with key state-level agencies. The project will begin with detailed engineering surveys, utility mapping, and traffic assessments, followed by preparation of a DPR conforming to Kerala Municipal Building Rules (KMBR), PWD standards, and barrier-free design guidelines.

Implementation will follow a multi-agency work sequencing plan, wherein PWD undertakes road and footpath redevelopment, KWA and KSEB complete pre-construction utility shifting, and the Municipality manages streetscape, cycle tracks, and urban design components. Junction improvements and traffic management interventions will be coordinated with the Kerala Police - Traffic Wing.

To ensure quality and timely delivery, the project will be executed through a tender-based contracting model with performance-based milestones, supervised by the Municipal Engineering Wing and an external Project Management Consultant (PMC). A citizen engagement mechanism - including merchant associations, resident groups, and public institutions - will be integrated for feedback during implementation. Post-completion, O&M responsibilities will be institutionalized through dedicated Municipal teams and ward committees.

6) Other Associated Issues to be addressed

While implementing the project, several critical issues must be proactively managed to ensure safety, continuity of services, and long-term functionality. The corridor houses major public institutions, schools, and commercial establishments; therefore, traffic diversion planning and pedestrian safety during construction are essential. Coordinated scheduling with PWD, KSEB, KWA, and Telecom operators is required to avoid delays caused by late-stage utility conflicts. Given the high pedestrian footfall - especially school children - temporary footpaths, barricaded work zones, adequate lighting, and signage must be ensured throughout construction. Strict monitoring is needed to prevent unauthorized street vending, illegal parking, and encroachment that could compromise completed works. Advertising hoardings must be regulated to avoid visual clutter and to maintain the intended design language.

As the town centre is economically active, construction debris, dust, and noise must be managed through controlled work timings, debris removal protocols, and adherence to the Kerala State Pollution Control Board (KSPCB) norms. Additionally, long-term success will depend on ensuring sustainable O&M, preventing damage to street furniture, overseeing waste management, and ensuring the safety of cycle lanes and pedestrian zones.

7) Project Cost and Period

Table 36.28: Project Cost Estimate for RJ Road Redevelopment

Project Cost Estimate - Haripad Hub - Town Centre Redevelopment		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Road resurfacing, geometric improvements & drainage upgrades (790 m)	180
2	Dedicated pedestrian footpaths with tactile tiles, protective railings & universal access ramps	220
3	Dedicated cycle lane with pavement markings	85
4	Shaded pavilions, public seating, street furniture & urban design elements	120
5	Street lighting (solar-powered), smart poles & cabling	150
6	Tree planting, landscaping & micro-greens	60
7	Waste receptacles, drinking water kiosks & public amenities	55
8	Road signage, wayfinding, traffic calming & safety improvements	40
9	Cycle stands, rent-a-cycle docking points	25
10	Advertisement board system & digital display infrastructure	35
11	Relocation of on-street parking & creation of connected parking pockets	90
12	Contingencies, design & DPR preparation, PMC charges	70
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 11.3 Crores

Table 36.29: Project Duration for RJ Road Redevelopment

Project Duration - Haripad Hub - Town Centre Redevelopment			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Pre-Construction Phase	Final surveys, detailed measurements, stakeholder consultations, preparation & approval of DPR, statutory clearances, traffic management planning	2 months
2	Site Preparation	Utility shifting, temporary traffic diversions, removal of old street elements, preliminary demolition works	1 month
3	Core Infrastructure Upgradation	Road strengthening & resurfacing, drainage improvement, footpath base preparation, cycle track foundation	3 months
4	Streetscape Development	Footpath paving, tactile tiles, railings, landscaping, shaded pavilions, seating, cycle stands, signage installation	3 months
5	Lighting & Amenities Installation	Solar streetlights, smart poles, drinking water kiosks, waste bins, wayfinding systems	1.5 months

6	Final Integration & Safety Works	Road markings, traffic calming measures, junction refinements, testing of amenities	0.5 month
7	Handover & Monitoring Phase	Final inspection, defect rectification, commissioning, public communication, handover to O&M team	1 month
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 12-15 months

36.4.7 Haripad Kshethra Veedhi - Temple Road Redevelopment

1) Project Brief



The Haripad Kshethra Veedhi project aims to transform the 300-metre approach road from Town Hall Junction to the Haripad Subramanya Swamy Temple into a culturally significant, pedestrian-friendly, and aesthetically unified temple corridor. As one of the most spiritually important and visually prominent streets in the town, the stretch currently suffers from encroachments, congested movement, inadequate pedestrian facilities, and an inconsistent built form. The redevelopment will establish a distinct temple-town identity, enhance visitor experience, and strengthen Haripad's position as a major religious destination.

Need for the Project

The existing road is heavily used by students, pilgrims, and residents but lacks adequate footpaths, shading, and safety features. Unplanned street vending, on-street parking, and temporary structures obstruct movement and diminish the sanctity of the temple precinct. A comprehensive redevelopment is essential to restore visual integrity, enhance cultural experience, ensure pedestrian safety, manage festival crowds, and preserve the temple's axial prominence.

Aim of the Project

The project aims to create a model heritage street that provides a safe, accessible, and visually coherent approach to the Haripad Subramanya Swamy Temple by integrating traditional architectural character, pedestrian priority, and high-quality streetscape elements.

Project Objectives

- To develop a culturally rich and pedestrian-first temple corridor with safe walkways, bicycle access, and shaded seating.
- To establish a uniform architectural façade and regulated building heights to reinforce the visual axis toward the temple gopuram.
- To relocate street vendors to designated vending zones, improving mobility and aesthetics.
- To introduce traditional street lighting, landscaping, and street furniture that reflect Kerala's vernacular character.
- To enhance visitor convenience through amenities such as water ATMs, waste bins, tourist helpdesks, take-a-break facilities, and paid parking.

- To support efficient festival and crowd management through structured circulation and designated holding areas



Figure 36.18: Existing condition of Haripad Subramanya Swamy Temple Roiad

2) Location and Ownership

The Haripad Kshethra Veedhi stretches between Town Hall junction Haripad Subramanya Swamy temple entry gate.

Land Ownership	Private and Municiplaity
Ward Number	6, 26
Project Area	2.90 Acres
Survey Number	303, 302, 295, 294, 284, 283

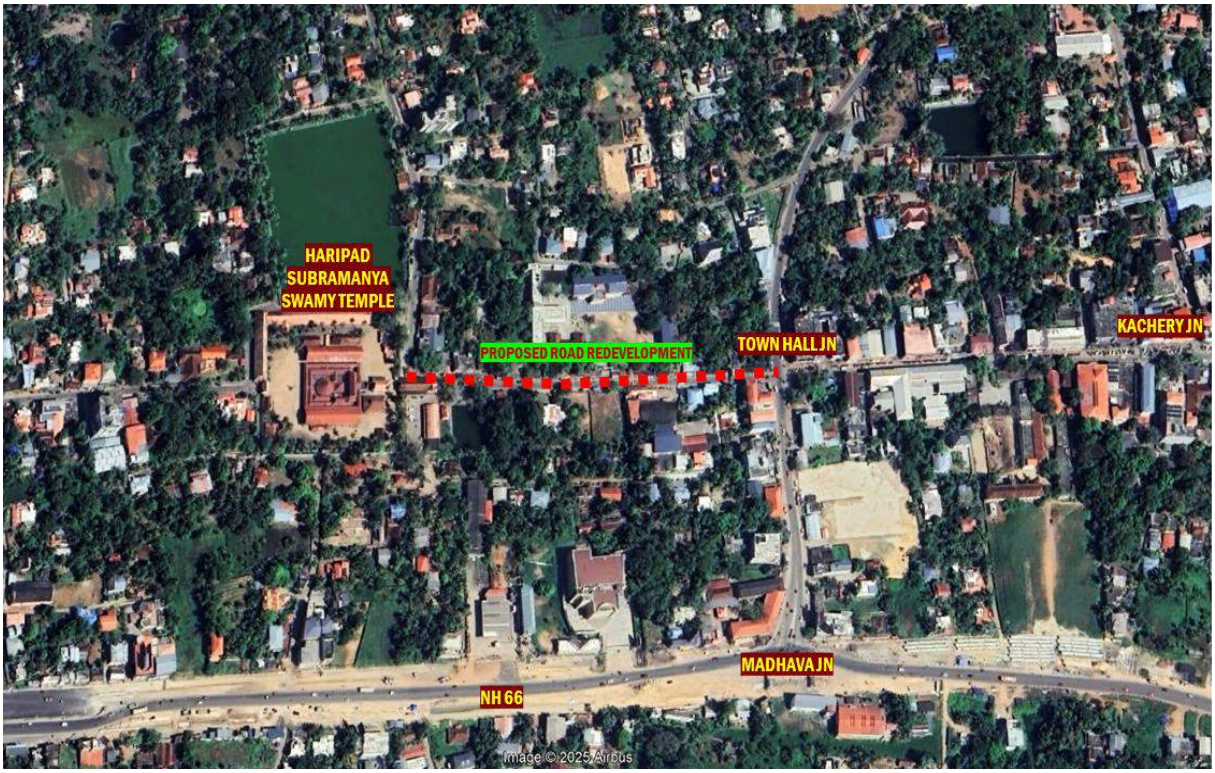


Figure 36.19: Location of Haripad Kshethra Veedhi

3) Project Components

The various components that will form part of the project include:

1. Pedestrian and Mobility Enhancements
   - Widening of existing road to 12m.
   - Dedicated pedestrian footpaths with tactile paving.
   - Continuous bicycle track with cycle stands.
   - Protective railings near school zones.
   - Traffic calming and one-way circulation improvements.
2. Heritage and Visual Identity Improvements
   - Uniform architectural façade code for all buildings along the stretch.
   - Building height regulations to preserve temple gopuram visibility.
   - Traditional Kerala-style street lighting and signage.
   - Temple-inspired streetscape materials, motifs, and colours.
3. Vendor & Parking Management
   - Relocation of existing street vendors to planned vending zones.
   - Paid parking areas on plots adjacent to the stretch.
   - Organized autorickshaw bays.
4. Urban Amenity Upgrades
   - Street seating, shaded pavilions, water ATMs, waste receptacles.
   - Tourist helpdesk and crowd-management kiosks.
   - "Take a Break" facility for pilgrims and visitors.
5. Landscape & Environmental Interventions
   - Tree planting for shade and microclimate improvement.
   - Upgraded stormwater drainage and pavement detailing.

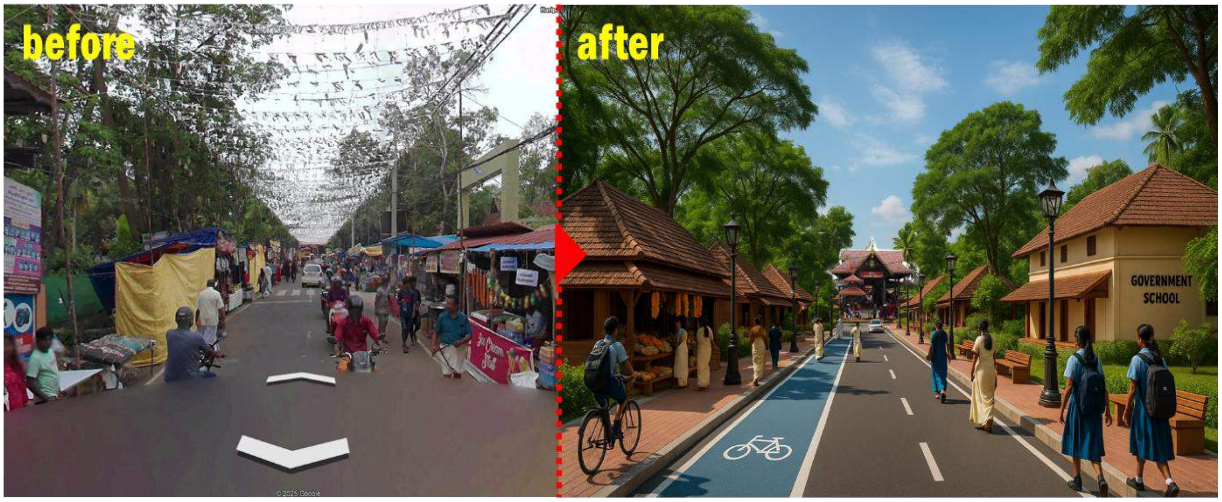


Figure 36.20: Existing and proposed conceptual view of Haripad Kshethra Veedhi

4) Agencies Responsible

Table 36.30 : Agencies responsible for Haripad Kshethra Veedhi - Temple Road Redevelopment

Agencies responsible for Haripad Kshethra Veedhi - Temple Road Redevelopment		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**

1	Overall project coordination, stakeholder consultation, phasing, and monitoring	Haripad Municipality
2	Streetscape design, façade regulation guidelines, pedestrian pathways, cycle tracks, landscaping	Town & Country Planning Department (TCPD), Appointed Urban Design Consultant
3	Roadway improvements, drainage upgrades, pavement works, traffic management	PWD (Roads), Haripad Municipality Engineering Wing
4	Traditional lighting, electrical works, festival illumination	Kerala State Electricity Board (KSEB), Municipality Electrical Section
5	Vendor relocation planning, identification of designated vending zones, livelihood transition support	Haripad Municipality, Kudumbashree Mission, District Collectorate
6	Heritage-sensitive design review, façade controls, building height enforcement	Haripad Municipality, Department of Archaeology / Heritage Experts
7	Safety railings, child-safe zones near school, crowd management arrangements	Kerala Police, Traffic Police, School Authorities
8	Installation and management of amenities: water ATMs, waste bins, street seating, "Take-a-Break" facility	Haripad Municipality, Kudumbashree / SHG Operators
9	Temple precinct coordination, festival circulation planning, cultural integration	Haripad Subrahmanya Swamy Temple Devaswom (Travancore Devaswom Board)
10	Environmental clearance, tree planting, biodiversity integration	Kerala Forest Department, Haripad Municipality
11	Vendor management, shop façade regulation, commercial activity coordination	Haripad Municipality, Town Planning Wing, Local Merchant Associations

5) Suggested Implementation Mechanism

The Haripad Kshethra Veedhi redevelopment should follow a phased and carefully coordinated implementation process, given its cultural sensitivity and proximity to major religious and institutional nodes. The project may be executed through a joint framework led by Haripad Municipality, with technical support from the Town & Country Planning Department (TCPD) and engineering oversight from PWD (Roads). Initial steps include detailed site surveys, preparation of a streetscape design and façade control plan by a qualified urban design consultant, and sequential execution beginning with underground utilities, drainage improvements, and vendor relocation.

Relocation of street vendors to designated vending zones should be carried out in coordination with Kudumbashree, ensuring livelihood protection and compliance with the Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act. Streetscape works - footpaths, cycle tracks, railings, tree planting, lighting, and amenity installation - should follow the utility upgrades to avoid rework. The temple-facing design elements must be finalized through consultation with the Travancore Devaswom Board to respect cultural norms and

festival circulation. Continuous monitoring by the Municipality, with regular stakeholder meetings, will ensure smooth implementation and conflict resolution.

6) Other Associated Issues to be addressed

Given the heritage and religious importance of the Kshethra Veedhi, several associated issues must be addressed during implementation. Heritage sensitivity is paramount, requiring careful control over building façades, signage, and construction practices to maintain the visual axis toward the Haripad Subrahmanya Swamy Temple and ensure architectural coherence. Dust, noise, and debris during construction must be managed through protective barriers - especially near the school, temple precinct, and residential buildings.

Crowd management and traffic control are critical due to temple festivals and daily pilgrim flow. Temporary circulation plans, pedestrian diversions, and safety barricades must be coordinated with Kerala Police and Traffic Police. The relocation of street vendors may face social resistance and therefore requires transparent communication, fair allocation of vending spaces, and strong municipal enforcement to prevent re-encroachment.

The road's proximity to dense commercial establishments necessitates strict supervision to avoid utility disruptions, unauthorized parking, or informal stalls returning to the corridor. Rainwater drainage upgrades must consider monsoon flooding patterns typical to Kerala. Coordination with KSEB, KWA, and PWD is essential to avoid conflicts with ongoing pipeline or electrical maintenance works. Finally, long-term maintenance responsibilities - particularly for street furniture, lighting, and plantation - must be clearly assigned to ensure the corridor remains vibrant, safe, and culturally aligned with Haripad's identity.

7) Project Cost and Period

Table 36.31: Project Cost Estimate for Haripad Kshethra Veedhi - Temple Road Redevelopment

Project Cost Estimate - Haripad Kshethra Veedhi - Temple Road Redevelopment		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Site preparation, vendor relocation & temporary	25
2	Roadway improvements (carriageway resurfacing, drainage upgrades)	40
3	Dedicated pedestrian footpath with tactile paving	55
4	Bicycle track & cycle stands	20
5	Protective pedestrian railings (school stretch + temple approach)	18
6	Traditional architectural façade improvements & signage control	45
7	Street lighting (traditional-themed solar/hybrid lights)	30
8	Street furniture (seating, shade pavilions, bollards)	22
9	Landscaping & tree planting (avenue plantation, planters)	15
10	Water ATMs, drinking water kiosks & waste receptacles	12
11	Tourist helpdesk / crowd management booths	10
12	"Take a Break" facility	15
13	Utility shifting (KSEB, KWA, telecom)	20
14	Paid parking area development (adjacent identified plots)	30
15	Contingency & price escalation (10%)	35

** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*

Total Estimated Cost would be approx. 3.92 Crores

Table 36.32: Project Duration for Haripad Kshethra Veedhi - Temple Road Redevelopment

Project Duration - Haripad Kshethra Veedhi - Temple Road Redevelopment			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Preparatory Stage	Detailed topographic survey, traffic diversion planning, stakeholder consultations, finalizing vendor relocation plan	1 month
2	Utility Coordination & Shifting	Relocation of KSEB lines, KWA pipelines, telecom cables; temporary access arrangements	1 month
3	Road & Drainage Works	Road resurfacing, drainage upgrades, kerb works, pedestrian pathway sub-base preparation	2 months
4	Streetscape & Mobility Infrastructure	Footpaths with tactile paving, bicycle track construction, protective railings, signage & markings	2 months
5	Urban Design & Architectural Integration	Façade treatments, traditional lighting installation, street furniture, landscaping	2 months
6	Amenities & Public Facilities	Water ATMs, "Take a Break" kiosk, tourist helpdesk, waste receptacles, cycle stands	1 month
7	Finishing, Testing & Commissioning	Quality checks, lighting & safety audits, vendor resettlement, final cleaning & handover	1 month

** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*

The overall duration required for installation of one unit would be around 10-12 months

36.4.8 Pilgrim Amenities Centre

1) Project Brief



The Pilgrim Amenities Centre is proposed near the Haripad Subrahmanya Swamy Temple, strategically located at the junction between the temple and the temple pond - an area that experiences high pilgrim movement throughout the day. The project envisions a compact yet well-designed support facility that provides essential amenities to pilgrims in an organized, hygienic, and culturally appropriate manner. Designed in the traditional Kerala vernacular style with sloping tiled roofs, laterite/wooden detailing, and climate-responsive features, the centre aims to elevate the visitor experience and reduce congestion around the temple precinct.

Need for the Project

Haripad Subrahmanya Swamy Temple attracts a significant number of devotees daily, and footfall increases substantially during festivals, vratas, and special pujas. Currently, essential pilgrim-support services such as shoe racks, cloak storage, drinking water access, waste management, and resting pockets are insufficient or scattered, resulting in congestion, unsafe pedestrian movement, and compromised pilgrim comfort. The Pilgrim Amenities Centre addresses these gaps by creating a consolidated, well-managed, accessible, and culturally sensitive service hub that enhances both pilgrim convenience and temple precinct management.

Aim of the Project

The primary aim of the Pilgrim Amenities Centre is to create an integrated and aesthetically coherent public facility that supports the basic functional needs of pilgrims while reinforcing the cultural identity and visual integrity of the Haripad temple precinct. The project seeks to organize pilgrim services, improve hygiene standards, enhance safety, and contribute to a more pleasant and efficient spiritual experience.

Project Objectives

- To provide organized, accessible, and hygienic facilities for shoe storage, cloak keeping, mobile deposit, and dress changing.
- To reduce clutter and encroachment near temple entrances by relocating scattered amenities into a unified center.
- To enhance pedestrian safety and flow within the high-footfall temple precinct.
- To incorporate traditional Kerala architectural vocabulary that complements the temple complex.
- To ensure the availability of essential utilities such as drinking water, seating, sanitation, and waste management.
- To improve the overall visitor experience, especially during peak pilgrimage seasons and festivals



Figure 36.21 : Existing condition of site chosen for Piligrim Amenities Centre

2) Location and Ownership

The Piligrim Amenities Centre is located at the junction between Haripad Subramanya Swamy Temple and temple pond.

Land Ownership	Travancore Devaswom Board
Ward Number	26
Project Area	0.07 Acre
Survey Number	175(p)



Figure 36.22: Location of Proposed Pilgrims Amenities Centre

3) Project Components

The various components that will form part of the project include:

1. Architectural Building Block (Traditional Kerala Style):
   - Sloping tiled roof, timber/wood-like detailing, laterite/mud-finish walls, raised plinth for flood resilience.
2. Pilgrim Support Facilities:
   - Dedicated shoe racks with organized storage bays.
   - Cloak room facility with secure locker systems.
   - Mobile phone deposit counters, CCTV-monitored.
   - Dress changing rooms (male and female), with proper ventilation.
   - Drinking water kiosks/Water ATMs.
   - Resting benches and shaded waiting pockets.
3. Public Health & Convenience Amenities:
   - Handwash counters, sanitary bins, and waste receptacles.
   - Filtered drinking water points, bottle-refill stations.
   - First-aid kiosk for emergencies (optional).
4. Site Development & Landscape Features:
   - Paved pedestrian-friendly access paths.
   - Planters, low-maintenance shrubs, and shaded zones.
   - Traditional street lighting for aesthetics and safety.
   - Clear directional signages and wayfinding elements.
5. Safety & Operational Components:
   - CCTV surveillance and basic security post.
   - Fire safety equipment, emergency exits.
   - Provision for future expansion if required during festival seasons.



Figure 36.23 : Conceptual view of Proposed Pilgrim Amenities Centre

4) Agencies Responsible

Table 36.33 : Agencies responsible for Pilgrim Amenities Centre

Agencies responsible for Pilgrim Amenities Centre		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project ownership, approvals, coordination	Haripad Municipality
2	Temple precinct coordination, cultural compliance, space allocation	Travancore Devaswom Board (TDB)
3	Architectural design, layout planning, traditional-style building design	Appointed Architectural Consultancy Firm
4	Civil construction, utility installation, interior fit-out	Accredited Contractors (experience in Kerala traditional architecture preferred)
5	Water supply, drinking water kiosk connection and certification	Kerala Water Authority (KWA)
6	Electricity supply, traditional lighting systems, backup arrangements	Kerala State Electricity Board (KSEB)
7	Sanitation systems, waste receptacles, cleaning & maintenance	Haripad Municipality - Health & Sanitation Wing

8	Fire safety clearances and emergency preparedness	Kerala Fire & Rescue Services
9	Security, crowd management, access control	Kerala Police + Temple Security Personnel
10	Operations & maintenance, staffing (cloakroom, shoe racks, etc.)	Haripad Municipality / Kudumbashree SHGs (as O&M partners)
11	Tourism information integration, signage, visitor support	Department of Tourism, DTPC Alappuzha

5) Suggested Implementation Mechanism

The Pilgrim Amenities Centre should be implemented through a coordinated, multi-agency approach led by Haripad Municipality in consultation with the Travancore Devaswom Board (TDB) and the Haripad Subrahmanya Swamy Temple Advisory Committee. A detailed architectural design and technical DPR must be prepared by an accredited consultant with expertise in traditional Kerala architecture and public-amenity planning.

Land ownership verification and statutory approvals (including Kerala Municipality Building Rules, Fire & Safety, and PWD utilities clearance) should be secured prior to tendering. Construction may be undertaken through a competitive tendering process under municipal supervision, with periodic review meetings involving TDB representatives to ensure cultural compatibility and operational relevance.

Post-completion, the centre should be managed through a Municipality - Devaswom co-management model, with Kudumbashree or trained local staff handling day-to-day operations such as cloakroom management, cleaning, security, and visitor support. Digital ticketing/locker systems and CCTV monitoring should be incorporated for efficient management and transparency.

6) Other Associated Issues to be addressed

Given the building's proximity to the temple, strict adherence to heritage-sensitive design practices is essential to maintain visual harmony with the sacred precinct. Construction activities must be carefully managed to avoid noise, dust, or disruptions during temple rituals, festivals, or high-footfall periods. Adequate protective barriers and dust-control measures should be installed to safeguard nearby structures and the temple pond from debris contamination.

Security concerns such as misuse of cloak facilities, vandalism, illegal parking, and crowding near the entrance must be addressed through CCTV surveillance, controlled access points, proper lighting, and police/Devaswom coordination during peak periods. Provision for universal accessibility, including wheelchair-friendly pathways, tactile indicators, and gender-inclusive facilities, should be ensured. Integration with existing water supply lines, sewage systems, and waste-collection routes must be coordinated with the Kerala Water Authority (KWA) and Haripad Municipality Health Wing to avoid operational conflicts.

Finally, the temple's unique crowd patterns - especially during festivals like Chithira, Avani, and Ayyappa season - must be factored into the design to ensure that the facility supports efficient pilgrim movement and does not create congestion near the temple entrance.

7) Project Cost and Period

Table 36.34: Project Cost Estimate for Pilgrim Amenities Centre

Project Cost Estimate - Pilgrim Amenities Centre		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Site preparation, compound wall, levelling & basic utilities	8.00
2	Construction of Pilgrim Amenities Building (traditional Kerala architecture) - structure, roofing, finishes	38.00
3	Cloakroom, shoe racks, secure mobile-phone deposit counters	6.50
4	Washrooms, dress-changing rooms & sanitation block	10.00
5	Drinking water kiosk & water ATM installation	4.00
6	Waste receptacles, signage, notice boards & queue management elements	2.50
7	Landscaping, paving, planters & shaded seating	5.00
8	Lighting (traditional-style poles & LED fixtures) & electrical works	4.50
9	CCTV surveillance & security systems	2.50
10	Contingencies (5%)	4.00
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 80 Lakhs

Table 36.35: Project Duration for Pilgrim Amenities Centre

Project Duration - Pilgrim Amenities Centre			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Pre-Construction Phase	Site survey, approvals from Municipality & Devaswom Board, design finalization, tendering	2 months
2	Construction Phase	Civil works, structural construction, roofing (traditional Kerala style), internal partitions & flooring	4 months
3	Infrastructure & MEP Works	Electrical, plumbing, sanitation block installation, lighting, water kiosk setup	2 months
4	Amenity Installation	Shoe racks, cloak facilities, mobile deposit counters, seating, signage, waste bins	1 month
5	Landscaping & External Works	Pathways, planters, paving, shaded seating areas	1 month
6	Testing & Commissioning	Utility testing, safety checks, CCTV installation, final inspection	1 month
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 6-8 months

36.4.9 Haripad Cultural centre- Haripad Kottaram Premise Redevelopment

1) Project Brief



The Haripad Cultural Centre project envisions the holistic conservation and adaptive reuse of the historic Haripad Kottaram - an Ettukettu palace complex located directly opposite the Haripad Subramanya Swamy Temple. Currently in a deteriorated condition and underutilized despite its immense heritage value, the premise offers significant potential to become a cultural, artistic, and community-oriented landmark. The project proposes to restore the existing heritage structures, reorganize the site layout, and introduce compatible new facilities that together create a vibrant cultural hub supporting tourism, performing arts, community gatherings, and heritage education.

Need for the Project

Haripad Kottaram, with its Ettukettu structure and traditional spatial typology, is a significant cultural asset that is presently in a dilapidated state, posing a risk of heritage loss. Its strategic location opposite the Haripad Subramanya Swamy Temple makes it a prime anchor for cultural tourism. Inadequate maintenance, lack of functional spaces, and the presence of temporary structures (such as the elephant stable) limit its potential. Redeveloping the premise is critical to safeguard the heritage complex, enhance the religious - cultural tourism circuit, offer meaningful public spaces, and generate economic opportunities through cultural programming and tourism-based activities.

Aim of the Project

The primary aim of the project is to transform the Haripad Kottaram premise into a dynamic cultural centre that preserves Haripad's architectural heritage while providing modern, functional spaces for cultural performances, community activities, and tourism services. The project intends to create a multi-use cultural campus that acts as a gateway to Haripad's tradition, art, craft, and temple culture..

Project Objectives

- Heritage Conservation: Restore and conserve the Ettukettu and auxiliary structures using appropriate conservation practices and traditional materials.
- Adaptive Reuse: Convert the Ettukettu into a cultural museum, interpretation centre, and performance space showcasing Haripad's history, rituals, and art traditions.
- Cultural Infrastructure Development: Create modern yet contextually sensitive facilities to support cultural performances, events, learning workshops, and community activities.
- Tourism Enhancement: Provide visitor-centric amenities and curated cultural experiences to strengthen Haripad's temple and heritage tourism network.
- Community Engagement: Establish the Cultural Centre as a town-level gathering space fostering local arts, crafts, and cultural entrepreneurship.



Figure 36.24 : Existing condition of Haripad Kottaram

2) Location and Ownership

The Haripad Cultural Centre is proposed in the current premise of Haripad Kottaram. This has been demarcated as a Special Zone in the Proposed Land Use Map for Haripad Town.

Land Ownership	Government
Ward Number	6
Project Area	0.96 Acre
Survey Number	165-11



Figure 36.25 : Location of proposed Haripad Cultural Centre

3) Project Components

1. Heritage Conservation & Restoration
   - Structural consolidation and architectural conservation of the Ettukettu.
   - Restoration of timber elements, roofing tiles, verandahs, and courtyards.
   - Conservation-oriented MEP retrofitting (wiring, lighting, drainage).
2. Adaptive Reuse & Interior Reconfiguration
   - Cultural Museum & Interpretation Centre showcasing temple rituals, Haripad history, art forms, and heritage exhibits.
   - Indoor performance hall for classical music, dance, and ritual arts.
   - Curated exhibition spaces for traditional crafts, artefacts, and documentaries.
3. New Cultural Infrastructure
   - Open-air amphitheatre for public performances, festivals, and community programs.
   - Multi-purpose community hall for events, workshops, and rentals.
   - Workshop studios for Kalamezhuthu, mural art, mask-making, craft training etc.
   - Souvenir shops promoting local artisans.
   - Traditional restaurant/refreshment court serving local cuisine.
   - Tourist information & facilitation centre with digital kiosks.
4. Site Development & Public Realm Enhancement
   - Redesigned internal circulation with paved walkways.
   - Landscaped gardens with native flora and shaded seating areas.
   - Bicycle parking and rental points.
   - Dedicated area for the temple elephant (relocated to a structurally appropriate enclosure, if required).
   - Safe pedestrian access from the temple road.
   - Waste management systems and public conveniences.
   - Decorative lighting and signage aligned with traditional Kerala aesthetics.
5. Visitor Amenities & Support Systems
   - Drinking water kiosks, "Take a Break" facilities, cloakroom, mobile deposit counter.
   - CCTV-based security system and visitor management.

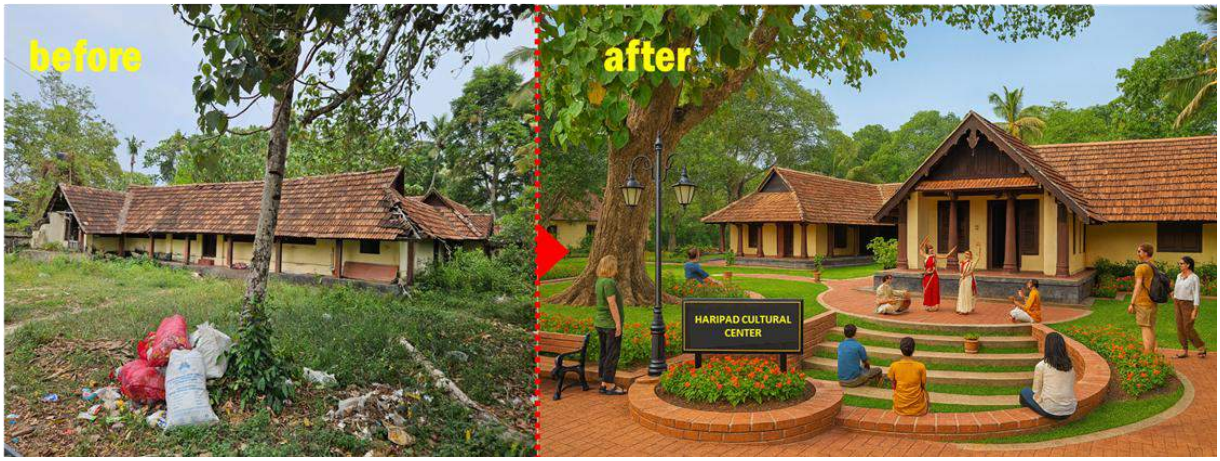


Figure 36.26: Conceptual view of Haripad Cultural Centre (Haripad Kottaram Redevelopment)



Figure 36.27: Conceptual views of Haripad Cultural Centre (Haripad Kottaram Redevelopment)

4) Agencies Responsible

Table 36.36 : Agencies responsible for Haripad Cultural Centre (Haripad Kottaram Redevelopment)

Agencies responsible for Haripad Cultural Centre (Haripad Kottaram Redevelopment)		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project ownership, coordination, approvals	Haripad Municipality
2	Heritage conservation oversight, technical guidance	Department of Archaeology, Kerala; Conservation Architects

3	Structural assessment and restoration engineering	Accredited Structural Engineering Consultants
4	Architectural design, master planning, adaptive reuse planning	Selected Architectural Consultancy Firm
5	Execution of civil, restoration, and new construction works	Accredited Contractors experienced in heritage restoration
6	Tourism programming, cultural activation, event coordination	Kerala Tourism Department; DTPC Alappuzha
7	Temple-related coordination and heritage integration	Travancore Devaswom Board (TDB)
8	Landscaping, horticulture, and site beautification	Haripad Municipality; Kerala Forest Department (for native species)
9	Electrical, lighting, communication & safety systems	KSEB; Fire & Rescue Services; Approved Electrical Contractors
10	Operations & maintenance post-completion	Haripad Municipality; Cultural Centre Management Committee
11	Security, crowd management, and protection of assets	Kerala Police; Municipality Enforcement Wing
12	Funding facilitation and scheme alignment	State Planning Board; Department of Local Self Government (LSGD); AMRUT/KSUDP (if applicable)

5) Suggested Implementation Mechanism

The Haripad Cultural Centre project should be implemented through a phased and conservation-led approach coordinated by the Haripad Municipality in partnership with the Travancore Devaswom Board (TDB), Department of Archaeology, and accredited heritage architects. The initial phase should include detailed condition assessment, heritage documentation, and structural audit of the existing Ettukettu, followed by preparation of a Conservation Plan adhering to Kerala's heritage conservation guidelines and Kerala Municipality Building Rules (KMBR).

Execution should be carried out through empanelled contractors experienced in traditional timber construction and lime-based restoration techniques, with periodic technical supervision by conservation specialists. New buildings and cultural infrastructure should be implemented through a tender-based EPC framework ensuring contextual design, structural safety, and environmental sensitivity.

A dedicated Project Steering Committee - with representatives from the Municipality, TDB, Kerala Tourism Department, KIIFB, and local cultural organizations - should oversee project approvals, progress monitoring, and stakeholder coordination. Long-term operation and management may be handled through a Public - Public partnership between the Municipality and TDB, or via a Tourism Promotion Society to ensure professional programming, maintenance, and revenue generation.

6) Other Associated Issues to be addressed

Given the heritage significance of the Ettukettu and the palace precinct, a comprehensive conservation approach is essential to prevent irreversible architectural loss. All restoration works must minimize vibrations, avoid heavy machinery near fragile structural elements, and strictly control dust, debris, and moisture exposure. Protective screening, material staging areas, and controlled demolition protocols should be mandated during construction of new blocks within the premises.

The site's proximity to the Haripad Subramanya Swamy Temple and the high pilgrim footfall necessitate robust crowd management, traffic regulation, and safe pedestrian pathways during both construction and operation phases. Risks of vandalism, unauthorized entry, illegal parking, and misuse of the open areas must be addressed through CCTV surveillance, on-site security personnel, and coordination with the Police and Devaswom security teams.

Environmental considerations - including stormwater management, tree preservation, proper elephant enclosure relocation (if retained), noise control during cultural events, and responsible waste handling - must be incorporated into the design. Coordination with departments like Kerala Water Authority, KSEB, and PWD is crucial to avoid conflicts during utility upgrades and ensure seamless service integration.

Finally, meaningful community engagement is necessary to address concerns of local residents, temple authorities, cultural groups, and artisans, ensuring that the redeveloped Cultural Centre remains inclusive, culturally sensitive, and strongly rooted in Haripad's identity.

7) Project Cost and Period

Table 36.37: Project Cost Estimate for Haripad Cultural centre (Haripad Kottaram Premise Redevelopment)

Project Cost Estimate - Haripad Cultural centre (Haripad Kottaram Premise Redevelopment)		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Structural conservation & restoration of Ettukettu (roof, timber, flooring, façade, verandahs)	180
2	Restoration of outhouse structures	45
3	Construction of new Cultural Centre block (museum galleries, halls, amenities)	220
4	Open-air amphitheatre & performance court	120
5	Tourist information centre & reception pavilion	35
6	Traditional restaurant & café block	60
7	Souvenir shop cluster & artisan kiosks	35
8	Bicycle parking, rental bay & mobility infrastructure	20
9	Landscaping, gardens, paved walkways, water features	90
10	Internal pathways, signage & wayfinding system	25
11	Electrical systems, solar lighting & power backup	35
12	Plumbing, sanitation & drainage upgrades	30
13	Safety, surveillance & site security systems	18
14	Boundary wall enhancement & heritage-style entrance	40
15	Miscellaneous works, contingencies & statutory approvals	47

** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*

Total Estimated Cost would be approx. 10 Crores

Table 36.38: Project Duration for Haripad Cultural centre (Haripad Kottaram Premise Redevelopment)

Project Duration - Haripad Cultural centre (Haripad Kottaram Premise Redevelopment)			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Pre-Construction	Detailed documentation of heritage structures, condition assessment, architectural conservation study, stakeholder consultations, statutory approvals	3 months
2	Structural Restoration	Conservation works for Ettukettu & outhouse (roof, timber, flooring, façade stabilization)	6 months
3	New Construction Works	Construction of Cultural Centre block, amphitheatre, tourist info centre, restaurant block, artisan kiosks	8 months
4	Site Development & Infrastructure	Landscaping, pathways, lighting, drainage, mobility infrastructure, safety systems	4 months
5	Interior Works & Fit-Outs	Museum interiors, gallery displays, furnishing, signage & wayfinding, ICT and AV setup	3 months
6	Testing & Commissioning	Utilities testing, finishing checks, accessibility verification, trial operations	1 month
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 25 months

36.4.10 Haripad Vinoda Veedhi - Haripad Temple to Mannarasala Temple Road Redevelopment

1) Project Brief



Haripad Vinoda Veedhi - Haripad Temple to Mannarasala Temple Road Redevelopment is envisioned as a culturally vibrant, pedestrian-friendly corridor linking the Haripad Subramanya Swamy Temple to the Mannarasala Nagaraja Temple via TPN Junction. Spanning approximately 1.2 km, the project aims to create a scenic, safe, and well-designed walkway that enhances pilgrim experience, improves urban mobility, and uplifts the overall character of this important cultural spine. The intervention includes upgraded footpaths, street furniture, heritage-inspired lighting, dedicated vending zones, junction improvements, pond rejuvenation, and systematic pedestrian infrastructure. Designed as Haripad's flagship cultural tourism corridor, the project

reorganizes movement patterns, strengthens public spaces, and highlights the heritage significance of the town's temple district.

Need for the Project

The existing corridor is unable to support the heavy pedestrian and pilgrim movement during festivals and peak temple hours. Narrow stretches, encroachments, poor lighting, and lack of dedicated walking paths affect safety and comfort. Given that the road connects multiple major cultural landmarks - including Haripad Subramanya Swamy Temple, the temple pond, the proposed Haripad Cultural Centre, and Mannarasala Temple - upgrading this corridor is essential to strengthen Haripad's position as a prominent cultural tourism destination.

Aim of the Project

The aim of Haripad Vinoda Veedhi is to transform the temple-to-temple stretch into a safe, accessible, and aesthetically rich pedestrian corridor that offers a comfortable walking experience for pilgrims and residents. By improving pathways, public spaces, and supporting amenities, the project seeks to strengthen the cultural identity of the area and promote sustainable, people-centred mobility.

Project Objectives

- To create a continuous, barrier-free pedestrian walkway with seating, lighting, and street furniture.
- To enhance the cultural character of the corridor through landscaping, hardscaping, and heritage-sensitive design.
- To rejuvenate the Subramanya Swamy Temple Pond and create recreation space around it.
- To redevelop Tutu (TPN) Junction to ensure safe pedestrian crossings and smoother movement.
- To manage crowds effectively by widening minor temple-side roads and removing roadside encroachments.
- To introduce dedicated street vending zones that support livelihoods without obstructing pedestrian flow.
- To improve overall mobility, safety, and wayfinding through signage, road markings, and lighting.



Figure 36.28 : Existing Condition of Haripad Vinoda Veedhi

2) Location and Ownership

The Haripad Vinoda Veedhi is proposed from Haripad Subramanya Swamy Temple to Mannarasala Temple via TPN Junction.

Land Ownership	Road owned by Muniapiality & PWD. Land on sides are partly private owned and partly government land.
Ward Number	28, 29, 6, 3
Project Area	2.22 Acres
Survey Number	165-11



Figure 36.29: Location of Haripad Vinoda Veedhi

3) Project Components

- Widening of Road to 12m.
- Designed pedestrian footpaths with seating, pavilions, safety railings, barrier-free ramps.
- Traditional street lighting, ambient lighting, and energy-efficient fixtures.
- Landscaping and hardscaping, including planter beds and shaded resting pockets.
- Rejuvenation of Haripad Subramanya Swamy Temple Pond and jogging track development.
- Redevelopment of Tutu (TPN) Junction with improved traffic management and pedestrian safety.
- Widening of minor access roads around the temple for better crowd handling.
- Relocation of encroachments along the temple approach road.
- Dedicated street vending zones with designed kiosks.

- Parking reorganization, including removal of on-street parking near temple pond.
- Tourism-oriented signage, wayfinding boards, and road markings.
- Smart waste receptacles and street-side amenities.



Figure 36.30 : Conceptual view of Haripad Vinoda Veedhi

4) Agencies Responsible

Table 36.39 : Agencies responsible for Haripad Vinoda Veedhi

Agencies responsible for Haripad Vinoda Veedhi		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project planning, coordination, monitoring	Haripad Municipality; Project Management Unit (PMU)
2	Detailed design preparation, drawings, and technical specifications	DPR Consultant / Urban Design Team; NATPAC (as advisory for mobility)
3	Land assessment, identification of encroachments, and relocation facilitation	Haripad Municipality; Revenue Department; Local Police (for enforcement support)
4	Road widening, pavement construction, and streetscape development	PWD (Roads Division); Contractor / Civil Works Agency
5	Temple pond renovation, walkway and jogging track development	Haripad Municipality; Irrigation Department; Temple Devaswom / Temple Management Committee
6	Street lighting installation (traditional and energy-efficient lighting)	KSEB; Haripad Municipality
7	Landscaping, hardscaping, and creation of pavilions, seating, and aesthetic elements	Haripad Municipality; Department of Tourism; Horticulture Department
8	Traffic management measures including signages, road markings, pedestrian safety elements	PWD; Motor Vehicles Department (MVD); Traffic Police
9	Provision and demarcation of dedicated street vending zones	Haripad Municipality; Kudumbashree / Local Vendors' Associations
10	Utility coordination (water lines, electricity, drainage, telecom)	Kerala Water Authority (KWA); KSEB; BSNL/Telecom Service Providers
11	Waste management facilities including bins and maintenance plan	Haripad Municipality (Health & Sanitation Wing)
12	Construction supervision, quality control, and safety audits	PMU; Third-Party Quality Audit (TPQA) Agency
13	Community engagement and grievance redressal	Haripad Municipality; Ward Committee; Local Stakeholder Groups
14	Project financing and fund allocation	Haripad Municipality; State Government Departments (LSGD / Tourism); Possible CSR Partners

5) Suggested Implementation Mechanism

The redevelopment of Haripad Vinoda Veedhi should be executed through a phased and coordinated implementation strategy led by the Haripad Municipality. Initial activities must include detailed topographic surveys, traffic and pedestrian flow studies, and architectural/streetscape design preparation by an empanelled consultant with expertise in Kerala's traditional urban character. The design should be validated through consultative meetings with the Travancore Devaswom Board (TDB), Mannarasala Temple authorities, and local community stakeholders, ensuring cultural sensitivity and smooth integration with pilgrim movements.

Once the DPR (Detailed Project Report) is finalized, construction should be implemented through tendered EPC contracts, with strict adherence to quality, safety, and heritage-friendly materials. Works such as utility shifting, drainage improvement, and streetlight installation should be coordinated with KWA, KSEB, BSNL, and the Municipality's engineering division to avoid service disruptions. Streetscape components - pedestrian walkways, cycle tracks, signage, and lighting - should be completed in stages to maintain uninterrupted temple access, especially during festival seasons. A dedicated Project Monitoring Committee consisting of municipal officials, PWD representatives, temple authorities, and local residents should oversee progress and resolve site-level issues. Post-completion, the corridor's upkeep may be managed through a Municipality, Kudumbashree O&M model, ensuring cleanliness, maintenance, and visitor support.

6) Other Associated Issues to be addressed

Redeveloping this culturally significant corridor requires careful management of multiple sensitivities and operational challenges. As the road serves large numbers of pilgrims during peak Mandala-Makaravilakku season and Mannarasala Ayilyam, construction sequencing must minimize disruptions, with no heavy works scheduled during major temple festivals. The introduction of uniform façade guidelines could face resistance from private property owners, necessitating participatory consultations, incentives, and clear regulatory guidance.

Given the corridor's semi-rural setting with patches of vegetation, encroachments, and informal vending zones, issues such as vendor relocation, prevention of re-encroachment, and proper enforcement must be addressed through municipal and police coordination. Safety risks also exist due to narrow stretches and temple crowds, requiring traffic calming measures, dedicated pedestrian zones, bollards, and improved lighting

Environmental concerns such as tree protection, dust management, and noise pollution during construction must be regulated through contractor compliance with Kerala State Pollution Control Board norms. Periodic monitoring should ensure that traditional architectural elements are executed authentically and that new materials do not compromise the heritage ambiance. Long-term sustainability will require a structured O&M plan involving municipal engineering staff, Kudumbashree units, and local temple bodies to maintain cleanliness, regulate signage, and manage visitor amenities.

7) Project Cost and Period

Table 36.40: Project Cost Estimate for Haripad Vinoda Veedhi

Project Cost Estimate - Haripad Vinoda Veedhi		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**

1	Road redevelopment & geometric improvements (1.2 km)	350
2	Designed pedestrian footpath with seating & resting zones	180
3	Pavilions, safety railings & shaded structures	120
4	Traditional street lighting & electrical infrastructure	150
5	Signages, tourist information boards & road markings	60
6	Landscaping & hardscaping along corridor	140
7	Renovation of Haripad Subramanya Swamy Temple Pond	200
8	Redevelopment of Tutu Junction (TPN Junction)	100
9	Jogging track around temple pond	75
10	Relocation of encroachments & minor road widening	90
11	Dedicated street vending zone development	80
12	Dedicated parking grounds & removal of existing pond-side parking	130
13	Utility shifting, stormwater drainage & miscellaneous works	125
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 18 Crores

Table 36.41: Project Duration for Haripad Vinoda Veedhi

Project Duration - Haripad Vinoda Veedhi			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Pre-construction Phase	Land surveys, stakeholder consultation, utility mapping, approvals, tendering	2 months
2	Site Preparation & Encroachment Removal	Clearing, temporary traffic arrangements, relocation of affected vendors/structures	1.5 months
3	Road Widening & Infrastructure Works	Road excavation, base preparation, drainage upgrades, widening works	4 months
4	Footpath, Railings & Streetscape Works	Footpath construction, pavilions, traditional lighting, street furniture, vending zone setup	3 months
5	Temple Pond Renovation & Jogging Track	Desilting, wall strengthening, jogging track construction, pond beautification	2.5 months
6	Junction Redevelopment (TPN Junction)	Layout reorganization, traffic safety features, surface improvement	1 month
7	Finishing & Commissioning	Road marking, signage installation, testing of lighting, landscaping	1 month
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 17-20 months

36.4.11 Haripad Temple Pond (Perumkulam) Renovation

1) Project Brief



The Haripad Temple Pond (Perumkulam) Renovation project aims to restore, conserve, and enhance one of the most culturally and spiritually significant water bodies in Haripad. Located adjacent to the Haripad Subramanya Swamy Temple, Perumkulam is integral to temple rituals, festivals, and everyday spiritual practices. However, prolonged siltation, structural degradation, poor edge conditions, and insufficient public amenities have impacted its functional and cultural value.

This project proposes a comprehensive, heritage-sensitive renovation that improves water quality, strengthens structural components, enhances public access, and transforms the pond precinct into an attractive, serene, and culturally rooted urban space for pilgrims, tourists, and local residents.

Need for the Project

Perumkulam has experienced significant silt accumulation, weakened retaining structures, water quality deterioration, vandalism and outdated access infrastructure. During festival seasons, inadequate seating, lighting, and circulation space cause discomfort and safety risks for pilgrims. As a prominent heritage waterbody, its degradation affects the sanctity of temple rituals and undermines the visual and cultural character of the temple precinct. Renovation is essential to restore ecological balance, ensure structural stability, improve public access, and safeguard the pond's religious significance for future generations.

Aim of the Project

The aim of the project is to rejuvenate Perumkulam into a structurally sound, environmentally healthy, and aesthetically enriched temple pond that reinforces the cultural and spiritual ambience of the Haripad Temple precinct. The renovation seeks to create a welcoming public realm that supports ritual activity, improves visitor amenities, and strengthens Haripad's identity as a major temple town.

Project Objectives

- To restore the structural integrity of the pond through strengthening and reconstruction of retaining walls, steps, and edge treatments.
- To improve water quality through desilting, aeration systems, and ecological enhancement measures.
- To enhance the heritage and spiritual ambience using traditional Kerala architectural elements and materials.
- To improve accessibility, safety, and comfort for pilgrims and visitors through upgraded pathways, seating, lighting, and signage.
- To create a vibrant and serene public space that supports temple rituals, cultural activities, and daily community use.

2) Location and Ownership

Haripad Temple Pond is located close to the Haripad Subramanya Swamy Temple.

Land Ownership	Travancore Dewasom Board
Ward Number	28
Project Area	4.85 Acres
Survey Number	176



Figure 36.31: Location of Haripad Temple Pond (Perumkulam)

3) Project Components

1. Pond Restoration Works
   - Comprehensive desilting and cleaning of the pond bed.
   - Strengthening/reconstruction of retaining walls, ghats, and stepped access.
   - Stone pitching for long-term stability.
   - Installation of water circulation/aeration systems to improve water quality.
2. Edge and Surrounding Area Improvements
   - Paved access pathways and circumambulatory walkways (pradakshina paths).
   - Barrier-free access ramps for elderly and differently-abled visitors.
   - Shaded seating areas, mandapas/pavilions with Kerala-style timber detailing.
   - Well-placed waste receptacles and water ATMs.
   - Traditional Kerala-style lighting for enhanced safety and aesthetics.
   - Landscape enhancements including native trees, flowering species, and planters.
3. Pilgrim Amenities
   - Resting spaces and shaded seating zones.
   - Drinking water kiosks.

- Shoe racks and small utility kiosks (as appropriate).
- Crowd management railings for festival days.

4. Heritage & Cultural Enhancements
   - Traditional stone/wood signage and wayfinding structures.
   - Preservation of sightlines towards the temple gopuram and sacred elements.
   - Interpretive panels narrating the cultural history of the pond.
5. Safety & Environmental Management
   - Stormwater inlet protection and silt traps.
   - LED pathway lighting and CCTV surveillance.
   - Robust maintenance-friendly drainage and waste systems.



Figure 36.32 : Conceptual view of Haripad Temple Pond (Perumkulam) renovation

4) Agencies Responsible

Table 36.42 : Agencies responsible for Haripad Temple Pond (Perumkulam) Renovation

Agencies responsible for Haripad Temple Pond (Perumkulam) Renovation		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, tendering, supervision, and quality control	Haripad Municipality
2	Structural assessment, conservation guidance, heritage-sensitive design	Department of Archaeology / Conservation Architects / Accredited Heritage Consultants
3	Religious coordination, ritual-use alignment, cultural oversight	Travancore Devaswom Board (TDB) / Temple Advisory Committee
4	Pond cleaning, desilting, retaining wall repair, civil works execution	Selected Contractor(s) under Municipal Supervision
5	Water quality testing, environmental compliance, ecological management	Kerala State Pollution Control Board (KSPCB) / Accredited Water Testing Labs
6	Landscape, lighting, signage & urban design interventions	Landscape Architects / Design Consultants

7	Electrical works, traditional lighting installation	KSEB (Kerala State Electricity Board) / Licensed Electrical Contractors
8	Safety, public access management, festival-time crowd control	Haripad Municipality + Local Police + Temple Authorities
9	Routine O&M post-completion (cleaning, lighting, landscaping upkeep)	Municipality / Kudumbashree Units / Contracted Facility Managers

5) Suggested Implementation Mechanism

The Haripad Temple Pond (Perumkulam) Renovation should follow a phased and heritage-sensitive implementation framework led by Haripad Municipality in coordination with the Travancore Devaswom Board (TDB). The project may begin with a detailed structural, hydrological, and heritage assessment undertaken by accredited conservation architects and engineers. Based on this, the Municipality can prepare a DPR and tender documents through a transparent procurement process.

Execution should be carried out by pre-qualified contractors with experience in pond restoration, traditional masonry, and public space development. Continuous coordination between the Municipality, TDB, and Kerala State Pollution Control Board (KSPCB) is essential to ensure environmentally compliant desilting, safe disposal of silt, and preservation of aquatic ecology. Electrical works for traditional lighting may be implemented through KSEB. Landscaping, access improvements, and amenities can be executed in parallel under professional supervision. Post-completion, routine maintenance can be entrusted to the Municipality, supported by Kudumbashree units for cleanliness and upkeep, ensuring long-term sustainability.

6) Other Associated Issues to be addressed

The project must address several critical concerns to ensure long-term success and cultural integrity. Given the pond's proximity to the Haripad Subramanya Swamy Temple, all works must be synchronized with temple ritual schedules, festival calendars, and crowd movement patterns to avoid disruptions. As a heritage-sensitive site, the project requires conservation-oriented decision-making, including the use of traditional materials, lime-based treatments, and non-invasive structural interventions to protect the pond's cultural character.

During construction, strict protocols must be implemented to manage dust, debris, noise, and water contamination, with KSPCB ensuring adherence to environmental standards. Safety measures must also account for high pedestrian and pilgrim footfall, requiring barricading, proper signage, and secure access routes. Additional concerns include preventing future pollution through waste disposal controls, monitoring stormwater inflow quality, and incorporating safeguards against nuisance activities, vandalism, and encroachment. Coordination with irrigation and PWD departments is needed to avoid conflicts with nearby drainage networks. Long-term success will depend on a dedicated strategy for maintenance, water quality monitoring, and community stewardship, ensuring the pond remains a vibrant cultural and ecological asset for Haripad.

7) Project Cost and Period

Table 36.43: Project Cost Estimate for Haripad Temple Pond (Perumkulam) Renovation

Project Cost Estimate - Haripad Temple Pond (Perumkulam) Renovation

Sl. No.	Component	Estimated cost (INR Lakhs)
1	Cleaning, Desilting & Dewatering of Pond	25.00
2	Strengthening/ Reconstruction of Retaining & Pitching Walls	60.00
3	Traditional Stone Steps (Ghats) & Access Improvements	35.00
4	Paved Walkways, Edge Treatment & Mandapa / Pavilion Structures	45.00
5	Landscaping, Shaded Seating Areas & Green Buffer Creation	25.00
6	Traditional Kerala-Style Lighting & Electrical Works	20.00
7	Water Quality Improvement Measures (Aerators, Filtration Units)	18.00
8	Safety Railings, Signages & Barrier-Free Access Features	12.00
9	Waste Receptacles, Drinking Water Kiosk & Basic Pilgrim Amenities	10.00
10	CCTV Surveillance & Security Enhancements	8.00
11	Contingency & Price Escalation (10%)	25.00
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 3.5 Crores

Table 36.44: Project Duration for Haripad Temple Pond (Perumkulam) Renovation

Project Duration - Haripad Temple Pond (Perumkulam) Renovation			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	**Pre-Construction Phase**	Site survey, condition assessment, structural evaluation, water testing, DPR finalisation, statutory clearances	**1.5 months**
2	**Pond Cleaning & Core Restoration**	Dewatering, desilting, sludge removal, pond bed leveling, waste disposal	**1.5 months**
3	**Structural Rehabilitation Works**	Retaining wall reconstruction, stone pitching, steps/ghat works, access improvements	**3 months**
4	**Public Realm & Amenity Works**	Walkways, mandapas/pavilions, landscaping, lighting, seating, safety railings	**2.5 months**
5	**Utilities & Finishing Works**	Water treatment/aeration systems, signage, amenities installation, final quality checks	**1 month**
6	**Handover & Commissioning**	Inspection, approvals, defect rectification, commissioning of all facilities	**0.5 months**
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 10-12 months

36.4.12 Mangrove Fringe along Canals and Agricultural Fields

1) Project Brief



The Mangrove Fringe along Canals and Agricultural Fields project is a climate-resilient ecological intervention proposed for the flood-prone agrarian belt of Haripad, particularly along the Achankovil river stretch and adjoining canal networks. Over the years, recurrent flooding, saline intrusion, bank erosion, and field degradation have led to a sharp decline in agricultural productivity and the collapse of traditional multi-crop farming cycles. This project aims to establish continuous, scientifically planned mangrove buffers along vulnerable canals, riverbanks, and field edges to enhance natural protection, stabilize soil, improve water quality, and revive biodiversity. By integrating ecological restoration with climate-adaptive agriculture, the initiative supports long-term livelihood security, environmental conservation, and disaster risk reduction.

Need for the Project

Haripad's agricultural lands have experienced severe vulnerability due to recurring flooding, tidal backflow, and gradual soil salinization, resulting in reduced yields and abandoned farmlands. The absence of vegetative buffers has accelerated erosion along canals and field boundaries. A scientifically designed mangrove fringe will serve as a low-cost, self-sustaining natural defense system that protects farmlands, enhances ecological productivity, supports fisheries, and improves farmers' resilience to climate change. This intervention is crucial for securing long-term agricultural viability and reducing disaster risk in the region.

Aim of the Project

The primary aim of the project is to create a resilient, nature-based protective barrier along Haripad's water channels and agricultural fields through the systematic plantation of native mangrove species. The intervention is intended to reduce saline intrusion, mitigate flood impact, stabilize eroding banks, and restore ecological balance, thereby enabling farmers to return to sustainable multi-crop agricultural practices.

Project Objectives

- To establish continuous mangrove belts along canals, riverbanks, and agricultural field edges as natural flood and saline-intrusion barriers.
- To stabilize soil and prevent erosion through appropriate selection and plantation of native mangrove species.
- To support the revival of multi-crop agricultural cycles by improving soil health and reducing water-induced damage.
- To enhance biodiversity and promote habitat regeneration for aquatic and terrestrial species.
- To build local community capacity for mangrove management, monitoring, and sustainable agriculture.
- To integrate nature-based solutions into Haripad's climate adaptation and disaster-risk-reduction strategy.

2) Location and Ownership

Mangrove buffer protection is proposed as a natural buffer and protective edge along the Achankovil riverbanks, canal edges and paddy field edges etc.

Land Ownership	Private
Ward Number	11
Project length	8.3 Kms
Survey Number	538(p)-543(p), 568(p), 569(p), 570(p), 571(p), 572(p), 582(p)-598(p), 600(p), 601(p), 602(p), 603(p), 618(p)-636(p), 639(p), 575(p)-577(p), 607(p), 608(p), 615(p), 616(p), 636(p), 639(p), 567(p), 564(p), 561(p), 611(p), 611(p), 613(p)

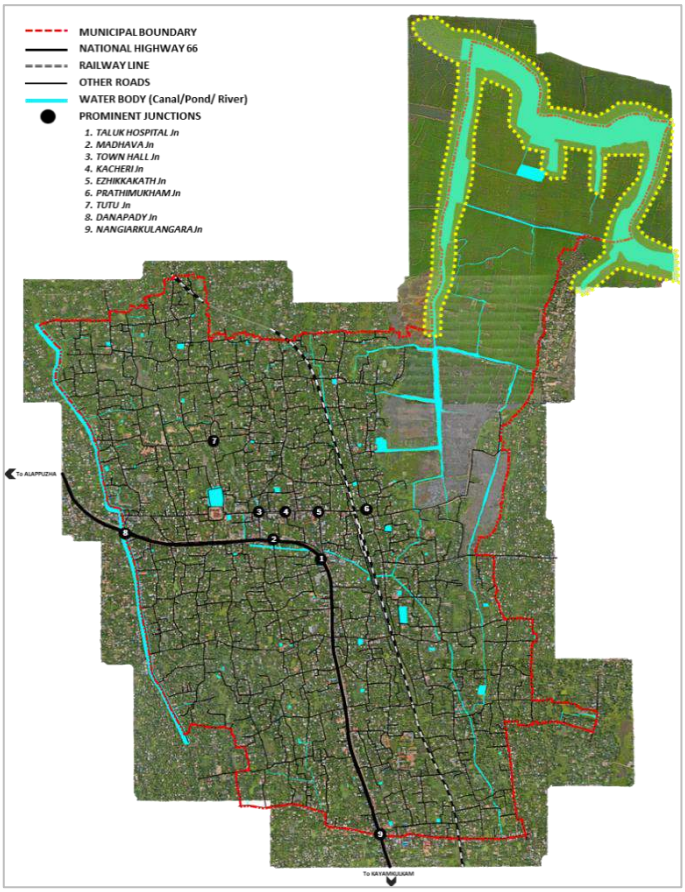


Figure 36.33 : Location of proposed mangrove fringe along Achanchankovil river, canal edges and paddy field edges

3) Project Components

The various components that will form part of the project include:

1. Scientific Site Assessment & Mapping : Hydrological analysis, soil salinity profiling, tidal influence assessment, and identification of priority plantation zones along Pilla Thodu, Danapady Thodu, Achankovil River margins, and field boundaries.
2. Mangrove Species Selection & Plantation: Plantation of native species including *Rhizophora mucronata*, *Rhizophora apiculata*, *Avicennia officinalis*, and *Acanthus ilicifolius*, based on site-specific hydrological and soil conditions.
3. Green Buffer Design : Determination of plantation width, density, spacing grids, and protective bund formation where required; creation of multi-layered green belts combining mangroves with compatible native shrubs and grasses.
4. Bio-engineering and Soil Stabilization Measures : Coir matting, brushwood barriers, vetiver strips, and sediment traps to enhance bank stability and support mangrove root establishment.
5. Community Nurseries & Capacity Building : Establishment of local mangrove nurseries managed by Kudumbashree units or farmer groups; training in mangrove propagation, maintenance, and ecological monitoring.
6. Monitoring & Maintenance Framework : Survival assessment, gap planting, seasonal monitoring, community-based protection measures, and integration with local disaster-management systems.

7. Supporting Ecological Infrastructure : Low-impact access paths for maintenance, interpretation boards for awareness, bird perches, and designated observation points to promote eco-tourism value.
8. Convergence with Agricultural Resilience Initiatives : Promotion of salt-tolerant crops, fish-paddy farming, and enhanced water-retention strategies supported by the restored ecosystem.



Figure 36.34 Inspiration image for mangrove fringe along river, canal and paddy fields

4) Agencies Responsible

Table 36.45 : Agencies responsible for Mangrove Fringe along Canals and Agricultural Fields

Agencies responsible for Mangrove Fringe along Canals and Agricultural Fields		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, stakeholder engagement, monitoring	Haripad Municipality
2	Technical guidance on mangrove species selection, ecological design, and plantation protocols	Kerala Forest & Wildlife Department; Kerala Forest Research Institute (KFRI)
3	Hydrological assessment, soil testing, canal-side engineering support	Irrigation Department; Minor Irrigation Division
4	Land identification, boundary demarcation, canal-bank protection and bio-engineering	Haripad Municipality; Revenue Department
5	Development of community nurseries, plantation labour support, local stewardship	Kudumbashree Units; Haripad Farmers' Groups; Joint Liability Groups (JLGs)
6	Waterbody rejuvenation support, silt removal coordination, canal maintenance	Department of Water Resources; Haripad Jalanidhi Cell (if constituted)
7	Climate adaptation integration, disaster-risk reduction alignment	Kerala State Disaster Management Authority (KSDMA)

8	Awareness campaigns, training, and ecological monitoring	Local NGOs; Environmental Clubs; Academic Institutions
9	Funding support and convergence with government schemes	Haripad Municipality; State Environment Department; National Coastal Mission / CAMPA (as applicable)

5) Suggested Implementation Mechanism

The project shall be implemented through a phased, science-driven, and community-supported approach. Initial stages will involve detailed hydrological assessment, soil salinity testing, and site demarcation by the Irrigation Department, Forest Department, and Haripad Municipality. Plantation designs - including species mix, spacing, and buffer width - will be finalised in consultation with KFRI and other ecological experts to ensure ecological appropriateness.

Nurseries for native mangrove species may be developed locally through Kudumbashree units, Joint Liability Groups (JLGs), and farmer collectives, enabling livelihood generation and long-term stewardship. Plantation and initial maintenance will follow a structured schedule aligned with seasonal tidal patterns and monsoon cycles. Continuous monitoring will be undertaken using geotagged plantation records, periodic survival assessments, and community surveillance groups supported by the Municipality and local environmental clubs. Funding and technical convergence will be pursued under schemes such as CAMPA, Haritha Kerala Mission, and the National Coastal Mission, alongside municipal allocations.

6) Other Associated Issues to be addressed

Successful implementation requires addressing several ecological, social, and operational concerns. Canal bunds and agricultural field edges often experience encroachment, debris dumping, and unregulated land modifications - these must be cleared and legally protected through coordinated action by the Revenue Department and Municipality. Ensuring long-term survival of newly planted mangroves is critical; threats such as grazing by livestock, damage during canal desilting, and vandalism must be prevented through fencing, community monitoring, and awareness campaigns.

Care must also be taken to avoid conflicts between mangrove planting zones and active agricultural operations, requiring careful alignment of plantation width and buffer distances. Continuous water flow and tidal exchange in canals should be maintained; blocked culverts or silted channels could impede mangrove growth and must be addressed by the Irrigation Department. During implementation, safe access for plantation workers must be ensured, especially along slippery or unstable canal edges. Furthermore, saline-water inflow structures, if modified, should be approved by technical authorities to avoid unintended impacts on upstream farmlands. Managing exotic or invasive species and ensuring compatibility with existing biodiversity corridors will also be essential. By proactively addressing these issues, the project can deliver a resilient ecological buffer that supports agriculture, enhances biodiversity, and strengthens Haripad's long-term climate adaptation capacity.

7) Project Cost and Period

Table 36.46: Project Cost Estimate for Mangrove Fringe along Canals and Agricultural Fields

Project Cost Estimate - Mangrove Fringe along Canals and Agricultural Fields		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**

1	Baseline ecological assessment (soil salinity tests, hydrology survey, GPS mapping)	4.50
2	Site preparation (clearing debris, bund strengthening, minor)	6.00
3	Mangrove nursery development (native species propagation through SHGs/JLGs)	5.00
4	Plantation works (planting ~25,000 - 30,000 saplings including labour)	12.00
5	Protective measures (biofencing, bamboo fencing, cattle guards)	4.00
6	Canal desilting & minor restoration (selective stretches)	10.00
7	Water management structures (small bunds, controlled sluice repairs)	6.50
8	Community awareness and capacity-building programmes	1.50
9	Monitoring & maintenance (2 years - survival checks, replantation, upkeep)	8.00
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 65 Lakhs

Table 36.47: Project Duration for Mangrove Fringe along Canals and Agricultural Fields

Project Duration - Mangrove Fringe along Canals and Agricultural Fields			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Pre-Implementation Phase	Baseline ecological assessment, hydrological survey, soil salinity testing, site selection, community consultations	1 month
2	Site Preparation Phase	Clearing of debris, bund strengthening, minor levelling, selective canal desilting, preparation of planting zones	1 month
3	Nursery Preparation Phase	Collection of propagules/seeds, raising saplings in mangrove nurseries (SHGs/FGs), procurement of materials	1 - 2 months
4	Plantation Phase	Field planting of native mangrove species, installation of biofencing, marking of plantation grids	1 month
5	Initial Stabilisation & Early Maintenance	Watering (where necessary), replacing damaged saplings, controlling cattle intrusion, early monitoring	3 months
6	Ongoing Monitoring & Maintenance	Survival assessment, replantation, maintenance of protective structures, periodic field inspections	12 months
7	Impact Evaluation & Handover	Final monitoring, documentation, handover to community/ward-level monitoring committee	1 month
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 18-20 months

36.4.13 Municipal Sports Centre and Playground

1) Project Brief



The Municipal Sports Centre and Playground project proposes the comprehensive redevelopment of the existing municipal ground at Thrippakudam into a modern, inclusive, and multi-sport facility for Haripad. With part of the premises already accommodating the under-construction 7 LL OHSR under AMRUT 2.0, the project aims to efficiently reorganise the remaining land to create a well-planned, high-quality sports ecosystem that supports training, recreation, and community engagement. The upgraded facility will integrate indoor and outdoor sports amenities, youth-focused infrastructure, and safe, universally accessible public spaces that cater to athletes, school students, and the wider community.

Need for the Project

Haripad currently lacks a dedicated municipal-level sports complex with structured facilities, restricting opportunities for organised sports, youth development, and community wellness. The existing ground is underutilised, uneven, and lacks basic amenities such as lighting, changing rooms, seating, and secure boundaries. With high youth population density, multiple schools in the vicinity, and increasing interest in sports and fitness, the Municipality requires a well-designed facility to promote physical activity, talent development, and healthy lifestyles. Additionally, given the presence of the new OHSR, the site must be reorganised to ensure safe co-existence of utility infrastructure and public recreational spaces.

Aim of the Project

The aim of the project is to transform the Thrippakudam municipal ground into a state-of-the-art sports centre and community recreation hub that provides safe, accessible, and high-quality indoor and outdoor sports facilities, supports youth engagement programmes, and enhances the physical and social wellbeing of Haripad's residents.

Project Objectives

- To provide modern, multi-sport infrastructure that meets municipal-level training and recreational needs.
- To enhance safety, accessibility, and user comfort through organised layouts, lighting, fencing, and support facilities.
- To promote youth engagement, coaching programmes, and inter-school/inter-ward sporting events.
- To encourage community health, fitness, and social interaction through inclusive recreational amenities.
- To optimise land use around the AMRUT OHSR and ensure harmonious integration of sports and public utility functions.

2) Location and Ownership

The proposed Sports Centre and playground is proposed on the current Municiapla Playground site at Thrippakudam with land acquisition required of the nearby property to create a better enhanced facility for the Municipality.

Land Ownership	Haripad Muniipality

Ward Number	4
Project Area	Approx. 91.5 Acres
Survey Number	124(p)



Figure 36.35 : Location of proposed Sports Centre & Playground

3) Project Components

The various components that will form part of the project include:

1. Upgraded Outdoor Playground: Levelled turf, football/cricket ground, athletic track markings, practice nets.
2. Indoor Sports & Fitness Block: Multi-purpose indoor hall (badminton/table tennis/yoga), gym and fitness room, meeting room, storage areas.
3. Spectator & Public Amenities: Covered seating stands, drinking water kiosks, accessible toilets, changing rooms & lockers, first-aid room.
4. Recreational & Youth Facilities: Children's play area, open-air exercise zone, jogging/walking track, shaded rest areas.
5. Site Development & Landscaping: Boundary fencing, green buffer zones, tree planting, paved circulation, lighting poles.
6. Night Sports Infrastructure: LED floodlighting, pathway lighting, solar-powered fixtures where feasible.
7. Utility Integration: Safe demarcation and protective fencing around the new OHSR; coordinated landscaping and access management.
8. Digital Enhancements: CCTV surveillance, public announcement system, smart entry/usage monitoring (optional based on funds).
9. Parking & Access Improvements: Two-wheeler and bicycle parking, pedestrian-friendly pathways, signage, and wayfinding.



Figure 36.36 : Conceptual view of proposed Sports Centre and playground at Thrippakudam

4) Agencies Responsible

Table 36.48 : Agencies responsible for Municipal Sports Centre and Playground

Agencies responsible for Municipal Sports Centre and Playground		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, tendering, supervision, stakeholder consultation	Haripad Municipality
2	Technical design, DPR preparation, structural & services engineering support	Project Management Consultant (PMC) / Accredited Design Consultants
3	Civil works execution, playground development, indoor block construction	Selected Contractor(s) through tender
4	Electrical & lighting systems installation (including floodlights & solar options)	Electrical Inspectorate, Licensed Electrical Contractors
5	Landscaping, turf development, green buffer creation	Department of Agriculture / Accredited Landscape Consultants / Municipality
6	Safety audits, accessibility compliance, fire & emergency approvals	Kerala Fire & Rescue Services, Local Police, Department of Social Justice (Accessibility Cell)
7	Quality monitoring, periodic inspections, certification of works	Municipality Engineering Wing
8	Sports programming, youth engagement, training initiatives	Department of Sports & Youth Affairs / Local Sports Clubs / Schools
9	O&M of facilities, grounds management, security, cleaning	Haripad Municipality / Kudumbashree Units / Facility Management Agency

5) Suggested Implementation Mechanism

The project may be implemented through a phased, Municipality-led execution model supported by technical agencies of the Government of Kerala. Haripad Municipality shall serve as the nodal implementing authority, coordinating DPR preparation, tendering, and construction supervision through an accredited Project Management Consultant (PMC). The civil works - including ground development, indoor sports block construction, and utilities - should be tendered through the State e-Tendering Platform in compliance with PWD norms and Kerala Municipal Building Rules (KMBR).

Coordination with the Department of Sports & Youth Affairs is essential for ensuring compliance with sports infrastructure standards and for integrating training programmes. Electrical installations, including floodlights and solar-powered fixtures, must be executed with approvals from the Kerala State Electrical Inspectorate. Landscaping and turf development may be undertaken jointly with the Department of Agriculture, leveraging local expertise in turf management. Upon completion, the facility's operation and maintenance may be managed by the Municipality directly or through a Kudumbashree-led facility management model, ensuring cost-effective, community-embedded oversight

6) Other Associated Issues to be addressed

Several implementation challenges require proactive management. As the site already hosts the ongoing 7 LL OHSR construction under AMRUT 2.0, close coordination with the Kerala Water Authority (KWA) and AMRUT supervision teams is essential to prevent conflicts in site access, material movement, and safety. Dust, noise, and debris from simultaneous construction activities must be mitigated through strict environmental management protocols, including barricading, controlled work timings, and regular site cleaning.

Proper drainage planning is critical to prevent waterlogging on the playground, particularly given Kerala's heavy monsoon. Structural safety certifications, accessibility compliance (as per the Rights of Persons with Disabilities Act), and fire-safety clearances must be obtained prior to commissioning. Ensuring security - through boundary fencing, CCTV, and designated entry-exit points - will help prevent vandalism and unauthorized use. Long-term sustainability also depends on preparing a dedicated O&M plan covering turf upkeep, equipment maintenance, and periodic inspections. Attention must also be given to community concerns, such as minimizing disturbances to nearby residents and ensuring equitable access for schools, youth clubs, and women's groups.

7) Project Cost and Period

Table 36.49: Project Cost Estimate for Municipal Sports Centre and Playground

Project Cost Estimate - Municipal Sports Centre and Playground		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Site preparation, grading & compound wall/fencing	25
2	Playground development: turfing, drainage layer, athletic track, cricket/football markings	40
3	Floodlighting & electrical installations (including solar streetlights)	22

4	Construction of Indoor Sports Block (training hall, gym, equipment room, washrooms, changing rooms)	85
5	Spectator seating stands & shade structures	18
6	Practice nets (cricket), children's play area & fitness stations	12
7	Jogging/walking track with paving & safety railings	10
8	Landscaping & green buffer development	8
9	Water supply, sanitation, drinking water point & waste management	6
10	Parking area, internal pathways & lighting	12
11	CCTV, security cabins & gate improvements	7
12	Professional fees (DPR, PMC, site supervision)	10
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 2.2-2.5 Crores

Table 36.50: Project Duration for Municipal Sports Centre and Playground

Project Duration - Municipal Sports Centre and Playground			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Pre-Construction Phase	Detailed site survey, soil testing, stakeholder consultations, DPR finalisation, approvals from Municipality & line departments, tendering	2 months
2	Site Preparation & Civil Works	Site clearing, leveling, drainage works, boundary wall/fencing, utility shifting, internal pathways	3 months
3	Building Construction	Construction of indoor sports centre (training hall, gym, washrooms, changing rooms), structural systems, roofing, electrical & plumbing	5 months
4	Playground Development	Turfing, athletic track formation, cricket nets, play area installation, jogging track, landscaping	3 months
5	Lighting & Ancillary Infrastructure	Floodlighting, solar lights, CCTV, seating stands, water facilities, sanitation units, waste systems	2 months
6	Testing, Commissioning & Handover	Quality check, safety audits, trial use, rectifications, final handover & inauguration	1 month
7	Impact Evaluation & Handover	Final monitoring, documentation, handover to community/ward-level monitoring committee	1 month
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 16-20 months

36.4.14 Padasekharam Revitalization & Smart Irrigation Network

1) Project Brief



The Padasekharam Revitalization & Smart Irrigation Network project aims to rejuvenate Haripad's traditional agricultural landscapes by improving the functionality, resilience, and productivity of its major and minor Padasekharams. Through integrated interventions - ranging from bund strengthening and canal rehabilitation to the deployment of smart irrigation technologies - the project seeks to restore multi-cropping potential, reduce climate-induced vulnerabilities, and support long-term livelihood sustainability for farming communities. By blending traditional water management practices with modern automation systems, the initiative positions Haripad as a model for climate-adaptive agriculture in Kerala's coastal belt.

Need for the Project

Haripad's agriculture faces recurring risks from saline intrusion, waterlogging, inadequate bund maintenance, inefficient shutter operations, and poor access to agricultural plots - factors that have forced farmers to shift from multi-crop to single-cycle cultivation. With increasing climate variability and declining labour availability, the absence of mechanization-friendly access routes further exacerbates productivity losses. Revitalizing Padasekharams with robust infrastructure and smart water management systems is essential to restore ecological health, revive paddy cultivation, and strengthen the town's food security and rural economy.

Aim of the Project

The aim of the project is to establish a climate-resilient, technology-enabled irrigation network that ensures timely, reliable, and efficient water distribution across Haripad's Padasekharams, enhances farm accessibility, and enables multi-season cropping, thereby improving agricultural productivity and farmer income.

Project Objectives

- To modernize and automate irrigation control structures for timely, efficient, and climate-responsive water regulation.
- To strengthen bunds, canals, and drainage networks to prevent saline intrusion, flooding, and crop losses.
- To improve internal farm access for mechanized agriculture and faster emergency response.
- To enhance multi-cropping potential and overall agricultural productivity through integrated water management.
- To promote sustainable, community-driven maintenance frameworks involving farmers, cooperative societies, and local institutions

2) Location and Ownership

The Municipality has 8 major padasekharams with a combined area of approx. 384 Ha. Further the surrounding local bodies have another 7 padasekahrams. The locations of various padasekharams within the Municipality, paddy field locations are shown below:

3) Project Components

The various components that will form part of the project include:

1. Smart Irrigation Infrastructure
   - Installation of sensor-based automated and semi-automated shutters at Thottappally Spillway, Danapady Bund, Pulinkuzhi Bund, and key Padasekharam regulators.
   - Real-time water flow monitoring systems, telemetry units, and alert mechanisms for farmers.
2. Bund and Canal Rehabilitation
   - Bund strengthening using turfing, geo-textiles, and stone pitching.
   - Clearing, deepening, and desilting of supply canals, field channels, and secondary drains.
   - Repair and reconstruction of deteriorated sections of irrigation channels.
3. Padasekharam Infrastructure Improvement
   - Upgrading internal farm roads for tractor access, threshing operations, and emergency movement.
   - Development of decentralized sump-based water retention systems for dry-season management.
   - Construction of culverts, cross-drainage structures, and footbridges for safe farm connectivity.
4. Salinity Protection & Flood Management
   - Shutter modernization at Thottappally to prevent backflow of saline water.
   - Installation of flap gates at vulnerable inlets.
   - Peripheral bund strengthening in low-lying Padasekharams.
5. Farmer Support & Capacity Building
   - Training programs on automated irrigation systems, multi-cropping, and water-efficient practices.
   - Community-led maintenance committees and joint monitoring systems.
   - Integration with Kuttanad Package initiatives, Krishi Bhavans, and Farmer Producer Organisations (FPOs).
6. Sustainability & Ecological Enhancement
   - Introduction of controlled-flow irrigation to reduce wastage.
   - Riparian buffer planting along key canal stretches.

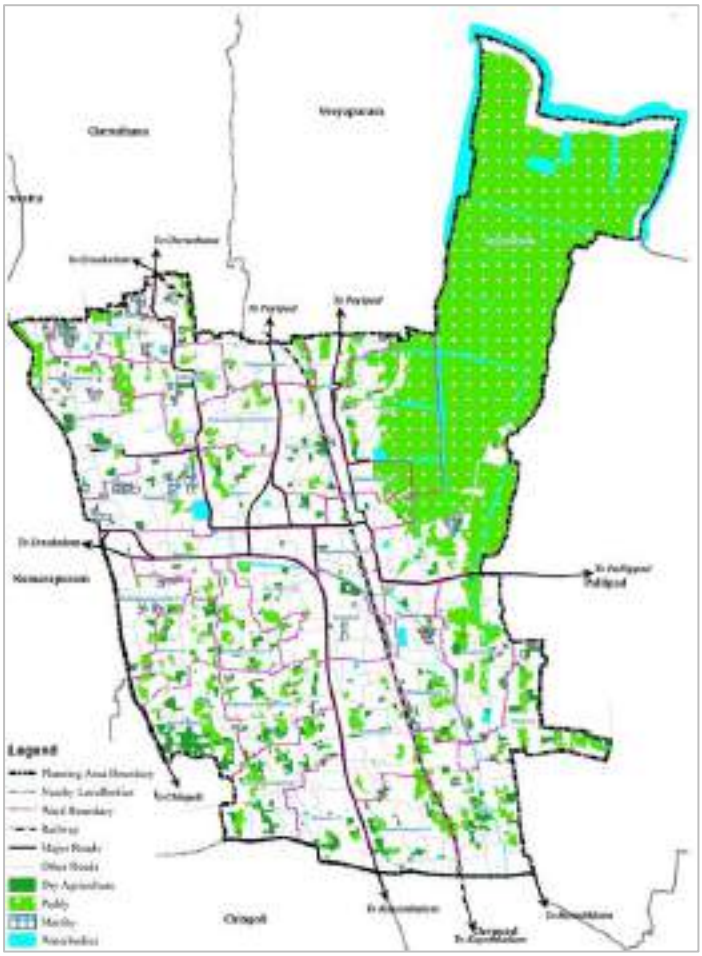


Figure 36.37: Location of Padasekharams and paddy fields in Haripad

- Promotion of climate-resilient crop varieties and integrated farming systems.

The agriculture department has identified the following repair works as part of padasekhams to be carried out at the earliest

Table 36.51 : Padasekharams and intended repair works in each

Padasekharams and the intended repair works in each			
Sl. No	**Name of Padasekharam**	**Local Body**	**Proposed works**
1	Padinjare Parambikkeri	Haripad Municipality	Motor Shed, protection wall, thodu clearing
2	Kizhakke Parambikkeri B Block Padasekharam	Haripad Municipality	Ramps
3	Vazhuthanam Padinjaru Thekku Padasekharam	Haripad Municipality	Protection wall, ramps, deepending of thodu
4	Kareeli Padasekharam	Pallipad GP	Protection wall, Ramp
5	Koikalethu Padasekharam	Pallipad GP	Protection wall
6	Kureethara Padasekjaram	Pallipad GP	Motorshed
7	Muttathu Vadakku Padasekharam	Pallipad GP	Motorshed
8	Chendenkeri Padasekharam	Pallipad GP	Box Culvert
9	Chalunkal Padasekharam	Cheruthana GP	Ramps
10	Ezhankeri East Padasekharam	Karuvatta GP	Pothumada, Ramp
11	Cheruthuruthu Padasekharam	Cheruthana GP	Protection wall, Ramp
12	Pullamvazhichal PAdasekharam	Karuvatta GP	Desilting of thodu
13	Padinjare Pocha Padasekharam	Cheruthana GP	Pothumada, Side protection of muttu
14	Pandy Vadakku Padasekharam	Cheruthana GP	Motor shed
15	Vellokkery Padasekharam	Karuvatta GP	Pothumada

4) Agencies Responsible

Table 36.52 : Agencies responsible for Padasekharam Revitalization & Smart Irrigation Network

Agencies responsible for Padasekharam Revitalization & Smart Irrigation Network		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, monitoring, inter-agency convergence	Haripad Municipality
2	Technical leadership for irrigation design, bund strengthening, canal rehabilitation	Department of Agriculture / Krishi Bhavan
3	Installation, calibration, and maintenance of smart shutters, sensors & telemetry systems	Irrigation Department / Kerala Water Resources Department (WRD)

4	Operation and protection of Thottappally Spillway shutters & key regulators	Irrigation Department / Kerala State Electricity Board (for power supply support)
5	Soil conservation measures and bund stabilization	Soil Conservation Department
6	Surveying, GIS mapping, hydrological assessments, and technical design validation	Kerala State Remote Sensing & Environment Centre (KSREC) / CWRDM
7	Strengthening internal farm roads and culverts	Haripad Municipality / LSGD Engineering Wing
8	Farmer mobilization, community-led maintenance committees, capacity building	Krishi Bhavan / Farmer Producer Organisations (FPOs) / Padasekharam Samithis
9	Environmental compliance, wetland protection, biodiversity safeguards	Kerala State Pollution Control Board / Department of Environment & Climate Change
10	Financial facilitation for farmers (subsidies, credit-linked schemes)	Department of Agriculture, NABARD, Cooperative Banks
11	Monitoring & evaluation, periodic quality checks	Haripad Municipality, Department of Agriculture, Third-party technical auditors

5) Suggested Implementation Mechanism

The project will be implemented through a phased, convergence-based approach led by Haripad Municipality in coordination with the Department of Agriculture, Irrigation Department, and Padasekharam Samithis. Initial activities will include detailed field surveys, hydrological assessments, and GIS mapping undertaken with technical support from KSREC and CWRDM to identify priority bunds, canals, and irrigation gaps. Smart shutter and sensor-based systems will be procured and installed through the Irrigation Department following state procurement norms, with long-term maintenance contracts ensuring operational reliability.

Padasekharam Samithis and Farmer Producer Organisations (FPOs) will be engaged in community-led monitoring, routine canal cleaning, and reporting system efficiency issues. Strengthening of internal farm roads and culverts will be executed through the LSGD Engineering Wing under municipal supervision. Funding will be mobilised through a mix of state agriculture schemes, Kuttanad Package components, NABARD assistance, and municipal allocations, ensuring steady project progression. Digital dashboards may be introduced for real-time monitoring of shutters, water levels, and irrigation flow to improve decision-making during monsoons and dry spells.

6) Other Associated Issues to be addressed

Several technical, environmental, and social challenges must be proactively managed for successful project delivery. Salinity intrusion during high tides and monsoon variations requires constant coordination with the Irrigation Department and Thottappally Spillway operations team to ensure timely closure and opening of shutters. Siltation in canals and drains remains a recurrent issue and will require periodic desilting and community-based surveillance to prevent blockages.

Land ownership complications along canal shoulders may pose constraints to access roads and bund strengthening, necessitating LSGD mediation and community consensus-building. Smart shutters and sensors will require uninterrupted power supply and protection against theft or vandalism, requiring support from the Municipal Enforcement Wing and local vigilance committees. Ecological safeguards must be maintained by ensuring that interventions do not negatively affect wetland biodiversity, with compliance monitored by the Pollution Control Board and Department of Environment & Climate Change.

Finally, long-term sustainability depends on sustained farmer participation, adequate training on smart irrigation practices, and financial support mechanisms to help small-scale farmers adopt modern agricultural methods. Continuous institutional coordination and community ownership will be central to ensuring that Haripad's revitalized Padasekharams remain resilient and productive.

7) Project Cost and Period

Table 36.53: Project Cost Estimate for Padasekharam Revitalization & Smart Irrigation Network

Project Cost Estimate - Padasekharam Revitalization & Smart Irrigation Network		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Detailed Surveys, GIS Mapping & Hydrological Assessment	25
2	Canal Desilting, Clearing & Minor Repairs (multiple Padasekharams)	150
3	Bund Strengthening & Reconstruction (Danapady, Pulinkuzhi, other sites)	200
4	Smart Shutter System (Sensors, Automation, Control Panels) at Key Regulators including Thottappally Spillway interface	180
5	Drainage Link Improvement & Internal Irrigation Channel Repairs	120
6	Farm Access Road Upgradation for Machinery Movement	250
7	Salinity Barrier Strengthening & Anti-intrusion Measures	100
8	Renewable Energy Backup (Solar Power Units for Smart Shutters)	40
9	Community Infrastructure - FPO Support, Training, Farmer Mobilisation	30
10	Monitoring System (Remote dashboard, sensors, maintenance tools)	35
11	Contingencies (5%)	57
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Further the cost involved works of padasekharams as assessed by irrigation department are listed below.

Table 36.54 : Project cost for repair works for various padasekharams

Project Cost Estimate - Repair works in various padasekharams

Sl. No	Name of Padasekharam	Local Body	Proposed works	Estimated cost (INR Lakhs)
1	Padinjare Parambikkeri	Haripad Municipality	Motor Shed, protection wall, thodu clearing	32
2	Kizhakke Parambikkeri B Block Padasekharam	Haripad Municipality	Ramps	4
3	Vazhuthanam Padinjaru Thekku Padasekharam	Haripad Municipality	Protection wall, ramps, deepending of thodu	100
4	Kareeli Padasekharam	Pallipad GP	Protection wall, Ramp	44
5	Koikalethu Padasekharam	Pallipad GP	Protection wall	110
6	Kureethara Padasekjaram	Pallipad GP	Motorshed	54
7	Muttathu Vadakku Padasekharam	Pallipad GP	Motorshed	54
8	Chendenkeri Padasekharam	Pallipad GP	Box Culvert	32
9	Chalunkal Padasekharam	Cheruthana GP	Ramps	6
10	Ezhankeri East Padasekharam	Karuvatta GP	Pothumada, Ramp	34
11	Cheruthuruthu Padasekharam	Cheruthana GP	Protection wall, Ramp	27
12	Pullamvazhichal Padasekharam	Karuvatta GP	Desilting of thodu	18
13	Padinjare Pocha Padasekharam	Cheruthana GP	Pothumada, Side protection of muttu	30
14	Pandy Vadakku Padasekharam	Cheruthana GP	Motor shed	51
15	Vellokkery Padasekharam	Karuvatta GP	Pothumada	24

Source : Cost Estimate provided by Department of Agriculture

Total Estimated Cost would be approx. 17 crores

Table 36.55: Project Duration for Padasekharam Revitalization & Smart Irrigation Network

Project Duration - Padasekharam Revitalization & Smart Irrigation Network			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	**Baseline Assessment & Preparatory Works**	Detailed surveys, hydrology mapping, stakeholder consultations	**2 months**

2	**Canal & Drain Rehabilitation**	Thodu desilting, clearing, channel deepening, structural repairs	**4 months**
3	**Bund Strengthening Works**	Construction/repair of protection walls, slope stabilization	**3 months**
4	**Smart Irrigation & Automated Shutter System**	Installation of smart shutters, sensor units, solar backups	**3 months**
5	**Farm Access Route Upgradation**	Upgrading internal farm roads for mechanized farming	**2 months**
6	**Testing, Calibration & Community Training**	System testing, calibration, farmer capacity building	**1 month**
		** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*	

Table 36.56 : Project duration for repair works for various padasekharams

Project Duration - Repair works in various padasekharams			
	Project Phase	**Key Activities**	**Duration**
1	Padinjare Parambikkeri	Motor shed, protection wall, thodu clearing	**2 months**
2	Kizhakke Parambikkeri B Block	Ramps	**1 month**
3	Vazhuthanam Padinjaru Thekku	Protection wall, ramps, deepening of thodu	**2 months**
4	Kareeli	Protection wall, ramp	**1.5 months**
5	Koikalethu	Protection wall	**1 month**
6	Kureethara	Motor shed	**1 month**
7	Muttathu Vadakku	Motor shed	**1 month**
8	Chendenkeri	Box culvert	**2 months**
9	Chalunkal	Ramps	**1 month**
10	Ezhankeri East	Pothumada, ramp	**1.5 months**
11	Cheruthuruthu	Protection wall, ramp	**1.5 months**
12	Pullamvazhichal	Desilting of thodu	**1 month**
13	Padinjare Pocha	Pothumada, muttu side protection	**1.5 months**
14	Pandy Vadakku	Motor shed	**1 month**
15	Vellokkery	Pothumada	**1 month**
		** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*	

The overall duration required the project would be approximately 18 months

36.4.15 Pillathodu Canal Front Redevelopment – Stretch 01

1) Project Brief



The Pillathodu Canal Front Redevelopment – Stretch 01 project focuses on the ecological restoration and neighbourhood-scale improvement of a 220-metre stretch of Pillathodu between Haripad Temple Road and NH 66. Once a functional flowing canal, this stretch has deteriorated due to pollution, weed infestation, and inadequate maintenance, resulting in stagnant water conditions, environmental degradation, and public health concerns for the surrounding residential areas. The project seeks to restore the canal's hydrological function while selectively introducing safe, context-sensitive public spaces along the canal edge, enhancing environmental quality and local liveability.

Need for the Project

Pillathodu currently poses environmental and sanitation risks due to stagnant water, uncontrolled vegetation growth, and weak canal edges, directly affecting nearby households. Given Haripad's vulnerability to waterlogging and flooding, restoring the canal's flow and structural integrity is essential for improving urban drainage, public health, and neighbourhood safety. The project addresses an urgent need to transform a neglected waterbody into a functional ecological asset while carefully accommodating limited public use where spatially feasible.

Aim of the Project

The aim of the project is to rejuvenate Pillathodu by restoring water flow, improving environmental conditions, and strengthening canal infrastructure, while creating modest, well-designed canal-edge public spaces that enhance neighbourhood character without disturbing adjoining residential areas.

Project Objectives

- Restore natural flow and improve water quality through canal cleaning and desilting
- Strengthen canal sidewalls and pitching to prevent erosion and ensure long-term stability
- Reduce health hazards caused by stagnant water and poor sanitation conditions
- Introduce safe, small-scale public amenities along suitable canal stretches
- Improve the visual quality and environmental performance of the canal corridor.

2) Location and Ownership

The project site is located in between the Haripad Temple Road and NH 66 for a distance of 220m. As part of the redevelopment the land on the sides of the canal will be developed appropriately.

Land Ownership	Private
Ward Number	26
Project Area	0.450 Acre
Survey Number	282-8(p), 282-10(p), 281-15(p), 281-22(p), 286-2(p), 286-3(p), 286-4(p)



Figure 36.38 : Location of proposed Sports Centre & Playground



Figure 36.39 : Existing condition of Pilla Thodu Stretch 01

3) Project Components

The various components that will form part of the project include:

1. Comprehensive canal cleaning, desilting, and weed removal
2. Structural strengthening of canal sidewalls, pitching, and erosion-control measures
3. Reconstruction of damaged or underperforming canal edges
4. Provision of pedestrian walkways where space permits
5. Shaded seating areas and small pavilions at selected locations
6. Landscaping with native vegetation and bio-filtration elements
7. Safety railings and edge protection near residential plots
8. Basic amenities such as waste receptacles, lighting, and signage
9. Stormwater inflow regulation and maintenance access provisions
10. Limited land acquisition, where essential, for safe and effective implementation.



Figure 36.40 : Conceptual view of Pilla Thodu Stretch 01- Redevelopment

4) Agencies Responsible

Table 36.57 : Agencies responsible for Pilla Thodu Canal Front Redevelopment – Stretch 01

Agencies responsible for Pillathodu Canal Front Redevelopment – Stretch 01		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, approvals, and execution	Haripad Municipality

2	Technical design, canal engineering, and structural works	Local Self Government Department (LSGD – Engineering Wing)
3	Canal desilting, sidewall strengthening, and pitching works	LSGD / PWD (Buildings & Roads – as applicable)
4	Stormwater integration and drainage connectivity	Kerala Water Authority (KWA)
5	Environmental guidance and waterbody protection	Kerala State Pollution Control Board (KSPCB)
6	Landscape design and ecological restoration support	Department of Environment & Climate Change, Govt. of Kerala
7	Solid waste control and sanitation measures along canal	Haripad Municipality – Health & Sanitation Wing
8	Utility coordination (water lines, lighting, underground services)	KWA / KSEB / Municipal Engineering Wing
9	Land acquisition and right-of-way coordination (if required)	Revenue Department, Govt. of Kerala
10	Community coordination and local monitoring	Ward Committees / Residents' Associations

5) Suggested Implementation Mechanism

The Pillathodu Canal Front Redevelopment – Stretch 01 shall be implemented under the leadership of Haripad Municipality, with technical support from the Local Self Government Department (LSGD – Engineering Wing). The project should be executed in a phased manner, beginning with canal cleaning, desilting, sidewall strengthening, and drainage correction to restore hydrological functionality, followed by public realm improvements along feasible stretches. Detailed engineering designs shall be prepared in consultation with KWA and KSPCB to ensure water quality compliance and proper stormwater integration. Landscaping and public-space elements may be implemented through specialized contractors, while operation and routine maintenance shall be undertaken by the Municipal Engineering and Health Wings, with active involvement of ward-level committees and local residents for long-term upkeep

6) Other Associated Issues to be addressed

Given the canal's proximity to residential properties, careful attention must be paid to construction safety, dust control, noise management, and protection of adjacent structures during execution. Temporary access arrangements and clear communication with residents will be essential to minimize inconvenience. Encroachment prevention and solid waste dumping control must be strengthened through surveillance, signage, and enforcement by the Municipality. Coordination with utility agencies such as KWA and KSEB is critical to avoid service disruptions. Post-redevelopment, regular desilting, vegetation management, and water-quality monitoring will be necessary to prevent re-pollution. Climate resilience considerations - including adequate freeboard, erosion protection, and flood-compatible design - must be integrated to ensure the long-term sustainability of the canal front within Haripad's broader disaster risk reduction framework.

7) Project Cost and Period

Table 36.58: Project Cost Estimate for Municipal Sports Centre and Playground

Project Cost Estimate - Pillathodu Canal Front Redevelopment – Stretch 01		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Canal cleaning, desilting, weed removal & debris disposal	35
2	Strengthening of canal sidewalls, pitching & erosion control	55
3	Repair / reconstruction of damaged drain links & outlets	25
4	Walking paths, paving & canal-edge safety treatments	30
5	Seating areas, shaded pavilions & small public amenities	20
6	Landscaping, plantation & green buffers	15
7	Street lighting (solar / energy-efficient fixtures)	12
8	Signage, railings, waste bins & street furniture	8
9	Minor land acquisition / utility shifting (where required)	10
10	DPR preparation, supervision & contingencies	15
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 2.2-2.5 Crores

Table 36.59: Project Duration for Municipal Sports Centre and Playground

Project Duration - Pillathodu Canal Front Redevelopment – Stretch 01			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Pre-Implementation & Approvals	Site surveys, utility mapping, stakeholder consultations, DPR preparation, technical sanctions	2 months
2	Canal Cleaning & Restoration	Desilting, weed removal, debris clearance, restoration of water flow	2 months
3	Structural Works	Strengthening canal sidewalls, pitching, erosion control, drain repairs	3 months
4	Public Realm Development	Walkways, paving, seating areas, pavilions, safety railings	2 months
5	Landscaping & Utilities	Landscaping, plantation, street lighting, signage, waste bins	1 month
6	Finishing & Commissioning	Final inspections, safety checks, community handover	1 month
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 12-15 months

36.4.16 Malikadavu Ambal Padam (Water Lily–Based Farm Tourism Initiative)

1) Project Brief



The Malikadavu Ambal Padam project is a nature-based farm tourism and ecological recreation initiative proposed in the northern part of Haripad Municipality. The project leverages the seasonal transformation of paddy fields - where water lilies naturally bloom during non-cropping periods - to create a low-impact, experiential tourism destination. By integrating traditional agriculture, inland waterways, and community-led tourism, the initiative seeks to activate fallow landscapes while preserving their ecological and agrarian character.

Need for the Project

Large extents of paddy fields in Malikadavu remain underutilized outside the single annual crop cycle, resulting in limited livelihood opportunities and inactive rural landscapes. At the same time, Haripad lacks distinctive, eco-sensitive farm tourism destinations that reflect its agricultural identity. The project addresses this gap by transforming the seasonal water lily phase into an economic and cultural asset - enhancing farmer incomes, attracting visitors, and promoting conservation-oriented land use without compromising agricultural productivity or ecological balance.

Aim of the Project

The project aims to establish Malikadavu Ambal Padam as a model farm-tourism landscape, showcasing water lily–based seasonal cultivation and experiential tourism while ensuring ecological conservation, livelihood enhancement, and sustainable rural activation within Haripad.

Project Objectives

- Promote seasonal water lily cultivation as a supplementary farm-based livelihood.
- Develop eco-sensitive boating and walking experiences within paddy landscapes.
- Enhance rural tourism through low-impact, reversible infrastructure.
- Strengthen farmer participation and local entrepreneurship in tourism services.
- Preserve ecological integrity in accordance with the Ecological Conservation Zone regulations.



Figure 36.41 : Existing condition of Malikadavu area

2) Location and Ownership

The project site is located at Malikadavu, Haripad. The proposed water lily fields extends between Malikadavu and Nelpurakadavu areas.

Land Ownership	Private
Ward Number	9
Project Area	Approx. 91.5 Acres
Survey Number	487, 488, 489, 490, 479, 478(p), 480(p), 395(p), 406(p), 472, 473, 474, 475, 476, 492, 493, 494



Figure 36.42 : Location of Malikadavu Ambal Padam

3) Project Components

The various components that will form part of the project include:

1. Seasonal Water Lily Cultivation
   - Controlled ambal flower cultivation during non-crop periods
   - Farmer-managed harvesting and visitor interaction
2. Waterway Enhancement
   - Cleaning and desilting of existing field channels
   - Creation of safe, navigable routes for small row boats
3. Boating & Experiential Tourism
   - Non-motorised boating routes linking Malikadavu and Nelpurakadavu
   - Flower-plucking, photography, and nature-interpretation experiences
4. Pedestrian & Viewing Infrastructure
   - Strengthened field bund pathways
   - Temporary wooden walkways and viewing decks
   - Simple boarding platforms for boat access
5. Visitor Amenities (Low-Impact)
   - Signage, resting areas, shade structures
   - Drinking water points, waste segregation bins
   - Safety railings at sensitive edges
6. Local Economic Activation
   - Promotion of ethnic food stalls and farm-based kiosks along Malikadavu–Nelpurakadavu road
   - Support for SHGs and local residents in operating tourism services
7. Environmental Safeguards
   - Reversible construction using eco-friendly materials
   - No permanent buildings within conservation zones
   - Monitoring of water quality and biodiversity impacts



Figure 36.43 : Inspiration images to showcase intended componets as part of the project

4) Agencies Responsible

Table 36.60 : Agencies responsible for Malikadavu Ambal Padam (Water Lily–Based Farm Tourism Initiative)

Agencies responsible for Malikadavu Ambal Padam (Water Lily–Based Farm Tourism Initiative)		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, approvals, and local implementation	Haripad Municipality
2	Agricultural planning, water lily cultivation guidance, farmer coordination	Department of Agriculture Development & Farmers' Welfare (Kerala)
3	Paddy field management, canal upkeep, bund strengthening	Padasekhara Samithis / Local Farmers' Collectives
4	Eco-tourism planning, visitor experience design, tourism promotion	Department of Tourism, Govt. of Kerala
5	Water channel cleaning, desilting, and hydrological interventions	Minor Irrigation Department / Water Resources Department, Kerala
6	Ecological safeguards, mangrove/wetland protection, environmental clearances	Department of Environment & Climate Change / Kerala State Biodiversity Board
7	Regulation and monitoring within Ecological Conservation Zone	Town & Country Planning Department, Kerala
8	Community participation, operation of food kiosks and local services	Kudumbashree Mission / Local Self-Help Groups

9	Boating safety standards and inland water regulations	Kerala Inland Waterways Authority / Port & Inland Navigation Dept.
10	Maintenance of access roads and basic infrastructure	Public Works Department (PWD) / Local Engineering Wing
11	Waste management, sanitation, and site upkeep	Haripad Municipality – Health & Sanitation Wing
12	Monitoring, evaluation, and capacity-building support	District Planning Committee / Alappuzha District Administration

5) Suggested Implementation Mechanism

The Malikadavu Ambal Padam project shall be implemented through a phased, community-led, and ecologically regulated approach under the coordination of Haripad Municipality, in partnership with the Department of Agriculture, Department of Tourism, and Water Resources Department. Initial phases will focus on detailed ecological assessment, stakeholder consultations with Padasekhara Samithis, and preparation of site-specific intervention guidelines in line with Ecological Conservation Zone norms. Canal cleaning, desilting, and water-flow restoration will be undertaken through the Minor Irrigation Department, followed by the development of low-impact tourism infrastructure such as temporary walkways, viewing decks, and boat jetties using eco-friendly, reversible materials.

Tourism activities - including boating operations, guided farm experiences, and local food kiosks - shall be managed through Kudumbashree units, farmer collectives, and local youth groups, with technical support from the Department of Tourism. Clear operational protocols, seasonal activity calendars, and safety guidelines will be established. Continuous monitoring will be carried out jointly by the Municipality, Agriculture Department, and Biodiversity Board to ensure ecological integrity, livelihood benefits, and long-term sustainability

6) Other Associated Issues to be addressed

Given the project's location within an Ecological Conservation Zone, strict adherence to environmental safeguards is critical. Care must be taken to prevent disturbance to soil structure, water quality, and existing biodiversity, particularly during boating and visitor movement. Over-commercialisation and unregulated tourism must be avoided through visitor caps, seasonal operation limits, and clearly demarcated activity zones.

Flooding, water-level fluctuations, and monsoon-related safety risks must be addressed through adaptive design, seasonal closures, and emergency response protocols coordinated with the District Disaster Management Authority. Solid waste management, sanitation, and wastewater control along the activity stretch require continuous monitoring by the municipal health wing. Finally, clear land-use agreements, revenue-sharing mechanisms, and maintenance responsibilities must be defined upfront to avoid conflicts between farmers, operators, and local authorities, ensuring that the project remains farmer-friendly, ecologically sensitive, and economically viable over the long term.

7) Project Cost and Period

Table 36.61: Project Cost Estimate for Malikadavu Ambal Padam (Water Lily–Based Farm Tourism Initiative)

Project Cost Estimate - Malikadavu Ambal Padam (Water Lily–Based Farm Tourism Initiative)		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**

1	Detailed ecological assessment, DPR preparation & statutory clearances	10
2	Cleaning, desilting, and restoration of water channels	35
3	Controlled water lily cultivation support & field preparation	15
4	Development of bund-top pathways and temporary wooden walkways	30
5	Small boating infrastructure (row boats, jetties, safety gear)	25
6	Viewing decks, photography points & resting platforms (eco-materials)	20
7	Signage, interpretation boards & wayfinding	8
8	Basic visitor amenities (toilets, drinking water, waste bins – temporary/eco units)	15
9	Capacity building for farmers, SHGs & local operators	7
10	Project management, monitoring & contingency	10
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 1.0-1.25 Crores

Table 36.62: Project Duration for Malikadavu Ambal Padam (Water Lily–Based Farm Tourism Initiative)

Project Duration - Malikadavu Ambal Padam (Water Lily–Based Farm Tourism Initiative)			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Project Preparation & Approvals	Ecological assessment, stakeholder consultations, DPR preparation, statutory clearances	3 months
2	Water System Restoration	Cleaning and desilting of water channels, flow improvement works	3 months
3	Agricultural & Ecological Interventions	Water lily cultivation support, field preparation, bund strengthening	2 months
4	Tourism Infrastructure Development	Walkways, viewing decks, jetties, boating infrastructure, signage	4 months
5	Community Capacity Building	Training of farmers, SHGs, boat operators, safety protocols	1 month
6	Pilot Operations & Soft Launch	Trial runs, visitor management systems, feedback and fine-tuning	1 month
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 12-14 months

36.4.17 Nelpurakadavu Farm Tourism

1) Project Brief



The Nelpurakadavu Farm Tourism Project proposes the revitalisation of one of Haripad's oldest and most historically significant riverine nodes into a flagship, heritage-led farm tourism destination. With a history spanning over a century, Nelpurakadavu once functioned as a vital trans-shipment hub, where agricultural produce from Haripad was transported through canals and the Achankovil River to the Travancore kingdom, including for temple offerings at Sree Padmanabhaswamy Temple. Today, the historic light mast, canals, and riverbanks stand neglected due to siltation, pollution, and lack of maintenance. The project seeks to restore this legacy by combining canal rejuvenation, heritage conservation, and immersive farm-based tourism experiences.

Need for the Project

Nelpurakadavu's strategic location amidst extensive paddy fields and its historic role in Haripad's agrarian economy present a strong opportunity for heritage-based rural tourism. However, declining canal health, underutilised river edges, and the absence of organised visitor facilities have limited its potential. The project is required to restore canal functionality, improve environmental conditions, generate alternative livelihoods for farmers, and create a structured farm tourism destination that strengthens Haripad's rural economy while conserving its agricultural and cultural heritage.

Aim of the Project

The aim of the Nelpurakadavu Farm Tourism Project is to transform a neglected historic riverine landscape into a vibrant, eco-friendly farm tourism hub that celebrates Haripad's agricultural traditions, enhances local livelihoods, and offers immersive, year-round experiential tourism rooted in heritage, ecology, and community participation.

Project Objectives

- Revive Nelpurakadavu's historic identity through conservation of the light mast and canal-based infrastructure.
- Restore canal navigability and water quality through desilting and ecological interventions.
- Develop a safe, accessible, and attractive canal-front public realm for visitors and local communities.
- Promote experiential farm tourism that supports farmers, SHGs, and local enterprises.
- Strengthen Haripad's position within regional eco-tourism and agri-tourism circuits.

2) Location and Ownership

The project is located at Nelpurakadavu and is located very close to the PWD guest house, Haripad.

Land Ownership	Private
Ward Number	8, 9
Project Area	Approx 91.5 Acres
Survey Number	414-1(p), 414-6(p), 470-1(p), 470-2(p), 467(p), 466(p), 472-1(p), 472-2(p), 494(p), 413, 471, 495

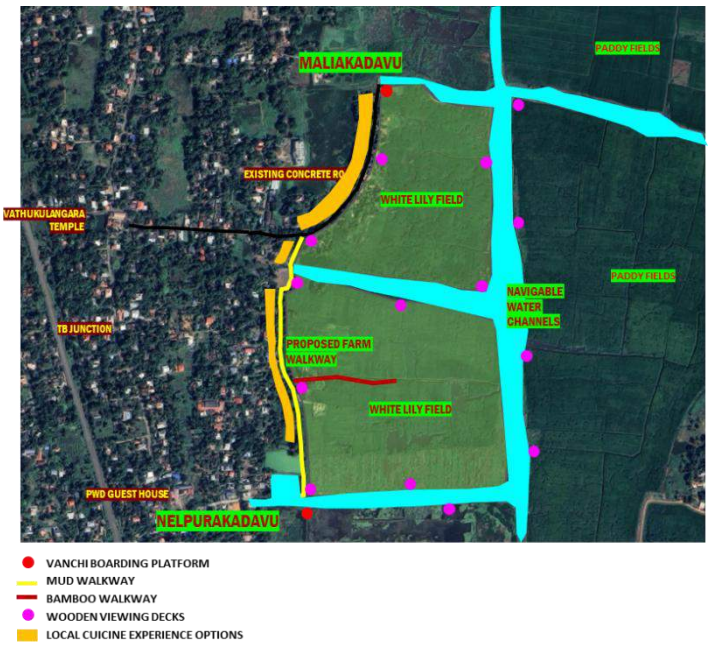


Figure 36.44 : Location of Nelpurakadavu Farm Tourism



Figure 36.45 : Existing condition of Nelpurakadavu area

3) Project Components

The Nelpurakadavu Farm Tourism Project is envisioned as a model for heritage-led, community-driven agri-tourism, seamlessly integrating canal restoration, cultural memory, and experiential learning - positioning Haripad as a distinctive destination for sustainable rural tourism in Kerala. The various components that will form part of the project include:

1. Heritage & Water Infrastructure
   - Reconstruction of the historic Nelpurakadavu light mast as a landmark feature
   - Canal desilting, cleaning, and restoration to ensure navigability
   - Strengthening and protection of canal banks and river edges
2. Boating & Canal Connectivity
   - Development of a boating terminal at Nelpurakadavu
   - Self-row boating routes connecting Nelpurakadavu and Malikadavu
   - Safety measures including railings, lighting, life-saving equipment, and CCTV
3. Canal-Front Public Spaces
   - Promenades with seating, shaded pavilions, and viewing decks
   - Landscape and hardscape work using context-sensitive materials
   - Barrier-free access, signage, and wayfinding systems
4. Farm Tourism & Experiential Activities
   - Designated farm trails, demonstration plots, and crop identification panels

- Hands-on activities: paddy cultivation, irrigation displays, farmer-for-a-day programmes
- Farm-to-table café spaces and local produce kiosks

5. Learning, Recreation & Family Facilities
   - Interactive knowledge sessions with farmers
   - Children-friendly zones (waterwheels, mud play, nature learning)
   - Photography points and seasonal ambal (water lily) viewing areas
6. Workshops & Community Engagement
   - Composting, seed-ball making, organic farming workshops
   - Capacity building for farmers, SHGs, and local guides
7. Support Amenities
   - Toilets, drinking water points, waste management systems
   - Parking zones, bicycle rental points, first-aid and tourist helpdesk



Figure 36.46 : Inspiration images to showcase intended components and activites as part of Nelpurakadavu Farm Tourism



Figure 36.47 : AI Generated conceptual views of Proposed Nelpurakadavu Farm Tourism Areas

4) Agencies Responsible

Table 36.63 : Agencies responsible for Nelpurakadavu Farm Tourism Project

Agencies responsible for Nelpurakadavu Farm Tourism Project		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Overall project coordination, local approvals, asset ownership	Haripad Municipality

2	Canal rejuvenation, desilting, bank protection, hydrological works	Irrigation Department, Govt. of Kerala
3	River and canal navigation clearance, boating safety standards	Inland Water Transport (IWT) Department, Kerala
4	Heritage conservation guidance for light mast and historic features	Department of Archaeology, Govt. of Kerala
5	Farm tourism planning, agri-experiential activities, farmer engagement	Department of Agriculture Development & Farmers' Welfare
6	Promotion of farm tourism, visitor programming, marketing support	Department of Tourism, Govt. of Kerala
7	Environmental safeguards, wetland and biodiversity protection	Kerala State Biodiversity Board (KSBB)
8	Community participation, SHG involvement, local enterprise support	Kudumbashree Mission
9	Operation of farm cafés, workshops, local produce kiosks	Farmer Producer Organisations (FPOs) / Local Farmer Groups
10	Landscape design, public space development, urban design inputs	District Town Planning Office / empanelled consultants
11	Safety, crowd management, festival-time regulation	Kerala Police & District Administration
12	Maintenance of public amenities and canal-front facilities	Haripad Municipality / Community-based O&M agencies

5) Suggested Implementation Mechanism

The project shall be implemented through a phased and multi-agency coordination model led by Haripad Municipality as the nodal authority. Initial phases will focus on canal desilting, bank strengthening, and reconstruction of the historic light mast, executed in coordination with the Irrigation Department and Inland Waterways Authority of Kerala. Tourism-oriented infrastructure - such as promenades, boating terminals, and public amenities - shall follow, supported by the Department of Tourism and Kudumbashree for community-based operations. Farm tourism activities, guided experiences, and learning programmes will be developed in partnership with the Department of Agriculture and local farmers' groups. Where feasible, PPP or community-managed models may be adopted for boating operations, cafés, and experiential activities, with clear O&M frameworks and safety protocols.

6) Other Associated Issues to be addressed

Given Nelpurakadavu's ecological sensitivity and agricultural setting, strict environmental safeguards must be ensured during construction and operations to prevent pollution, bank erosion, and disturbance to farming activities. Seasonal flooding and fluctuating water levels require adaptive design of promenades and boating infrastructure. Continuous water quality monitoring, solid waste management, and control of plastic usage are essential to maintain environmental integrity. Crowd management during peak tourist seasons, safety along canal

edges, boating regulations, and protection of nearby private agricultural lands must be carefully addressed through signage, surveillance, and operational guidelines. Long-term success will also depend on capacity building of farmers and SHGs, equitable benefit-sharing mechanisms, and consistent maintenance to prevent degradation of restored canals and public spaces.

7) Project Cost and Period

Table 36.64: Project Cost Estimate for Nelpurakadavu Farm Tourism Project

Project Cost Estimate - Nelpurakadavu Farm Tourism Project		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Canal desilting & navigability restoration	120
2	Reconstruction of historic light mast	10
3	Boating terminal & basic water transport facilities	25
4	Canal-front promenades, seating & pavilions	35
5	Safety railings, lighting, CCTV & signage	20
6	Landscaping & hardscaping	20
7	Farm trails, demonstration zones & interpretation	15
8	Visitor amenities (toilets, kiosks, resting spaces)	20
9	Community activity infrastructure & workshops	10
10	Design, supervision & contingencies	10
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 3.0-3.5 Crores

Table 36.65: Project Duration for Nelpurakadavu Farm Tourism Project

Project Duration - Nelpurakadavu Farm Tourism Project			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Planning & Approvals	Surveys, DPR preparation, statutory clearances	3 months
2	Water System Restoration	Canal desilting, bank stabilisation	5 months
3	Core Infrastructure	Light mast reconstruction, boating terminal	4 months
4	Public Realm Development	Promenades, seating, landscaping, lighting	4 months
5	Tourism & Farm Experience Setup	Trails, demonstration zones, kiosks	3 months
6	Operational Readiness	Safety checks, community training, trial runs	2 months
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			

The overall duration required for installation of one unit would be around 18-24 months

36.4.18 Narayana Kulam- Pond rejuvenation & pond front redevelopment- near Kuttedath Junction

1) Project Brief



The proposed Narayana Kulam – Pond Rejuvenation & Pond-Front Redevelopment project focuses on the restoration and transformation of one of the key neighbourhood water bodies in Haripad town. This pond, located near Kuttedath Junction, plays an important ecological and social role in the area. The project involves scientific cleaning, desilting, structural strengthening, and systematic improvement of the pond and its surroundings. In addition to restoring its environmental health, the proposal envisions the creation of a well-designed public space with seating areas, walking tracks, shaded pavilions, and traditional street lighting, thereby transforming the pond-front into an active community node. As the site falls within a flood-prone zone, the rejuvenated pond will also act as an effective retention basin for stormwater management, contributing significantly to Haripad's flood resilience efforts.

Need for the Project

Narayana Kulam has experienced extensive siltation, edge erosion, and a decline in water quality due to years of inadequate maintenance. As a result, the pond's holding capacity has significantly reduced, limiting its ability to manage stormwater in a flood-prone part of Haripad. The surrounding neighbourhood also suffers from a lack of dedicated, accessible, and safe public spaces for community interaction, and the underdeveloped pond-front areas further discourage daily use, diminishing the site's social value. Strengthening traditional water bodies like Narayana Kulam is essential to Haripad's climate resilience and ecological health. Its rejuvenation will not only improve local environmental conditions but also enhance public amenities and restore the pond's natural water-retention and flood-mitigation functions.

Aim of the Project

The aim of the Narayana Kulam – Pond Rejuvenation & Pond-Front Redevelopment project is to restore the ecological health and functional capacity of the pond while transforming its surroundings into a vibrant, accessible, and culturally rooted public space for the residents of Haripad Town. The project seeks to enhance the pond's ability to serve as a stormwater retention basin during heavy rains, improve its structural stability through pitching and desilting, and create a welcoming environment equipped with walking tracks, seating, shaded pavilions, and traditional lighting. Through these coordinated interventions, the project strives to enhance neighbourhood wellbeing, strengthen local climate resilience, and preserve the heritage value of one of Haripad's important water bodies.

Project Objectives

- Enhance Water Quality & Capacity: Implement systematic cleaning, desilting, and ecological restoration to improve the pond's water quality and holding capacity.
- Strengthen Structural Stability: Construct pitching walls and reinforce pond edges to ensure long-term durability and prevent erosion.
- Develop Inclusive Public Spaces: Redevelop the pond-front into a welcoming, multi-use public space with seating, lighting, pathways, and shaded pavilions.

- Improve Accessibility & Safety: Upgrade circulation paths and lighting to ensure safe, barrier-free access for all users.
- Increase Stormwater Management Efficiency: Expand the pond's stormwater retention potential to support local flood mitigation.
- Promote Environmental Health: Enhance overall ecological quality and encourage biodiversity in and around the pond.
- Support Community Well-being: Provide high-quality social infrastructure that enriches public life and strengthens liveability in Haripad.



Figure 36.48 :Image showing existing condition of Narayana Kulam, Pond Near Kuttedath Junction, Haripad

2) Location and Ownership

Positioned as in Figure 34.4 near the prominent Kuttedath Junction, Narayana Kulam serves as an ecologically significant catchment and a socially important landmark within the urban fabric. Its location enhances its role as a community node, making its rejuvenation vital for strengthening environmental resilience and improving neighbourhood liveability.

Land Ownership	Haripad Municipality
Ward Number	2
Project Area	Approx. pond area alone 43 cents
Survey Number	72(p)

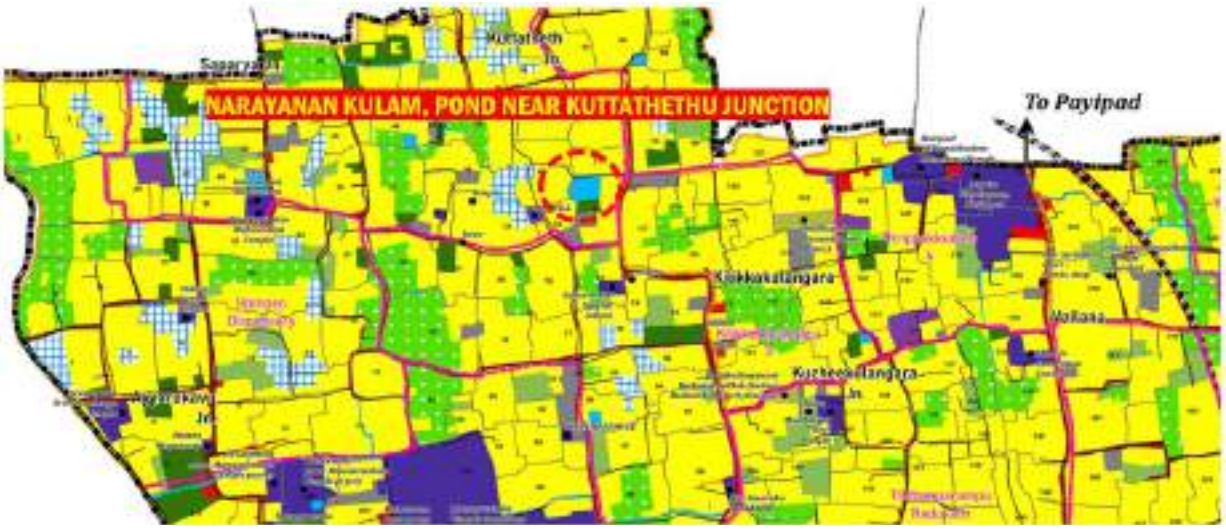


Figure 36.49 : Location of Narayana Kulam, Pond Near Kuttathethu Junction Haripad

3) Project Components

The various components that will form part of the project include:



Figure 36.50 : Satellite image showing the location and context of Narayana Kulam, Pond Near Kuttedath Junction Haripad

1. Desilting: To restore the pond's original depth, improve water-holding capacity, and enhance overall water quality.
2. Edge Reshaping: To stabilise the pond perimeter and create a uniform, erosion-resistant edge profile.
3. Stone Pitching Walls: To protect the pond edges from erosion and ensure long-term structural durability.
4. Retaining Wall Strengthening: To reinforce existing boundary structures and prevent collapse or seepage.
5. Inlet–Outlet Improvement: To regulate water inflow and outflow, reduce stagnation, and support improved water circulation.
6. Walkway Construction: To provide continuous, safe pedestrian movement around the pond and support daily community use.
7. Viewing Decks & Platforms: To create designated spaces for leisure, relaxation, and visual engagement with the waterbody.
8. Seating & Shaded Pavilions: To enhance user comfort and encourage social interaction along the pond-front.
9. Landscape Planting: To introduce native vegetation that improves ecological quality and creates shaded, green buffers.
10. Barrier-Free Pathways: To ensure universal accessibility and safe movement for all users, including elderly and differently abled individuals.
11. Entry Plazas & Signage: To establish clear access points and improve wayfinding from surrounding neighbourhood links.
12. Lighting Installations: To improve night-time visibility, strengthen site safety, and enhance the public realm after dark.
13. Stormwater Retention Features: To increase natural water absorption, reduce runoff, and support flood mitigation.
14. Habitat Zones & Aquatic Planting: To strengthen ecological diversity and support healthier pond ecosystems.
15. Public Amenities (bins, drinking water, utilities): To provide essential support services that improve daily usability and cleanliness.



Figure 36.51 : Conceptual view of proposed Narayana Kulam- Pond rejuvenation & pond front redevelopment

4) Agencies Responsible

The project may be implemented by Haripad Municipality directly or through any agency nominated by the Municipality. Support and coordination may also be sought from Haritha Kerala Mission (for greening works) and the Public Works Department (for pathways and related infrastructure). The feasibility of obtaining financial assistance from departments such as PWD, KTDC, Irrigation Department, and K-DISC (Kerala State Innovation Council) may be explored. A Public–Private Partnership (PPP) model may also be considered for project implementation and long-term maintenance.

5) Suggested Implementation Mechanism

The project shall be implemented through a phased and multi-agency mechanism led by the Haripad Municipality as the nodal authority. A Project Management Committee (PMC) comprising representatives from the Municipality, Minor Irrigation Department and other relevant departments/institutions/organisations shall be constituted to ensure coordinated decision-making and timely execution.

In the pre-implementation phase, detailed site surveys, hydrological studies, environmental assessments, and preparation of the Detailed Project Report (DPR) shall be carried out by appointed planning and design consultants. Necessary statutory approvals and stakeholder consultations, including with local residents, shall be completed at this stage.

The implementation phase shall be executed in clearly defined packages, including desilting and water restoration works, structural repairs to pond walls, stormwater integration, and pond-front public realm development. Works shall be tendered and awarded to qualified contractors, with regular technical supervision by concerned authorities.

The post-implementation phase shall focus on testing, commissioning, and landscaping establishment, followed by the preparation of a long-term Operation and Maintenance (O&M) plan. Routine maintenance shall be entrusted to the Haripad Municipality, with community participation through local resident to ensure sustainability, safety, and continued public use of the rejuvenated pond precinct.

6) Other Associated Issues to be addressed

In addition to the planned restoration and redevelopment works, several associated issues must be managed to ensure the effectiveness and sustainability of the rejuvenation effort at Narayana Kulam. Environmental concerns such as controlling sediment disposal, preventing pollution

during construction, and mitigating disturbance to existing aquatic life are critical. Proper handling of construction waste, avoiding chemical runoffs, and ensuring that machinery operations do not degrade water quality are essential safeguards. The site also requires measures to manage seasonal water fluctuations, control mosquito breeding, and prevent encroachments along the pond edges. Attention must be given to maintaining safe pedestrian access during construction, ensuring noise and dust control for nearby residents, and protecting existing vegetation wherever possible. Addressing these issues holistically will support a cleaner, safer, and more ecologically resilient pond environment throughout the rejuvenation process.

7) Project Cost and Period

Table 36.66: Project Cost Estimate for Narayana Kulam- Pond rejuvenation & pond front redevelopment

Project Cost Estimate - Narayana Kulam- Pond rejuvenation & pond front redevelopment		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Desilting, cleaning, strengthening of pond walls and inlet & outlet drains cost around	15
2	Walkway, seating, planter boxes, landscaping, pavilions and other infrastructure costs	30
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 45-55 Lakhs

36.4.19 Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment

1) Project Brief



The Kuzhiyilikulangara Pond Rejuvenation & Pond-Front Redevelopment project is envisioned as an integrated environmental and community infrastructure upgrade within Haripad Municipality. Kuzhiyilikulangara Pond, though compact in size, is an important neighbourhood water body that contributes to the ecological balance and social life of the surrounding residential area. The project proposes scientific cleaning, desilting, structural strengthening, and enhancement of the pond's holding capacity, followed by comprehensive redevelopment of the pond-front into a safe, accessible, and aesthetically improved public space. Planned interventions include pitching walls, seating areas, gathering space, kids play area, lighting and landscaped surroundings. Given its location within a flood-prone zone of the town, the rejuvenated pond will also serve as a functional retention basin for stormwater, thereby supporting local flood mitigation and contributing to Haripad's climate resilience initiatives.

Need for the Project

The Kuzhiyilikulangara Pond area presents several critical needs that justify its rejuvenation and redevelopment. Over time, the pond has experienced significant siltation and a decline in water quality due to the absence of systematic maintenance,

while structural deterioration of the pond edges has further reduced its stability and water-holding efficiency. The surrounding neighbourhood lacks adequate open spaces and community-level social infrastructure, limiting opportunities for social interaction and recreational use. Additionally, the site lies within a flood-prone zone, and the reduced capacity of the pond has weakened its function as a natural stormwater retention basin. Revitalizing such small neighbourhood water bodies is essential for enhancing environmental quality, improving stormwater management, and strengthening local resilience in Haripad. Upgrading the pond-front into a safe, accessible, and inclusive public space will significantly contribute to improved liveability, safety, and community engagement within the locality.

Aim of the Project

The aim of the Kuzhiyilikulangara Pond Rejuvenation & Pond-Front Redevelopment project is to restore the pond's ecological health and improve its structural stability while transforming its surroundings into a vibrant, neighbourhood-friendly public space. By enhancing the pond's water-holding capacity, developing user-friendly amenities, and strengthening its role as a stormwater retention basin, the project seeks to support flood resilience and enhance the quality of life for residents of Haripad town

Project Objectives

- Enhance Water Quality & Capacity: Undertake scientific cleaning, desilting, and ecological restoration to improve the pond's water quality and increase its storage capacity.
- Strengthen Structural Stability: Construct pitching walls and reinforce the pond edges to ensure long-term structural safety and prevent erosion.
- Create a Pedestrian-Friendly Public Realm: Develop an accessible pond-front that includes walking tracks, seating areas, shaded pavilions, and adequate lighting to promote safe and comfortable public use.
- Improve Accessibility & Visual Appeal: Provide well-defined access pathways and upgrade the site's aesthetics to create a visually appealing and user-friendly environment.
- Improve Stormwater Management: Enhance the pond's role as a functional stormwater retention basin to support flood mitigation in this vulnerable, flood-prone locality.
- Strengthen Community Infrastructure: Develop high-quality social and recreational infrastructure to support neighbourhood-level activities and enhance local liveability.



Figure 36.52 : Image showing the existing condition of Kuzhiyilikulangara Pond, Haripad

- Promote Ecological Enhancement & Biodiversity: Introduce thoughtful landscape design to improve environmental quality, support local biodiversity, and reinforce the ecological value of the pond.

2) Location and Ownership

Kuzhiyilikulangara Pond, as shown in Figure 36.53, is a small yet significant neighbourhood water body located within a residential area of Haripad Town and situated in a flood-prone zone of the town. The pond plays an important role in local stormwater retention, ecological balance, and everyday community life. Due to siltation, structural deterioration, and lack of maintenance, its environmental and functional performance has declined. The proposed rejuvenation aims to restore the pond as a resilient water system and transform the pond-front into a safe, accessible, and community-oriented public space.



Figure 36.53: Satellite image showing the location and context of Kuzhiyilikulangara Pond , Haripad

Land Ownership	Haripad Municipality
Ward Number	3
Project Area	11 cents
Survey Number	110(p)



Figure 36.54 : : Location of Kuzhiyilikulangara Pond

3) Project Components

The various components that will form part of the project include:

- **Pond Cleaning, Scientific Desilting & Silt Disposal:** Scientific removal of accumulated silt and debris to improve water quality, restore depth, and increase the effective storage capacity of the pond.

- **Pitching Wall Construction & Edge Reinforcement** : Construction of 32 metres (approx..) long Dry Rubble Masonry (DRM) pitching along the pond edge to prevent erosion, stabilize embankments, and ensure long-term structural integrity.
- **Inlet–Outlet Improvement & Stormwater Management Works** : Improvement of inlet and outlet structures to regulate inflow and outflow, facilitate stormwater retention during heavy rainfall, and enhance flood mitigation capacity. Use of permeable tiles for ground water recharging.
- **Walkways, Circulation Paths & Access Improvements**: Development of pedestrian walkways and circulation paths with a total paved area of 109.99 sq.m approx., ensuring safe, barrier-free access around the pond for public use.
- Children's Play & Community Spaces : Sand pit and children's play area
- Provision of informal community spaces to encourage neighbourhood interaction.
- **Landscaping & Green Infrastructure**
- **Lighting Infrastructure (Pathway & Lighting) :** Installation of 5 lamp posts (count may change according to the site condition) along pathways and activity areas to improve safety, visibility, and night-time usability.
- **Safety Measures, Signage & Site Furnishing** : Provision of safety railings, information signage, seating elements, waste bins, and site furniture to ensure user safety, orientation, and overall site identity.

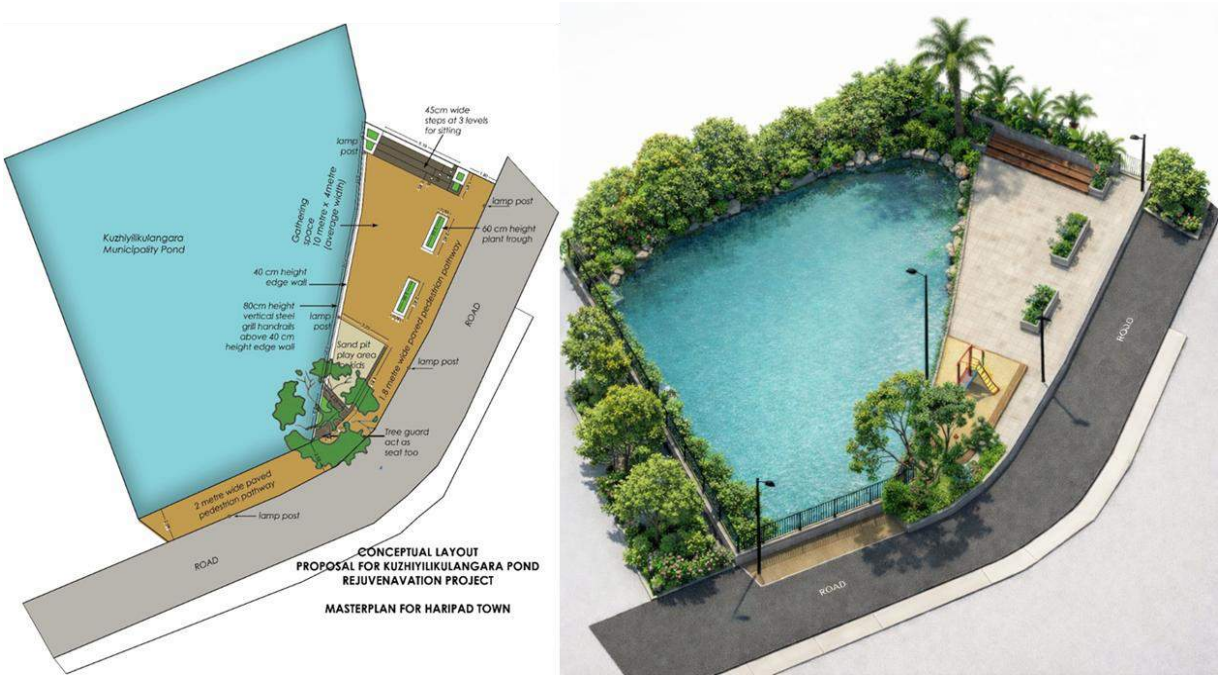


Figure 36.55 : Conceptual plan and view of proposed Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment

4) Agencies Responsible

The project may be implemented by Haripad Municipality directly or through any agency nominated by the Municipality. Support and coordination may also be sought from Haritha Kerala Mission (for greening works) and the Public Works Department (for pathways and related infrastructure). The feasibility of obtaining financial assistance from departments such as PWD, KTDC, Irrigation Department, and K-DISC (Kerala State Innovation Council) may be explored. A Public–Private Partnership (PPP) model may also be considered for project implementation and long-term maintenance.

5) Suggested Implementation Mechanism

The project shall be implemented through a phased and multi-agency mechanism led by the Haripad Municipality as the nodal authority. A Project Management Committee (PMC) comprising representatives from the Municipality, Minor Irrigation Department and other relevant departments/institutions/organisations shall be constituted to ensure coordinated decision-making and timely execution.

In the pre-implementation phase, detailed site surveys, hydrological studies, environmental assessments, and preparation of the Detailed Project Report (DPR) shall be carried out by appointed planning and design consultants. Necessary statutory approvals and stakeholder consultations, including with local residents shall be completed at this stage. The implementation phase shall be executed in clearly defined packages, including desilting and water restoration works, structural repairs to pond walls, stormwater integration, and pond-front public realm development. Works shall be tendered and awarded to qualified contractors, with regular technical supervision by concerned authorities.

The post-implementation phase shall focus on testing, commissioning, and landscaping establishment, followed by the preparation of a long-term Operation and Maintenance (O&M) plan. Routine maintenance shall be entrusted to the Haripad Municipality, with community participation through local resident to ensure sustainability, safety, and continued public use of the rejuvenated pond precinct.

6) Other Associated Issues to be addressed

In addition to core restoration activities, several associated issues must be managed to ensure the successful rejuvenation of Kuzhiyilikulangara Pond. These include controlling temporary environmental impacts such as silt disposal, water contamination risks, and disturbance to existing vegetation during construction. Proper drainage management is essential to avoid local flooding or stagnation during the works. Safety concerns related to construction activities, especially in a densely inhabited neighbourhood, must be handled through clear barricading, signage, and regulated site access. Utility lines in the vicinity may require careful relocation or protection. Attention should also be given to long-term maintenance planning to prevent recurrence of siltation and deterioration after project completion.

7) Project Cost and Period

Table 36.67: Project Cost Estimate for Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment

Project Cost Estimate - Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Desilting, cleaning, strengthening of pond walls and inlet & outlet drains	15.0
2	Walkway, Kids' Play area, seating, planter boxes, landscaping, pavilions on stilts and other infrastructure	15.0
3	Contingency (approx. 7 - 8%)	3.0
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 35 Lakhs

The project can be initiated in the first phase followed by 75% completion in the second and full completion in the third phase.

36.4.20 Rejuvenation of the Municipality pond near Kolath Devi Temple & pond front redevelopment

1) Project Brief



Rejuvenation of the Municipality pond near Kolath Devi Temple & Pond-Edge Redevelopment project is envisioned as a culturally sensitive and community-oriented intervention within Haripad Municipality. The Kolath Devi Temple is a prominent spiritual centre in the region, deeply rooted in the cultural identity of local residents. Reviving the pond and upgrading the surrounding edges into a safe, accessible, and elderly-friendly public space will significantly enhance both the functional and social value of the area. The project proposes systematic cleaning and desilting of the pond, strengthening and repair of pond walls, and comprehensive development of the pond-front with barrier-free walkways, shaded pavilions, seating, planters, recreation decks, and traditional lighting. Given the location of the site within a flood-prone zone, the rejuvenated pond will also support stormwater retention and play an important role in Haripad's broader climate resilience strategy.

Need for the Project

The pond has undergone siltation, structural deterioration, and a lack of periodic maintenance, reducing its functionality and overall condition. The surrounding neighbourhood, particularly its elderly residents, lacks safe and accessible open spaces for social interaction and daily walks, highlighting the need for improved public amenities. In addition to that, the pond's diminished holding capacity limits its effectiveness as a natural stormwater retention basin in a flood-prone locality. Redeveloping the pond-front would enhance safety, accessibility, and comfort for devotees and local residents, while also contributing to environmental improvement, aesthetic upliftment, and the overall wellbeing of the neighbourhood.

Aim of the Project

The aim of Rejuvenation of the Municipality pond near Kolath Devi Temple & Pond-Edge Redevelopment project is to restore the pond's ecological health while creating a calm, accessible, and elderly-friendly public space that supports daily gatherings and community interaction. By improving the pond's holding capacity, strengthening its structure, and introducing barrier-free amenities, the project strives to enhance the wellbeing of the neighbourhood and contribute meaningfully to Haripad's environmental resilience.

Project Objectives

- **Ecological Restoration and Water Management:** Restore the pond through scientific desilting and cleaning to improve water quality, increase storage capacity, and enhance its overall ecological health.

- **Inclusive Public Space Development:** Redesign the pond-front as a safe, comfortable, and senior-friendly social space with seating, shaded pavilions, lighting, and well-defined walkways.
- **Universal Accessibility:** Ensure barrier-free movement throughout the site to accommodate elderly users and persons with limited mobility.
- **Flood Mitigation and Resilience:** Strengthen the pond's role as a stormwater retention basin to reduce flood risks in the surrounding locality.
- **Environmental Enhancement and Community Engagement:** Improve local environmental conditions while encouraging community interaction, recreation, and a sense of shared ownership of the space.



Figure 36.56 : Images showing existing condition of Karimbalil Palace, Haripad

2) Location and Ownership

The project site is the Municipality pond located near the culturally significant Kolath Devi Temple in Haripad, as shown in Fig The pond is owned by Haripad Municipality. Strategically positioned within a residential neighbourhood, the site serves both as a community open space and a natural stormwater retention basin in a flood-prone area

Land Ownership	Travancore Devaswom Board
Ward Number	6
Project Area	16 Cents
Survey Number	152(p)



Figure 36.57 : Location of pond near Kolath Devi Temple

3) Project Components

1. **Surveys, Investigations & Concept DPR :** Rapid site survey and preparation of basic drawings and estimates to guide project execution.
2. **Scientific Desilting & Pond Cleaning :** Removal of accumulated silt and debris to restore water depth and improve water quality.
3. **Pond Wall Repair & Edge Strengthening :** Repair and stabilization of pond edges to prevent erosion and ensure structural safety.
4. **Stormwater Integration & Drainage Management :** Improvement of inlet–outlet systems to regulate water flow and support flood mitigation.
5. **Water Quality Improvement & Ecological Measures :** Introduction of bio-remediation and aeration measures to enhance ecological health.
6. **Pedestrian Pathway & Circulation Works :** Development of paved walkways to improve access and circulation around the pond.
7. **Gazebos with Wooden Floors on Stilts :** Construction of shaded gazebos for seating and viewing, integrated sensitively with the pond edge.
8. **Wooden Deck at Pond Edge :** Creation of a small viewing deck to allow safe interaction with the water edge.



Figure 36.58 : Satellite image showing the location and context of the Municipality pond near Kolath Devi Temple

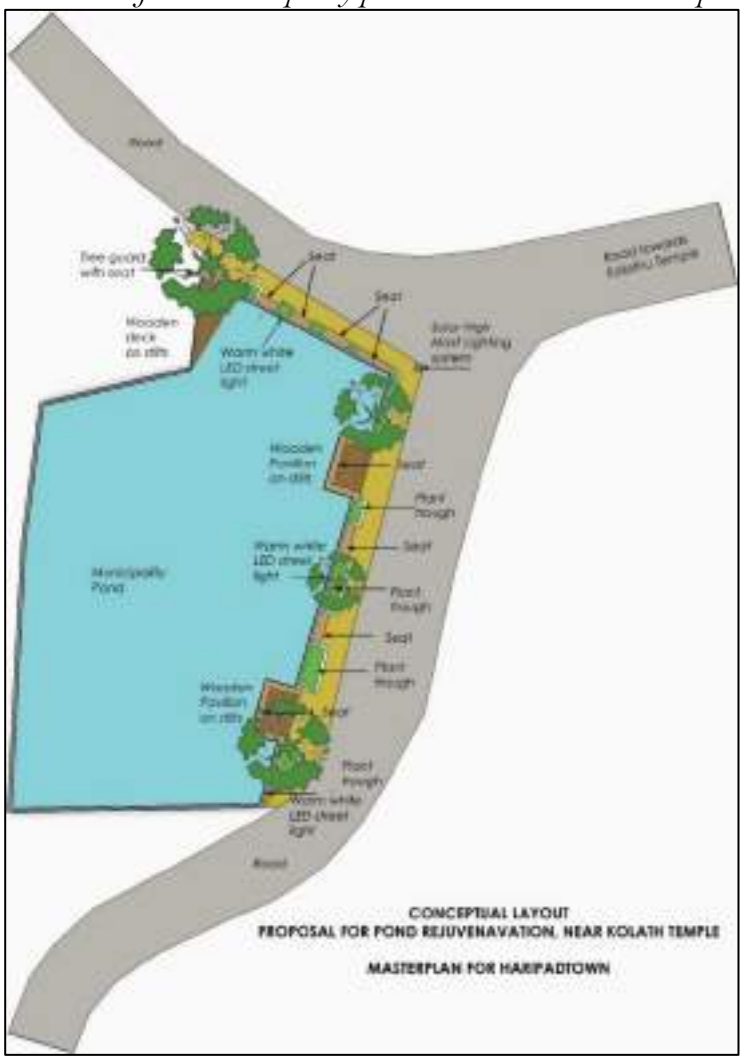


Figure 36.59 : Proposed conceptual Layout for Redevelopment of pond near Kolath Devi Temple & Pond-Edge

9. **Pond-Edge Seating & Planter Boxes :** Provision of continuous seating and raised planter boxes to enhance usability and aesthetics.
10. **Landscape Development & Planting :** Plantation of trees, shrubs, and ground cover to improve microclimate and visual appeal.
11. **Lighting, Electrical & Safety Installations :** Installation of solar and street lighting to enhance safety and night-time usability.
12. **Universal Accessibility Infrastructure :** Provision of ramps, handrails, and non-slip surfaces for inclusive access.



Figure 36.60 : Pond near Kolath Devi Temple & Pond-Edge Redevelopment concept (Proposed)

4) Agencies Responsible

The project may be implemented by Haripad Municipality directly or through any agency nominated by the Municipality. Support and coordination may also be sought from Haritha Kerala Mission (for greening works) and the Public Works Department (for pathways and related infrastructure). The feasibility of obtaining financial assistance from departments such as PWD, KTDC, Irrigation Department, and K-DISC (Kerala State Innovation Council) may be explored. A Public–Private Partnership (PPP) model may also be considered for project implementation and long-term maintenance.

5) Suggested Implementation Mechanism

The project shall be implemented through a phased, multi-agency mechanism led by Haripad Municipality as the nodal authority. A Project Management Committee (PMC), comprising representatives from the Municipality, Minor Irrigation Department, and other relevant agencies, shall ensure coordinated decision-making and timely execution.

During the pre-implementation phase, detailed site surveys, hydrological and environmental assessments, DPR preparation, statutory approvals, and stakeholder consultations shall be undertaken. The implementation phase will be executed in defined work packages covering desilting and water restoration, structural repairs, stormwater integration, and pond-front public realm development, through tendered contracts under technical supervision.

The post-implementation phase shall include testing, commissioning, landscaping establishment, and preparation of a long-term Operation and Maintenance (O&M) plan, with

routine maintenance entrusted to the Municipality and supported by community participation to ensure sustainability and continued public use..

6) Other Associated Issues to be addressed

Alongside the core rejuvenation works, several associated issues must be carefully managed during implementation. Proper handling and safe disposal of desilted material is critical to prevent secondary environmental impacts and nuisance to nearby residential areas. There is also a risk of water contamination during construction due to disturbed sediments, debris, or accidental inflow of pollutants, necessitating strict site management and water quality monitoring. Temporary disturbance to existing pond-edge vegetation may occur, requiring protection measures and compensatory plantation. Effective temporary drainage arrangements, along with adequate safety and environmental supervision, are essential to prevent water stagnation and local flooding during the construction period.

7) Project Cost and Period

Table 36.68 : Project Cost Estimate - Rejuvenation of the Municipality pond near Kolath Devi Temple & pond front redevelopment

Project Cost Estimate - Rejuvenation of the Municipality pond near Kolath Devi Temple & pond front redevelopment			
Sl. No.	**Project Component**	**Cost (₹ Crore)**	**Remarks**
1	Desilting, cleaning, strengthening of pond walls and inlet & outlet drains	15.0	Conservation per heritage norms
2	Walkway, Kids' Play area, seating, planter boxes, landscaping, pavilions on stilts and other infrastructure	15.0	Minor structural & interior works
3	Contingency (approx. 7 - 8%)	3.0	Contextual design with vernacular elements
* *Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*			

Total Estimated Cost would be approx. 35 Lakhs

The project can be initiated in the first phase followed by 75% completion in the second and full completion in the third phase.

36.4.21 Kilikke Kulam- Pond rejuvenation & pond front redevelopment

1) Project Brief



The Kilikke Kulam – Pond Rejuvenation & Pond-Front Redevelopment project is envisioned as a neighbourhood-level environmental and recreational upgrade within Ward 2 of Haripad Municipality. Kilikke Kulam is an important pond with an existing walking track, actively used by the residents of the locality. However, inadequate maintenance, vandalism, and structural deterioration have affected both the safety and usability of the space. This project aims to restore the ecological health of the pond, improve its water-retention capacity, and transform

its surroundings into a secure, inclusive, and family-friendly open space. Proposed interventions include cleaning and desilting, repair of pond walls, installation of seating, walkways, shaded pavilions, landscaped planters, traditional lighting, recreation decks, children's play facilities, and CCTV surveillance. As the site lies within a flood-prone part of the town, the rejuvenated pond will also act as a retention basin, supporting Haripad's wider stormwater management and flood mitigation efforts.

Need for the Project

The need for the Kilikke Kulam – Pond Rejuvenation & Pond-Front Redevelopment project arises from the visible deterioration of the pond and its surrounding public spaces due to inadequate periodic maintenance and repeated incidents of vandalism. Although the pond is an important neighbourhood asset, this space is underutilized because of structural damage, poor lighting, and safety concerns, limiting access especially for elderly residents and children. In addition, siltation and reduced pond depth have significantly weakened its function as a natural stormwater retention basin in a flood-prone area of Haripad. Redevelopment is therefore essential to restore the pond's ecological and hydrological role while providing a safe, well-lit, and universally accessible recreational environment. Upgrading Kilikke Kulam will enhance community wellbeing, improve neighbourhood safety, and contribute meaningfully to Haripad's environmental resilience and overall quality of the area.

Aim of the Project

The aim of the Kilikke Kulam – Pond Rejuvenation & Pond-Front Redevelopment project is to restore the pond's ecological condition while creating a safe, welcoming, and family-friendly public space for the people of Ward 2. By improving accessibility, strengthening safety features, and enhancing the pond's capacity to manage stormwater, the project seeks to build a clean, comfortable, and vibrant neighbourhood environment that supports daily recreation and strengthens community wellbeing in Haripad.

Project Objectives

- **Ecological Restoration:** To carry out thorough cleaning, desilting, and restoration of the pond in order to improve water quality and enhance its water-retention capacity.
- **Structural Stability:** To repair and strengthen the existing pond walls, ensuring long-term safety and durability of the structure.
- **Pond-Front Redevelopment:** To redesign the pond-front as an attractive public space with seating areas, shaded pavilions, landscaped planters, walkways, and recreation decks.
- **Inclusive Recreation:** To incorporate dedicated children's play facilities and age-friendly design features that cater to all sections of the community.
- **Safety and Security:** To provide traditional street lighting and CCTV surveillance to improve visibility, enhance user safety, and prevent vandalism.



Figure 36.61 : Image showing existing condition of Kilikke Kulam, Haripad

- **Universal Accessibility:** To enhance accessibility by promoting barrier-free and inclusive movement around the pond.
- **Flood Mitigation:** To enable the pond to function effectively as a stormwater retention basin in this flood-prone area.
- **Community and Environmental Wellbeing:** To improve the overall aesthetic quality, environmental health, and community engagement within Ward 2 of Haripad Municipality.

2) Location and Ownership



Figure 36.62: Satellite image showing the location and context of Kilikke Kulam, near Mannarasala

The Kilikke Kulam, shown in Fig. 34.57, Pond Rejuvenation & Pond-Front Redevelopment Project is a neighbourhood-level environmental and recreational improvement initiative aimed at restoring a Municipality-owned pond and enhancing its surroundings as a safe, inclusive public space. The project site is located at Kilikke Kulam in Ward 2 of Haripad Municipality, near the Kolath Temple Kettukazhcha starting point and in close proximity to the renowned Mannarasala Temple, and is owned and maintained by Haripad Municipality.

Land Ownership	Haripad Municipality
Ward Number	3
Project Area	Approx. 6 cents of pond area
Survey Number	96(p)



Figure 36.63 : Location of Kilikke Kulam near Mannarasala Temple

3) Project Components

The various components that will form part of the project include:

- **Pond Cleaning and Desilting:** Removal of accumulated silt, debris, and waste to improve water quality and increase water-holding capacity.

- **Pond Wall Repair and Strengthening:** Structural repair and stabilization of existing pond walls to ensure safety and long-term durability.
- **Ecological Restoration Measures:** Improvement of the pond's natural ecosystem through appropriate planting and edge treatments.
- **Walking Track and Pathway Upgrades:** Repair and enhancement of existing walkways with safe, durable, and non-slip surfaces.
- **Pond-Front Landscaping:** Development of landscaped areas with planters, native vegetation, and green buffers along the pond edge.
- **Seating and Rest Areas:** Installation of benches and seating spaces at key locations for public use.
- **Shaded Pavilions and Recreation Decks:** Creation of shaded structures and decks for relaxation, social interaction, and community activities.
- **Children's Play Area:** Provision of safe and age-appropriate play equipment within a defined play zone.
- **Lighting Infrastructure:** Installation of street lights to improve visibility and enhance the character of the space.
- **Safety and Surveillance Systems:** Provision of CCTV cameras and related infrastructure to enhance security and prevent vandalism.
- **Universal Accessibility Features:** Barrier-free access including ramps, handrails, and clear pathways to accommodate all users.



Figure 36.64 : Conceptual view of Proposed Kilikke Kulam- Pond Rejuvenation & Pond-Front Redevelopment

4) Agencies Responsible

The project may be implemented by Haripad Municipality directly or through any agency nominated by the Municipality. Support and coordination may also be sought from Haritha Kerala Mission (for greening works) and the Public Works Department (for pathways and related infrastructure). The feasibility of obtaining financial assistance from departments such as PWD, KTDC, Irrigation Department, and K-DISC (Kerala State Innovation Council) may be explored. A Public–Private Partnership (PPP) model may also be considered for project implementation and long-term maintenance.

5) Suggested Implementation Mechanism

The project shall be implemented through a phased, multi-agency framework, with Haripad Municipality as the nodal authority. A Project Management Committee (PMC) comprising representatives from the Municipality, Minor Irrigation Department, and other relevant departments and institutions shall be constituted to ensure coordinated decision-making and timely execution.

During the pre-implementation phase, detailed site surveys, hydrological and environmental studies, and preparation of the Detailed Project Report (DPR) shall be undertaken by appointed consultants, along with obtaining statutory approvals and conducting stakeholder consultations, including with local residents.

The implementation phase shall be carried out through clearly defined work packages covering desilting and water restoration, structural repairs to pond embankments, stormwater integration, and pond-front public realm development. Works shall be tendered to qualified contractors and supervised by the concerned authorities.

The post-implementation phase shall focus on testing, commissioning, landscape establishment, and preparation of a long-term Operation and Maintenance (O&M) plan. Routine maintenance shall be the responsibility of the Haripad Municipality, supported by community participation to ensure sustainability, safety, and continued public use of the rejuvenated pond precinct.

6) Other Associated Issues to be addressed

In addition to the proposed physical interventions, several associated measures are essential to ensure the long-term sustainability of the Kilikke Kulam Pond Rejuvenation and Pond-Front Redevelopment Project. These include effective solid waste management to prevent dumping of household and plastic waste, along with regular water quality monitoring to avoid contamination from surface runoff and sewage inflow. Proper integration of stormwater inlets and outlets is necessary for efficient drainage and flood management during the monsoon. Surveillance, signage, and community vigilance are required to prevent vandalism and misuse of public amenities. Adequate budgetary provisions and institutional arrangements must be ensured for routine maintenance of landscaping, lighting, and supporting infrastructure. Promoting native vegetation, controlling invasive species, and strengthening community awareness and local stewardship will help maintain ecological balance and encourage a sense of ownership among residents.

7) Project Cost and Period

Table 36.69: Project Cost Estimate for Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment

Project Cost Estimate - Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Desilting, cleaning, strengthening of pond walls and inlet & outlet drains	10.0
2	Walkway, Kids' Play area, seating, planter boxes, landscaping, pavilions and other infrastructure	15.0
3	Contingency (approx. 7 - 8%)	3.0
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 30 Lakhs

The project can be initiated in the first phase followed by 75% completion in the second and full completion in the third phase.

36.4.22 Urban Bus Shelters at Danapady and Subramanya Swamy Temple Road

1) Project Brief



The Urban Bus Shelters at Danapady and Subramanya Swamy Temple Road project is proposed as part of Haripad's broader mobility and public-transport improvement strategy, guided by NATPAC's Traffic and Transportation Study for Haripad Region. Danapady Junction and Subramanya Swamy Temple Road are two of the busiest and most culturally significant corridors in Haripad, serving daily commuters, students, workers, and a large number of temple visitors and pilgrims. However, the absence of proper bus shelters at these nodes results in discomfort, traffic disorder, and safety challenges for passengers.This project aims to establish modern, safe, and universally accessible bus shelters equipped with essential amenities such as seating, digital display boards, drinking water kiosks, waste receptacles, charging points, lighting, and barrier-free ramps. Designed with weather protection, improved visibility, and passenger convenience in mind, these shelters will substantially enhance the public transport experience while strengthening Haripad's connectivity to its major religious and tourism destinations.

Need for the Project

Key bus boarding points at Danapady Junction and Subramanya Swamy Temple Road presently lack formal, safe, and comfortable waiting facilities for passengers, despite handling heavy daily footfall. These locations serve major religious destinations such as Subramanya Swamy Temple and Mannarasala Temple, resulting in a continuous inflow of pilgrims and tourists in addition to regular commuters, students, and workers. In the absence of proper shelters, passengers are exposed to harsh weather conditions and are compelled to wait along unsafe roadside edges, leading to discomfort and safety risks. The unorganized waiting environment also contributes to traffic congestion, poor passenger management, and conflicts between pedestrians and vehicular movement. As Haripad aims to strengthen intra-town mobility and enhance its tourism potential, upgrading public transport amenities has become essential. NATPAC's Traffic and Transportation Study for the Haripad Region has identified these locations as priority bus stops, further reinforcing the need for modernized infrastructure. Providing well-designed bus shelters with accessible features will also promote inclusivity by addressing the needs of elderly citizens, children, and persons with disabilities, thereby improving overall urban mobility and public transport efficiency.

Aim of the Project

The aim of this project is to provide safe, comfortable, and modern bus shelters at Danapady and Subramanya Swamy Temple Road, ensuring a dignified waiting environment for daily commuters, pilgrims, and visitors. By offering essential amenities, barrier-free access, and improved passenger information systems, the project seeks to make public transport more user-friendly, reliable, and inclusive for the people of Haripad town.

Project Objectives

- **Infrastructure Development:** Construction of modern, durable, and weather-protected bus shelters at high-demand locations to provide safe and comfortable waiting spaces for passengers.

- **Passenger Amenities:** Provision of essential commuter facilities such as seating, digital information display boards, drinking water kiosks, waste bins, and mobile charging points to enhance convenience and user experience.
- **Universal Accessibility:** Incorporation of barrier-free design features including ramps, tactile indicators, and accessible seating to ensure inclusive access for the elderly, children, and persons with disabilities.
- **Safety and Visibility:** Improvement of passenger safety through adequate lighting, clear sightlines, and well-defined waiting areas that reduce roadside risks and pedestrian–vehicle conflicts.
- **Tourism and Temple Connectivity:** Enhancement of travel convenience for pilgrims and tourists visiting major temples by improving last-mile public transport facilities at key religious corridors.
- **Traffic and Operational Efficiency:** Streamlining of bus boarding and alighting processes to minimize congestion, improve traffic flow, and enhance the efficiency of public transport operations.
- **Alignment with Mobility Planning:** Strengthening of Haripad's public transport infrastructure in accordance with NATPAC's Traffic and Transportation Study and regional mobility improvement recommendations.



Figure 36.65 : Image showing identified location for the bus shelter at (A) Danapady (B) Subramanya Swamy Temple Road

2) Location and Ownership

The project delivers modern, universally accessible bus shelters equipped with smart commuter amenities, significantly enhancing passenger comfort, safety, and waiting experience. It also strengthens public transport connectivity to key religious and tourism destinations, supporting Haripad's mobility and tourism objectives. Locations identified are: Danapady Junction and Subramnya Swamy Temple Road, Haripad.. (Fig 34.66).

Land Ownership	Haripad Municipality
Ward Number	27 & 6
Survey Number	227(p) & 282(p)

3) Project Components

The various components that will form part of the project include:

- **Site Preparation and Platforms**: Site clearance, minor earthwork, levelling, and drainage works, along with construction of raised, non-slip platforms integrated with existing footpaths and pedestrian crossings.

- **Bus Shelter Structures**: At Danapady, a modern, durable shelter with adequate weather protection, ventilation, and visibility; at Subramanya Swamy Temple Road, a Kerala-style shelter with sloping tiled roofs, traditional proportions, wood-finished columns, and stone or laterite finishes compatible with temple architecture.
- **Seating and Waiting Areas**: Adequate seating based on passenger demand, including priority seating for elderly persons, children, and persons with disabilities, along with shaded waiting space for standing passengers.

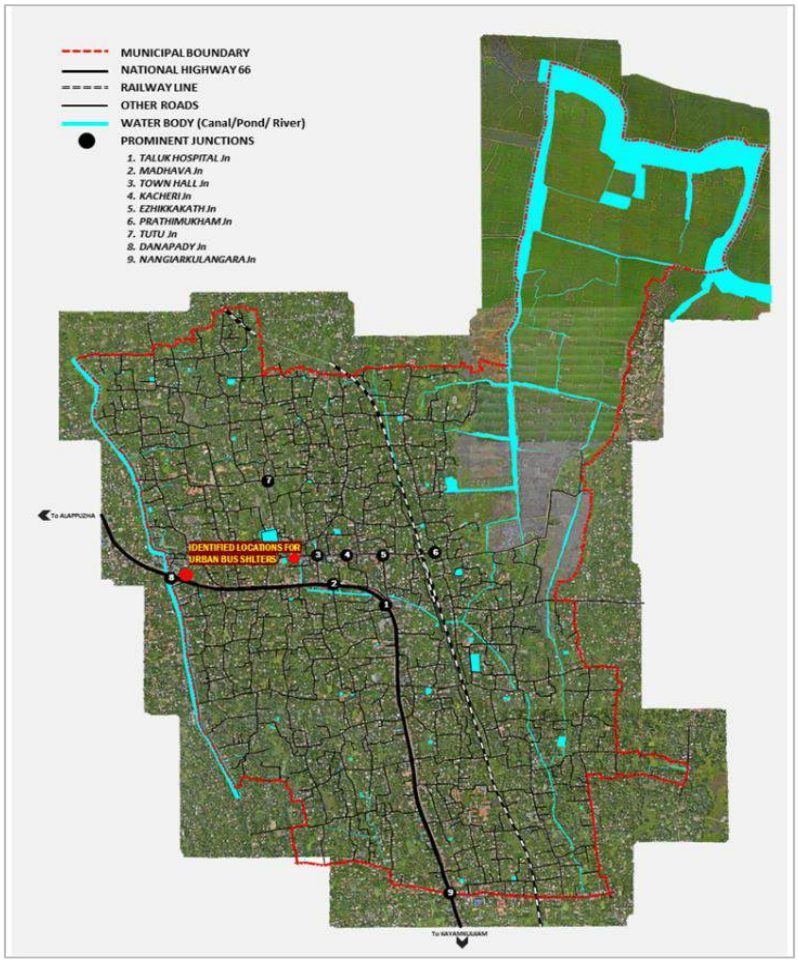


Figure 36.66: Location of Urban Bus Shelters at Danapady and Subramanya Swamy Temple Road

- **Passenger Information Systems:** Digital display boards for routes and arrival information, along with static route maps and timetable boards in Malayalam and English.
- **Universal Accessibility:** Barrier-free access through ramps, tactile paving for visually impaired users, wheelchair-friendly circulation, and accessible seating areas.
- **Safety and Lighting**: Adequate LED lighting, clear sightlines, anti-skid flooring, and well-defined boarding and alighting zones to enhance passenger safety.
- **Passenger Amenities:** Provision of essential commuter facilities such as drinking water (where feasible), segregated waste bins, mobile charging points, and public notice boards.
- **Landscaping and Streetscape Integration:** Landscaping with native plant species and simple streetscape elements, with special emphasis on maintaining a calm and dignified environment along the temple road.
- **Traffic and Operational Improvements**: Organised bus bay markings, improved pedestrian circulation, and smoother boarding and alighting arrangements to reduce congestion and improve traffic flow.
- **Sustainability and Durability:** Use of locally available materials, energy-efficient lighting, and climate-responsive design to ensure durability, low maintenance, and suitability to Kerala's climatic conditions.
- **Operation and Maintenance:** Robust, vandal-resistant fixtures and easy-to-maintain finishes, with clear provisions for regular upkeep by the local authority

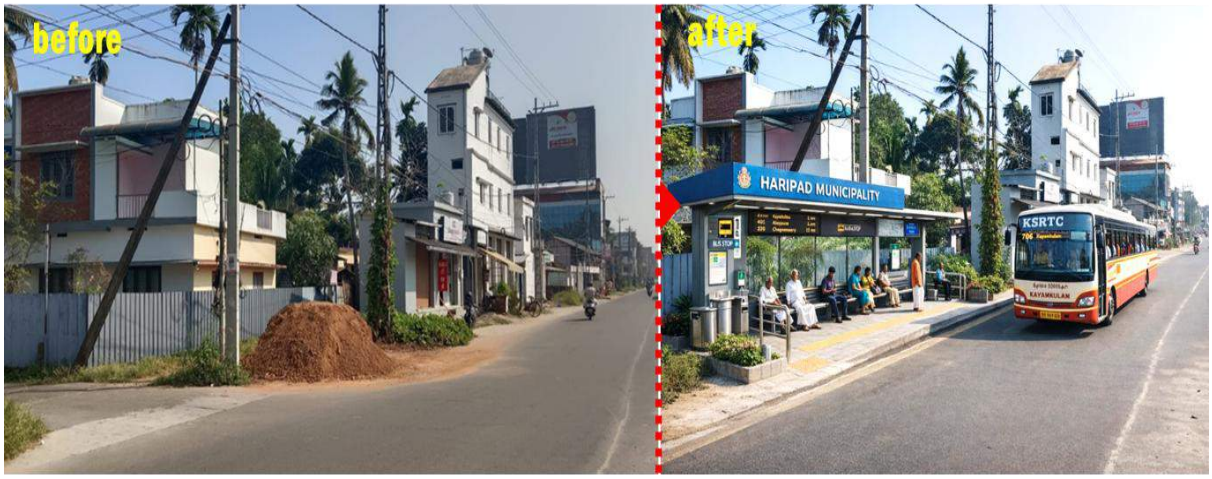


Figure 36.67 : Conceptual view of proposed Urban Bus Shelters at Danapady



Figure 36.68 : Conceptual view of proposed Urban Bus Shelter at Subramanya Swamy Temple Road

4) Agencies Responsible

The project may be implemented by Haripad Municipality directly or through any agency nominated by the Municipality. Support and coordination may also be sought from KSRTC, NATPAC, Haritha Kerala Mission (for greening works and waste management) and the Public Works Department (for pathways and related infrastructure). The feasibility of obtaining financial assistance from such as Pratheeksha Bus Shelters Kerala Limited, LSGD, Kerala Road Fund Board (KRFB), PWD, Private/Advertising Agencies, CSR funding and K-DISC (Kerala State Innovation Council) may be explored.

5) Suggested Implementation Mechanism

The project can be implemented in a phased manner to ensure smooth execution and coordination. Phase 1 – Planning and Design will involve site finalization, stakeholder consultations, traffic and safety assessments, and preparation of detailed architectural, structural, and accessibility-compliant designs in line with NATPAC recommendations. Phase 2 – Approvals and Procurement will include obtaining statutory approvals, finalizing cost estimates, tendering, and appointment of contractors and service providers for civil, electrical, and digital works. Phase 3 – Construction and Installation will focus on civil construction of shelters, provision of ramps and tactile features, installation of seating, lighting, digital display boards, drinking water kiosks, charging points, signage, and traffic safety measures, along with coordinated traffic management during execution. Phase 4 – Commissioning and Operations will cover testing of all facilities, integration with bus operations, public use rollout, and establishment of routine maintenance and

monitoring mechanisms by the Municipality to ensure long-term functionality and service quality.

6) Other Associated Issues to be addressed

While implementing the project, associated issues such as traffic disruption during construction, pedestrian safety, coordination with utility agencies, protection of nearby religious and cultural environments, effective waste management, and long-term maintenance responsibility must be addressed. Attention should also be given to encroachment control, signage clarity, drainage around shelters, and ensuring uninterrupted access for pilgrims, elderly passengers, and persons with disabilities to maximize the project's effectiveness and sustainability.

7) Project Cost and Period

Table 36.70: Project Cost Estimate for Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment

Project Cost Estimate - Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Civil works including platforms, roofing, seating, ramps, tactile paving, and related elements	5.0
2	Electrical works such as LED lighting, charging points, digital display boards, and other allied installations	2.0
3	Contingency (approx. 7 - 8%)	0.50
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 8 Lakhs

The project may be implemented in two phases:

Phase I can cover approvals and procurement. Phase II will include construction of bus shelters, provision of ramps and tactile features, and installation of seating, lighting, digital display boards, drinking water kiosks, charging points, signage and traffic safety measures.

36.4.23 Danapady Market Redevelopment

1) Project Brief



The Danapady Market Redevelopment project is envisioned as a major commercial improvement initiative in Haripad Municipality. As one of the oldest and most active markets in the region, Danapady Market serves a large catchment of residents, traders, farmers, and daily visitors. Its strategic location near a key entry point to Haripad and close to NH 66 makes it an important economic gateway for the town. Over time, however, the market has suffered from ageing infrastructure, limited amenities, inefficient movement of goods, and inadequate customer facilities.The redevelopment proposes a complete modernization of the market by introducing well-planned retail outlets, hygienic vending spaces, cold storage and warehouse facilities, loading–unloading bays, structured

internal circulation, improved parking, and enhanced public amenities. With its proximity to Danapady Thodu, the project also envisions river-edge improvements that can elevate the area into a small, attractive visitor zone. The intervention will create a safer, cleaner, more efficient, and socially vibrant marketplace for Haripad town.

Need for the Project

The Danapady Market Redevelopment Project is necessitated by the deteriorated and congested condition of the existing market infrastructure, which is no longer capable of meeting present-day commercial, safety, and hygiene requirements. The absence of organized vending spaces, proper storage and cold chain facilities, and designated loading–unloading areas has reduced the efficiency of trade, particularly for perishable agricultural goods, while creating inconvenience for traders and customers alike. Poor sanitation, inadequate public amenities, unsafe pedestrian movement, and traffic conflicts arising from unplanned parking and goods movement further undermine the market's functionality. Given its strategic location near a key entry point to Haripad, close proximity to NH 66, and adjacent to Danapady Thodu, the market holds significant potential to act as an economic and social anchor for the town. Redevelopment of the market will strengthen local livelihoods, support farmers and small traders, improve safety and hygiene standards, streamline traffic and logistics, and enable river-edge beautification and public realm improvements. Overall, the project is essential to transform Danapady Market into a modern, efficient, and vibrant commercial hub that enhances town-level service delivery and contributes to Haripad's long-term economic growth.

Aim of the Project

The aim of the Danapady Market Redevelopment project is to transform the historic marketplace into a clean, organized, and people-friendly commercial hub that supports traders, improves customer comfort, and strengthens Haripad's local economy. By introducing better infrastructure, efficient goods-handling facilities, and improved public amenities, the project seeks to create a modern market environment that feels safe, vibrant, and welcoming for everyone.



Figure 36.69 : Images showing existing condition of Danapady Market, Haripad

Project Objectives

- **Redevelopment of Market Infrastructure:** To redevelop the existing market with structurally sound, durable, and well-organized retail units and vending spaces that improve operational efficiency, visual order, and overall user experience.
- **Supply Chain and Storage Enhancement:** To establish modern warehouse facilities, cold storage systems, and dedicated loading–unloading bays that streamline the movement, storage, and handling of goods, particularly perishable agricultural produce.
- **Improved Internal Circulation and Parking:** To improve internal circulation through clearly designated pedestrian pathways, organized vehicular routes, and structured parking arrangements, thereby reducing congestion and enhancing safety within the market premises.
- **Upgradation of Customer Amenities:** To enhance customer convenience by providing adequate sanitation blocks, drinking water points, shaded areas, and comfortable waiting spaces that support longer and safer market use.
- **Safety, Hygiene, and Environmental Management:** To strengthen safety and hygiene standards through integrated waste management systems, improved drainage infrastructure, adequate lighting, and better maintenance provisions.
- **Urban Design and Riverfront Integration:** To beautify the market edges and integrate riverfront enhancements along Danapady Thodu, creating an attractive public realm and improving the overall urban character of the area.
- **Livelihood and Economic Support:** To support local livelihoods by creating a more efficient, organized, and attractive commercial environment that benefits traders, farmers, vendors, and related economic activities.
- **Universal Accessibility and Inclusivity:** To improve accessibility and create a barrier-free market environment through ramps, accessible pathways, and inclusive design features that cater to the elderly and persons with disabilities.

2) Location and Ownership

The Danapady Market Redevelopment Project aims to transform the existing market into a modern, organized, and efficient commercial hub that supports local trade and significantly improves the overall user experience. Located on the western side of NH-66 and easily accessible from the highway, the market has become physically separated from the town due to the new NH alignment; therefore, improved pedestrian-friendly connectivity and safe access links must be ensured in the planning to restore seamless integration with the town and meet its growing needs (Figure 34.70).

The redevelopment envisions structured vending spaces, improved internal circulation, dedicated loading and unloading zones, organized parking, and upgraded sanitation and waste management systems to enhance functionality and hygiene. By rationalizing circulation and strengthening infrastructure, the project will not only reduce congestion and safety risks but also reinforce Danapady Market's role as a key economic node within Haripad's urban framework.

Land Ownership	Municipality land
Ward Number	27
Project Area	32 cents
Survey Number	226(p), 243(p), 244(p)



Figure 36.70 : Location of Danapady Market

3) Project Components

The Danapady Market Redevelopment Project represents a strategic urban intervention aimed at revitalising the town's commercial core. Conceived as a blend of modern retail infrastructure and traditional market activity, the project seeks to enhance economic vibrancy, improve urban functionality, and strengthen community identity.

A shopping mall is proposed as the main commercial centre of the project. Alongside this, about 32 cents of land has been set aside for an open market, where local traders can continue their activities. This open market has to be designed carefully so that it connects well with the mall and the surrounding town, creating a balance between modern retail and traditional market culture:

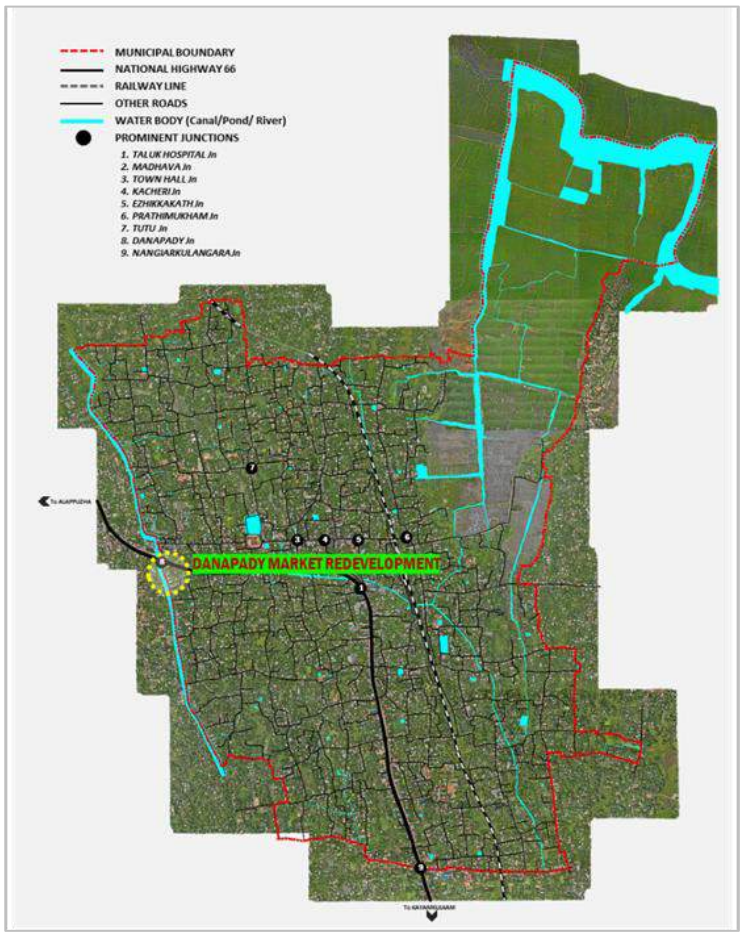


Figure 36.71: Location of Danapady Market

1. **Shopping Mall Component:** This component includes the municipally approved shopping mall, comprising organized retail spaces, commercial units, essential services, and supporting infrastructure, serving as a structured retail core for the market area.
2. **Open Market Area Development (32 Cents – Design to be Prepared):** Preparation of detailed architectural and layout designs for the open market, including covered and semi-covered vending zones for vegetables, fish, meat, flowers, and other daily essentials, with provision for flexible stall arrangements.

3. **Warehousing and Cold Storage Facilities:** Provision of warehouse spaces and cold storage units within or adjacent to the open market area to support efficient storage, handling, and preservation of perishable goods.
4. **Loading-Unloading and Service Areas:** Designated loading and unloading bays with service roads to facilitate smooth movement of goods, minimize conflicts with pedestrian areas, and reduce congestion within the market.
5. **Internal Circulation and Parking:** Development of well-defined internal pedestrian pathways, vehicular circulation routes, and organized parking spaces for two-wheelers, cars, and goods vehicles, ensuring safe and efficient movement.
6. **Public Amenities and Utilities:** Construction of sanitation blocks, drinking water facilities, waste collection and segregation areas, electrical and water supply infrastructure, fire safety systems, and adequate lighting throughout the market.
7. **Safety, Hygiene, and Waste Management Systems:** Implementation of solid and liquid waste management systems, improved drainage, non-slippery flooring, and hygienic vending conditions to enhance public health and safety standards.
8. **Accessibility and Universal Design Features:** Incorporation of barrier-free access elements such as ramps, tactile pathways, handrails, and accessible toilets to ensure inclusive use by elderly persons and persons with disabilities.
9. **Urban Design, Landscaping, and River Edge Interface:** Landscaping, streetscaping, and edge treatment along Danapady Thodu to improve aesthetics, create public gathering spaces, and integrate the market with its natural surroundings.
10. **Connectivity and Access Improvements:** Provision of safe pedestrian crossings, walkways, signage, and linkages to NH-66 and the town side to improve accessibility and reconnect the market with the urban fabric of Haripad



Figure 36.72 : Conceptual view of proposed Danapady Market Redevelopment

4) Agencies Responsible

The project may be implemented by Haripad Municipality directly or through any agency nominated by the Municipality. Support and coordination may also be sought from LSGD(Planning), Health & Food Safety Department (for inspecting the cleanliness and hygienic condition), Haritha karmasena for transporting waste to local collection centers (MCF/RRF), and the Public Works Department (for construction works). The feasibility of obtaining financial assistance from departments such as KIIFB, Kudumbasree, IMPACT Kerala Limited (IKL)and K-DISC (Kerala State Innovation Council) may be explored.

5) Suggested Implementation Mechanism

The Danapady Market Redevelopment Project may be implemented through a phased, Municipality-led execution mechanism, with Haripad Municipality acting as the nodal agency for coordination, approvals, and monitoring. Detailed designs for the open market area shall be prepared by appointed consultants, followed by transparent tendering and execution through qualified contractors, with continuous supervision and post-completion operation and maintenance managed by the Municipality or an outsourced facility management agency.

6) Other Associated Issues to be addressed

In addition to physical redevelopment, the project must address issues related to traffic management and connectivity, particularly safe pedestrian access across NH-66 and improved linkages with surrounding neighbourhoods. Environmental concerns, including effective stormwater drainage, solid waste management, and protection of Danapady Thodu from pollution, need to be integrated into the design. The project should also consider temporary relocation and livelihood continuity for existing traders during construction, along with institutional mechanisms for market management, maintenance, and regulation after completion to ensure long-term sustainability and efficient operation.

7) Project Cost and Period

Table 36.71: Project Cost Estimate for Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment

Project Cost Estimate - Kuzhiyilikulangara Pond – Rejuvenation & Pond-Front Redevelopment		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Shopping Mall Component (compact municipal commercial block, basic RCC + simple finishes)	420
2	Open Market Area Development – 32 cents (steel / GI roof sheds, modular stalls)	160
3	Warehousing & Cold Storage (small modular cold rooms + basic storage)	95
4	Loading–Unloading & Service Areas (paved bays, minimal service roads)	60
5	Internal Circulation & Parking (interlocking pavers, markings, drainage)	85
6	Public Amenities & Utilities (toilets, drinking water, basic electrical & fire safety)	65

7	Safety, Hygiene & Waste Management (drains, bins, flooring improvements)	*55*
8	Accessibility & Universal Design Features (ramps, tactile tiles, accessible toilets)	*25*
9	Landscaping & Danapady Thodu Edge Interface (soft landscaping, seating, railings only)	*65*
10	Connectivity & Access Improvements (footpaths, crossings, signage)	*50*
11	Design, DPR, Supervision & Contingencies (kept minimal)	70
	** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*	

Total Estimated Cost would be approx. 11.5 Crores

The project may be implemented in two phases. Phase I can cover approvals and procurement. Phase II can include civil works for open market, warehousing, cold storage, service areas; internal roads, parking, utilities; landscaping and river-edge improvements; coordination with shopping mall construction. Also, installation of electrical systems, lighting, sanitation, waste management facilities, accessibility features; integration with traffic and access improvements.

36.4.24 Kayaking Terminal, Choorellakkal

1) Project Brief



The Kayaking Terminal at Choorelleckkal is proposed as a key component of the Choorelleckkal Village Tourism Zone, designed to strengthen Haripad's identity as a nature-based tourism destination. Positioned at the edge of the scenic canal network that connects Choorelleckkal to Malikadavu and Nelpurakadavu, the terminal will serve as the main launching and return point for kayaking activities. The project aims to create a safe, organized, and visitor-friendly facility that supports eco-tourism while highlighting the region's beautiful agricultural landscapes and waterways. The development will include kayak launching decks, equipment storage, rental kiosks, parking areas, shaded waiting spaces, restrooms, signage, and essential safety infrastructure. Together, these interventions will encourage sustainable tourism and offer visitors a memorable way to explore Haripad's unique canal-and-paddy-field ecosystem.

Need for the Project

The need for a kayaking terminal at Choorelleckkal arises from the strong eco-tourism potential of Haripad's water network, which is currently underutilized due to the absence of safe and organized infrastructure. Although the scenic waterways connecting Choorelleckkal, Malikadavu, and Nelpurakadavu offer a unique experience through paddy fields and village landscapes, tourists lack proper access points and essential facilities to explore them. A designated kayaking terminal is therefore required to regulate visitor movement, ensure user safety, and minimize ecological disturbance in this environmentally sensitive area. The provision of basic amenities such as parking, shaded rest areas, washrooms, and clear signage is essential to enhance visitor comfort and overall experience. Integrating kayaking facilities within

the village tourism zone will also generate local livelihood opportunities through equipment rentals, guiding services, and small-scale hospitality, thereby supporting sustainable rural development while positioning Haripad as a low-impact, nature-based tourism destination.

Aim of the Project

The aim of the Kayaking Terminal at Choorelleckkal is to create a safe, welcoming, and well-organized starting point for tourists to explore Haripad's scenic canals and paddy fields through kayaking. By providing essential visitor amenities, proper launching facilities, and clear route guidance, the project seeks to make the experience enjoyable, accessible, and environmentally responsible for everyone.



Figure 36.73 : Images showing existing condition of the proposed Kayaking stretch, Haripad

Project Objectives

- **Kayak Access Infrastructure** : Establish a dedicated kayak launching and landing facility with safe, user-friendly boarding platforms.
- **Visitor Amenities & Comfort** : Provide shaded seating, restrooms, drinking water, and waiting areas to enhance the overall visitor experience.
- **Multimodal Parking Access** : Develop organized parking facilities for cars, two-wheelers, and bicycles to ensure seamless tourist access. (might have to acquire land for this)
- **Kayak Operations & Rentals** : Introduce rental kiosks, equipment storage, and lifejacket management systems to support smooth operations.

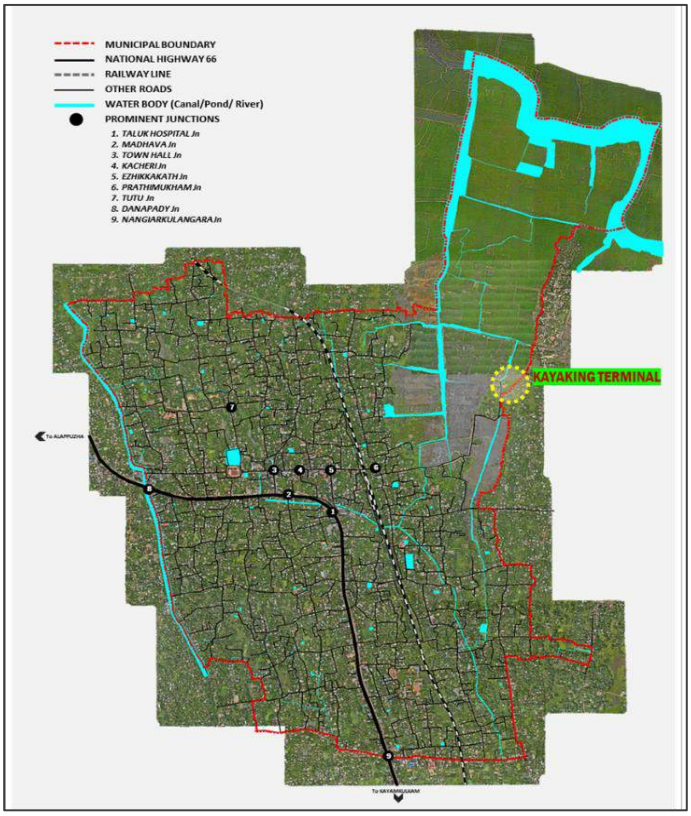


Figure 36.74: Satellite image showing the location of proposed location for Kayaking Terminal at Choorelakkal

- **Safety & Security Systems** : Ensure visitor safety through CCTV surveillance, adequate night lighting, and clearly marked canal routes.
- **Eco-Tourism Interpretation** : Integrate interpretive signage and wayfinding markers to enrich awareness of the local ecology and paddling trail.
- **Local Livelihood Promotion** : Generate employment opportunities through guided tours, kayak rentals, and allied tourism services.
- **Tourism Gateway Positioning** : Position Choorelleckkal as a strategic gateway for landscape tourism within Haripad Municipality.

2) Location and Ownership

The proposed project site is located near the Arayakulangara Devi Temple Pond precinct, set within a predominantly rural landscape characterized by canals, wetlands, and agricultural lands. The canal network, which forms a key natural feature of the area, runs through the middle of mostly privately owned lands that are largely classified as wetlands. While the surrounding parcels remain under private ownership, the project interventions are confined to publicly accessible areas associated with the temple pond and designated community-use spaces, ensuring no disruption to existing landholdings. From a tourism perspective, the project leverages the scenic canal–wetland setting to enhance the visual, cultural, and recreational appeal of the precinct, supporting low-impact, nature-based tourism while respecting the sensitive ecological and ownership context of the area.



Figure 36.75 : Location of proposed Kayak stretch

Land Ownership	??
Ward Number	2
Project Area	2.65 Acre
Survey Number	513(P)

3) Project Components

The proposed project envisions the canal precinct as a focused eco-recreation and tourism zone centered on kayaking and canal-side public spaces. By carefully activating the scenic canal stretch that passes through a wetland-dominated rural landscape, the development aims to offer visitors a close-to-nature experience while maintaining ecological sensitivity. The intervention prioritizes low-impact infrastructure such as walkways, small jetties, and open recreational spaces, creating a family-friendly destination that supports tourism, community

use, and environmental stewardship without encroaching on surrounding private lands. The major project components are outlined below:

- **Kayaking Canal Stretch** – Designated and managed canal segment developed for safe, low-impact kayaking experiences through the scenic wetland landscape.
- **Kayak Jetty and Boarding Deck** – Small-scale, eco-sensitive jetty with non-slip surfaces for easy boarding and return of kayaks.
- **Waiting and Resting Spaces** – Shaded seating areas near the jetty for users, families, and visitors, including viewing points along the canal.
- **Canal-Side Walkway** – Continuous, barrier-free pedestrian walkway running parallel to the canal, allowing visitors to enjoy the landscape and observe kayaking activities.
- **Children's Play Area** – Compact, safe play zone located near the waiting spaces, enabling family-friendly use of the site.
- **Safety and Support Infrastructure** – Railings, life-saving equipment, signage, lighting, and clear circulation for both pedestrians and kayakers.
- **Landscape and Ecological Enhancements** – Native planting, wetland buffers, and shaded areas that protect the canal ecosystem while enhancing visual appeal.
- **Tourism-Oriented Amenities** – Information boards, rest areas, and minimal service facilities that support eco-tourism and recreational use without disturbing private wetland lands.
- **Universal Accessibility Features:** Barrier-free access including ramps, handrails, and clear pathways to accommodate all users.



Figure 36.76 : Conceptual view of proposed Kayaking Terminal, Choorelakkal

4) Agencies Responsible

The project may be implemented by Haripad Municipality directly or through any agency nominated by the Municipality. Support and coordination may also be sought from KTDC, Irrigation Department, Haritha karmasena (for transporting waste to local collection centres (MCF/RRF)), and the Public Works Department (for construction works). The feasibility of obtaining financial assistance from departments such as KIIDC (Kerala Irrigation Infrastructure Development Corporation Ltd.), KTDC, KIIFB, and District Tourism Promotion Council (DTPC) may be explored.

5) Suggested Implementation Mechanism

The project shall be implemented through a phased approach led by the Municipality as the nodal agency. Planning and DPR preparation will be carried out in coordination with the LSGD Planning, Tourism and Irrigation Departments to ensure safety and ecological sensitivity. Kayaking operations and visitor services may be managed through the

Tourism Department and community-based groups, creating local livelihoods. Post-completion, the facility will be operated and maintained by the Municipality with support from tourism revenues and a local management committee.

6) Other Associated Issues to be addressed

While implementing the project, certain related issues need careful consideration. Coordination with private landowners along the canal is essential to avoid encroachment and ensure smooth execution. Environmental sensitivity of wetlands requires strict adherence to ecological guidelines to prevent water pollution and habitat disturbance. Seasonal water-level variations and flooding risks may affect kayaking operations and walkway durability, requiring resilient design solutions. Ensuring user safety through proper training, life-saving equipment, and clear operational protocols is critical. Additionally, long-term maintenance and crowd management must be planned to prevent degradation of facilities and preserve the site's tourism value.

7) Project Cost and Period

Construction of canal-side walkway, Kayak jetty and boarding deck, Waiting areas and shaded seating, Kayaking infrastructure and safety equipment, Children's play area, Landscape development and ecological planting, Sanitation facilities, Stormwater management and minor utilities costs around 2.5-3 crores. Land acquisition cost will be as per the latest purchase costs in that locality and that can vary depending on the time and location. In addition, recurring daily maintenance costs will include cleaning and upkeep, waste collection and removal, office consumables and procurements, and transportation of food and related supplies.

The project may be implemented in three phases. Phase I will cover stakeholder discussions and land acquisition (if required). Phase II will cover approvals and procurement. Phase III will include clearing, marking, canal-edge protection, temporary access arrangements, construction of canal-side walkway, kayak jetty, and safety railings, waiting spaces, children's play area, seating, waste management systems, planting, and lighting, procurement of kayaks, safety equipment, signage, and storage etc.

36.4.25 Municipal Crematorium near Choorellackal

1) Project Brief



The Municipal Crematorium at Choorelleckkal is proposed as a modern, inclusive, and dignified cremation facility serving the entire Haripad Municipal area. The crematorium is planned on the same site where an old, defunct crematorium currently exists in a dilapidated and non-functional condition. With Haripad's growing population and the increasing need for hygienic, well-managed, and accessible end-of-life service infrastructure, upgrading this site into a fully equipped gas crematorium has become a critical civic priority. The project aims to provide a respectful, safe, and user-friendly environment for families during moments of bereavement, while ensuring that cremation practices adhere to strict environmental norms, pollution control standards, and public health guidelines.

The redevelopment includes modern cremation units, dedicated spaces for multi-faith rituals, comfortable waiting and resting areas, sanitation facilities, structured internal circulation, and landscaped surroundings, creating a calm and dignified setting for all users.

Need for the Project

The existing crematorium at the Choorelleckkal site is defunct, structurally unsafe, and incapable of supporting present-day cremation requirements, leaving Haripad without a fully equipped municipal-level facility that can serve all religious practices and communities. Rapid population growth and urban expansion have significantly increased the demand for formal, hygienic, and environment-compliant cremation services, while traditional practices are often forced into unregulated or temporary locations, creating environmental, public health, and social concerns. Establishing a modern crematorium at this location will provide families with a safe, clean, and dignified space during bereavement, reduce pressure on surrounding areas, and offer a centrally accessible facility for the entire Municipality. The incorporation of emission-controlled cremation systems is essential to meet current environmental regulations, improve air quality, and ensure that end-of-life practices are conducted responsibly and sustainably.

Aim of the Project

The aim of the Municipal Crematorium at Choorelleckkal project is to create a modern, respectful, and inclusive facility that provides families with a dignified environment during bereavement while ensuring that all cremation activities take place safely and in full compliance with environmental and public health standards. By rebuilding the crematorium on the existing defunct site, the project seeks to restore essential civic infrastructure and offer a peaceful, accessible, and reliable service to the people of Haripad.



Figure 36.77 : Images showing existing condition of site for Municipal Crematorium at Chooralackal, Haripad

Project Objectives

- **Crematorium Redevelopment & Modernization** : To transform the existing dilapidated crematorium into a fully functional, modern municipal facility.
- **Environmental Compliance & Emission Control** : To install emission-controlled cremation chambers that meet prescribed environmental and pollution-control norms.
- **Inclusivity & Multi-Faith Use** : To provide equitable, inclusive spaces that accommodate rituals and practices of all communities.
- **User Comfort & Family Facilities** : To create dignified waiting areas, shaded seating, washrooms, and resting spaces for bereaved families.

- **Site Planning & Wayfinding** : To improve ease of movement through landscaped surroundings, internal pathways, ambient lighting, and clear signage.
- **Safety, Security & Disaster Preparedness** : To ensure safety through CCTV surveillance, boundary fencing, fire-safety measures, and disaster-management systems.
- **Access & Parking Management** : To organize designated parking areas and separate circulation routes for hearse vehicles and visitors.
- **Waste, Ash Handling & Hygiene** : To establish proper ash handling, waste management, and service zones to maintain cleanliness and hygiene.
- **Civic Infrastructure Enhancement** : To strengthen municipal service delivery and overall civic infrastructure in Haripad through improved cremation facilities.

2) Location and Ownership

The proposed crematorium redevelopment site is located within a predominantly rural setting characterized by extensive paddy fields, offering a calm and unobstructed environment suitable for such a facility. The land enjoys good road access, allowing smooth movement of visitors, service vehicles, and vans without disturbing residential areas. There are no residential houses in the immediate vicinity, which minimizes potential conflicts related to noise, emissions, or privacy. The land is under municipal ownership, enabling direct public-sector development and long-term management of the facility. Its location within open agricultural surroundings provides adequate buffer distances while ensuring accessibility and compliance with planning and environmental considerations.



Figure 36.78: Satellite image showing the location and context of Municipal Crematorium at Choorelleckkal , Haripad

Land Ownership	Municipality Land
Ward Number	2
Project Area	2.65 Acre
Survey Number	459/11

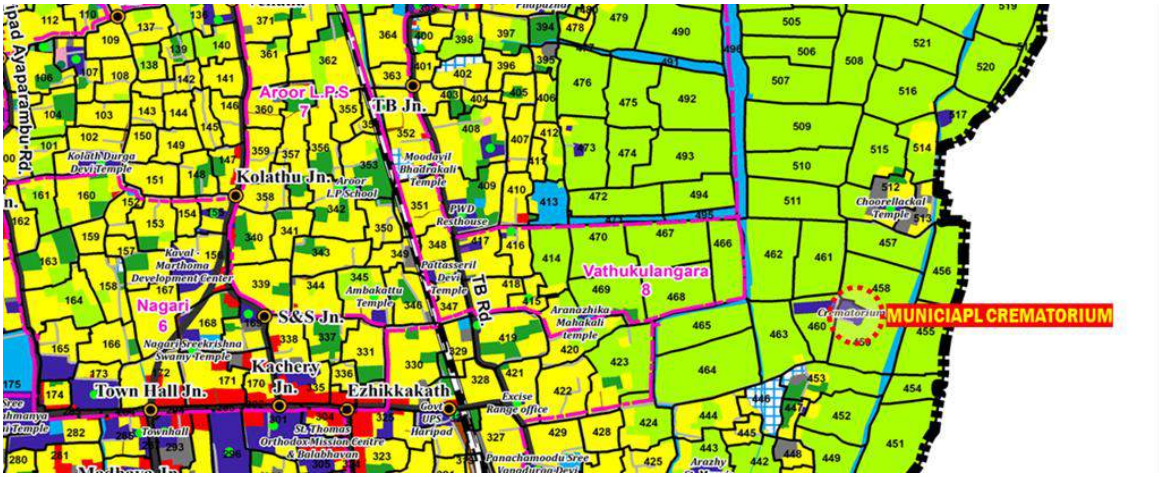


Figure 36.79 : : Location of proposed Municipal Crematorium at Chooralackal

3) Project Components



Figure 36.80 : Conceptual plan and view of proposed Municipal Crematorium at Chooralackal

The proposed project aims to redevelop the existing crematorium into a dignified, efficient, and environmentally responsible municipal facility that meets present-day service and safety standards. This serve the needs of diverse communities, the development focuses on modern cremation technology, user comfort, and respectful spatial planning. Set within a non-residential, open landscape, the project integrates functional infrastructure with landscaped surroundings to ensure smooth operations while providing a calm and orderly environment for families during last rites. The major project components are outlined below:

- **Modern Cremation Chambers** : Emission-controlled cremation units complying with environmental norms.
- **Ritual and Multi-Faith Spaces** : Designated areas to accommodate diverse religious practices.
- **Waiting and Resting Areas** : Covered seating spaces for families and visitors.
- **Administrative and Service Block** : Office, staff rooms, and operational support spaces.
- **Washrooms and Water Facilities** : Clean, accessible toilet and washing facilities.
- **Internal Roads and Pathways** : Well-defined vehicular and pedestrian circulation within the site.
- **Parking and Mortuary Van Access** : Designated parking areas and separate mortuary van movement routes.
- **Waste and Ash Handling Area** : Dedicated zones for ash collection, storage, and disposal.
- **Safety and Security Systems** : CCTV, boundary fencing, fire-fighting equipment, and emergency provisions.

- **Landscaping and Site Development** : Green buffers, shaded areas, lighting, and signage.

4) Agencies Responsible

The project may be implemented by Haripad Municipality directly or through any agency nominated by the Municipality. Support and coordination may also be sought from Suchitwa Mission, Haritha karmasena for transporting waste to local collection centres (MCF/RRF), and the Public Works Department (for construction works). The feasibility of obtaining financial assistance from departments such as IMPACT Kerala Limited, KIIFB, Suchitwa Mission, KURDFC (Kerala Urban and Rural Development Finance Corporation) and MLACDF (Member of Legislative Assembly Constituency Asset Development Fund) may be explored.

5) Suggested Implementation Mechanism

The project shall be implemented through a Municipality-led model. The Municipality will act as the nodal agency for planning, approvals, and coordination, while DPR preparation and technical designs will be undertaken with support from qualified consultants. Civil works and site development will be executed by the Haripad Municipality or PWD, and cremation equipment will be procured from approved suppliers in compliance with Kerala State Pollution Control Board norms. Upon completion, the Municipality will manage operations and maintenance through trained staff or outsourced service providers, ensuring environmental compliance, safety, and uninterrupted public service delivery.

6) Other Associated Issues to be addressed

While implementing the project, key issues include ensuring timely environmental clearances and compliance with emission norms set by the Kerala State Pollution Control Board. Proper handling of construction activities within surrounding paddy lands is necessary to avoid drainage disruption and soil damage. Coordination among multiple departments for utilities, fire safety, and equipment installation may affect timelines if not managed efficiently. Community sensitization and clear communication are also important to address social concerns related to crematorium operations, even in the absence of nearby residences. Additionally, long-term maintenance, skilled staffing, and uninterrupted power and water supply must be planned to ensure smooth and dignified operation of the facility.

7) Project Cost and Period

Cost of a Gas Cremation Equipment-The furnace and related machinery alone cost approximately ₹22 lakh to ₹40 lakh. The total project cost for the proposed gas crematorium is expected to range between ₹70 lakhs and ₹1 crore, subject to the inclusion of facilities like AC waiting rooms, parking, and other suggested infrastructure. Other components include Crematorium building (with office spaces, storage facilities, shop etc.) and ritual space, Waiting areas and family facilities, Washrooms and water supply systems, Internal pathways and parking, Electrical works, Waste and ash handling facilities, Landscaping and site development, Fire-fighting equipment, CCTV, and other security systems.

The project may be implemented in three phases. Phase I will cover approvals and procurement. Phase II will include Site preparation and Civil construction works. Phase III will include Equipment installation, Electrical, safety, and utility works, Landscape work.

36.4.26 Wetland Park in Ward 11

1) Project Brief



The proposed Wetland Park project is a strategic climate resilience intervention aimed at addressing Haripad's recurrent flood and waterlogging issues through nature-based solutions. Located within the town's low-lying and hydrologically sensitive landscape, the project seeks to restore and strengthen the natural flood absorption capacity of existing wetlands while integrating them into the urban fabric as multifunctional public open spaces. By combining ecological restoration with controlled public access, the Wetland Park will function as a flood buffer, biodiversity zone, and environmental learning space, contributing to both disaster risk reduction and improved urban liveability.

Need for the Project

Haripad's vulnerability to monsoon flooding is exacerbated by encroachments, loss of natural wetlands, siltation, and inadequate stormwater detention capacity. Traditional drainage infrastructure alone is insufficient to manage peak rainfall events in the town's flat terrain. There is an urgent need to revive and protect wetlands that naturally store, slow, and filter floodwaters. Developing a Wetland Park provides a sustainable, cost-effective alternative to purely engineering-based solutions, while also safeguarding ecological assets and preventing further degradation of critical flood plains.

Aim of the Project

The primary aim of the Wetland Park project is to enhance Haripad's flood resilience by restoring and strengthening wetland ecosystems that function as natural water retention and flood moderation zones, while simultaneously creating a safe, accessible, and educational public open space rooted in ecological conservation.

Project Objectives

- To restore the hydrological and ecological functioning of degraded wetland areas for effective flood attenuation.
- To provide controlled water storage and delayed discharge during peak rainfall events, reducing downstream flooding and waterlogging.
- To enhance groundwater recharge and improve local micro-climate conditions.
- To conserve native wetland biodiversity and create habitat corridors for flora and fauna.



Figure 36.81 : Image showing the existing condition of site chosen for Wetland Park

- To integrate environmental education, passive recreation, and community engagement into flood-resilient urban planning

2) Location and Ownership

The Wetland Park is proposed in Ward 11.

Land Ownership	Private
Ward Number	11
Project Area	3.65 Acres
Survey Number	446 (p), 453(p), 447(p)



Figure 36.82: Satellite image showing the location and context of proposed Wetland Park



Figure 36.83 : Location of proposed Wetland Park in Ward 11

3) Project Components

The various components that will form part of the project include:

- **Wetland Restoration and Hydrological Improvement:** Desilting, re-grading, and ecological rehabilitation of existing wetlands to enhance water retention capacity, regulate surface runoff, and restore natural flood moderation functions.
- **Flood Retention and Detention Zones :** Development of shallow basins, seasonal ponds, and overflow channels to temporarily store excess stormwater during peak rainfall and safely release it downstream.
- **Vegetation and Biodiversity Enhancement** : Plantation of native wetland species, reeds, grasses, and riparian vegetation to stabilize soils, improve water quality, and enhance habitat diversity.
- **Peripheral Bunds and Edge Protection** : Soft-engineered embankments, bio-fencing, erosion control measures, and vegetative buffers to protect wetland edges and prevent encroachments.

- **Pedestrian Walkways and Nature Trails** : Provision of raised walkways, boardwalks, and earthen trails along designated edges of the wetland, enabling safe public access without disturbing core ecological zones.
- **Seating and Passive Recreation Areas** : Installation of seating benches, shaded resting areas, and small viewing decks at strategic locations to support passive recreation, walking, and nature appreciation.
- **Public Open Spaces and Viewing Zones** : Creation of limited, well-defined open spaces overlooking the wetland for community use, bird watching, and leisure activities, designed to remain flood-compatible.
- **Environmental Education and Interpretation** : Interpretive signage, information panels, and outdoor learning spaces explaining wetland ecology, flood control functions, and climate resilience benefits.
- **Basic Visitor Amenities :** Drinking water kiosks, waste receptacles, solar lighting, safety railings, and clear wayfinding elements along public-access areas.
- **Monitoring and Management Infrastructure :** Simple water-level indicators, water-quality monitoring points, and access paths for maintenance and long-term wetland management.



Figure 36.84 : Conceptual plan and view of proposed Wetland Park, Haripad

4) Agencies Responsible

Table 36.72 : Agencies responsible for Wetland Park

Agencies responsible for proposed Wetland Park		
Sl. No.	**Responsibility / Function**	**Agencies / Departments Involved**
1	Nodal project planning, coordination, approvals, and execution	Haripad Municipality
2	Technical guidance on wetland restoration, flood mitigation, and hydrology	Kerala State Disaster Management Authority (KSDMA)
3	Ecological design, wetland conservation protocols, biodiversity management	Kerala State Biodiversity Board (KSBB)

4	Environmental clearance, wetland protection compliance, EIA support	Department of Environment & Climate Change, Govt. of Kerala
5	Canal connectivity, water flow regulation, and desilting support	Irrigation Department, Govt. of Kerala
6	Landscape design, nature trails, boardwalks, and eco-tourism components	Department of Tourism, Govt. of Kerala
7	Tree planting, habitat creation, and ecological monitoring	Social Forestry Wing / Forest Department, Kerala
8	Civil works, fencing, pathways, safety railings, and basic infrastructure	PWD (Buildings / Roads) – as required
9	Community participation, maintenance support, awareness programmes	Kudumbashree Mission / Local SHGs / Residents' Associations
10	Operation, maintenance, and periodic monitoring	Haripad Municipality (with empanelled agencies)
11	Safety, crowd management, festival-time regulation	Kerala Police & District Administration
12	Maintenance of public amenities and canal-front facilities	Haripad Municipality / Community-based O&M agencies

5) Suggested Implementation Mechanism

The Wetland Park project shall be implemented through a phased and ecology-first approach, led by Haripad Municipality as the nodal agency, with technical support from the Kerala State Disaster Management Authority (KSDMA), Irrigation Department, and Kerala State Biodiversity Board (KSBB). Initial phases will focus on hydrological assessment, wetland boundary demarcation, desilting, and restoration of natural water flow patterns to strengthen flood attenuation functions. This will be followed by habitat enhancement through native wetland vegetation, lotus zones, bird habitats, and buffer planting under the guidance of the Forest Department (Social Forestry Wing).

Recreational elements such as earthen walking trails, viewing decks, seating areas, and safety railings will be introduced only after ecological stabilization, ensuring minimal disturbance. Community participation through Kudumbashree units, local schools, and residents' groups will be integrated for plantation, monitoring, and upkeep. Long-term operation and maintenance will remain with the Municipality, supported by empanelled agencies and community stewardship models.

6) Other Associated Issues to be addressed

As the project site functions as a natural flood buffer, strict controls must be enforced to prevent future encroachments, land filling, or incompatible development. All interventions must comply with wetland conservation norms, avoiding concrete construction and ensuring reversibility of structures. Continuous monitoring of water quality, invasive species, and bird habitats will be required in coordination with KSBB and the Irrigation Department.

Public access must be carefully managed to balance recreation and conservation - through designated paths, safety railings, lighting, and signage - while preventing littering and vandalism. Seasonal flooding, mosquito control, and maintenance of vegetative buffers will need coordinated action with the Health Department and Municipality. Climate variability, especially extreme rainfall events, must be factored into design and maintenance protocols to ensure that the wetland continues to function as a resilient, nature-based flood mitigation system for Haripad.

7) Project Cost and Period

Table 36.73: Project Cost Estimate for proposed Wetladn Park

Project Cost Estimate - Wetland Park		
Sl. No.	**Component**	**Estimated cost (INR Lakhs)**
1	Basic Wetland Study, DPR & Layout Planning	6
2	Desilting, Weed Removal & Channel Cleaning	22
3	Earthen Bund Repair & Bio-engineering (coir matting, vetiver)	18
4	Native Wetland Vegetation, Lotus & Aquatic Planting	15
5	Bird Habitat Features (islets, perches, nesting poles)	8
6	Earthen Walking Trails & Viewing Paths	18
7	Seating & Viewing Areas (stone / timber / laterite)	12
8	Safety Railings & Fencing (bamboo / wooden posts / hedge)	12
9	Signage & Interpretation Boards	5
10	Solar Bollard Lights (limited, wildlife-friendly)	10
11	Waste Bins & Drinking Water Point (basic)	5
12	Tree Planting & Buffer Landscaping	12
13	Community Engagement & Awareness Activities	4
14	Contingencies & Initial Maintenance	8
** Cost estimates are indicative and subject to change based on detailed design, market conditions, approvals, and execution factors*		

Total Estimated Cost would be approx. 1.55 Crores

Table 36.74: Project Duration for proposed Wetland Park

Project Duration – Wetland PArk			
Sl. No.	**Project Phase**	**Key Activities**	**Duration**
1	Planning & Approvals	Baseline wetland study, DPR preparation, statutory approvals, community consultation	2
2	Site Preparation	Desilting, weed removal, channel cleaning, debris clearance	3
3	Ecological Restoration	Earthen bund strengthening, bio-engineering works, wetland grading	3
4	Plantation & Habitat Creation	Native wetland planting, lotus beds, bird habitat structures	3
5	Public Access Infrastructure	Earthen walkways, viewing points, seating, fencing & safety features	2

6	Utilities & Amenities	Solar lighting, signage, waste bins, drinking water point	1
7	Landscaping & Buffer Zones	Tree planting, hedges, landscape finishing	2
8	Commissioning & Stabilisation	Final inspections, soft opening, initial maintenance & monitoring	2
		** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*	

The overall duration required for installation of one unit would be around 18-20 months

36.4.27 Haripad KSRTC Bus Stand – Renovation

1) Project Brief



The Haripad KSRTC Bus Stand renovation project is proposed as a key urban transport and tourism-supporting intervention for Haripad Town. As Haripad aspires to strengthen its position as a regional hub for religious and cultural tourism, efficient regional connectivity becomes essential. KSRTC buses serve as one of the most reliable and widely used modes of travel for visitors arriving from across Kerala, especially pilgrims and festival attendees. However, the existing KSRTC bus stand currently lacks several basic passenger amenities, resulting in discomfort for daily commuters, long-distance travellers, and tourists.This project seeks to upgrade the bus stand into a clean, user-friendly, and well-equipped transit hub by introducing essential facilities. The upgraded facility will provide a safer, more pleasant experience for passengers while supporting Haripad's growing tourism economy

Need for the Project

The existing KSRTC bus stand at Haripad currently lacks several basic passenger amenities such as clean restrooms, safe drinking water, adequate seating, and cloakroom facilities. The town experiences a significant influx of visitors during temple festivals and religious events, which substantially increases the demand for well-organized and efficient passenger facilities. Upgrading the bus stand will greatly enhance commuter comfort and safety, especially for elderly passengers, women, and families with children. Improved pedestrian areas, clear signage, better lighting, and effective waste management systems will further enhance hygiene, safety, and overall operational efficiency. These improvements align with Haripad's broader vision of strengthening town-level infrastructure and promoting tourism, while also contributing to a positive travel experience for visitors arriving from different parts of the state.

Aim of the Project

The aim of the Haripad KSRTC Bus Stand renovation project is to create a clean, safe, and comfortable transit environment that meets the needs of daily commuters, long-distance travellers, and tourists. By improving essential amenities and creating a more

welcoming space, the project hopes to make travel easier and more pleasant for everyone visiting or passing through Haripad.

Project Objectives

- **Upgradation of Essential Passenger Amenities:** To improve basic facilities such as clean restrooms, safe drinking water points, comfortable waiting areas, and cloakroom services for daily commuters and visitors.
- **Enhanced Accessibility and Inclusivity:** To ensure barrier-free movement through accessible pathways, dedicated seating for elderly and differently abled passengers, and improved circulation spaces within the bus stand.
- **Optimised Layout and Circulation Planning:** To redesign the existing bus stand layout to improve vehicular and pedestrian circulation, reduce congestion, and efficiently accommodate additional passenger facilities and amenities.
- **Modern Passenger Information Systems:** To install digital timetable displays, route information boards, and clear directional signage for better passenger guidance and reduced confusion.
- **Improved Safety and Security Measures:** To enhance passenger safety through adequate lighting, CCTV surveillance, and clearly defined pedestrian zones separating vehicular and foot traffic.
- **Efficient Waste Management and Hygiene:** To introduce systematic waste management solutions including smart dustbins, proper segregation, and regular cleaning mechanisms to maintain a clean and hygienic environment.
- **Tourist-Friendly Infrastructure:** To provide facilities such as information kiosks, seating shelters, and shaded waiting areas that cater to tourists and occasional visitors.
- **Support to Haripad's Tourism and Urban Vision:** To create a positive first impression for travellers arriving at Haripad by upgrading the KSRTC bus stand as a functional, welcoming, and well-managed public transport hub.



Figure 36.85 : existing condition of KSRTC Bus Stand, Haripad

2) Location and Ownership

The KSRTC bus terminal is strategically located at the heart of Haripad town, making it one of the most accessible and active public transport hubs in the area. Its central location provides easy and convenient access to major landmarks such as Sree Subrahmanya Swamy Temple, Haripad Railway Station, and other important public buildings, all of which are situated within comfortable walking distance from the terminal. The bus stand is edged by a continuous row of commercial buildings along the NH-66 side, further enhancing its connectivity, visibility, and integration with the town's commercial and civic activities. Mannarasala Temple is just 2.5 km from the KSRTC Bus stand. This prime location reinforces the terminal's role as a key gateway for both daily commuters and visitors to Haripad.



Figure 36.86: Satellite image showing the location and context of KSRTC Bus Stand, Haripad

Land Ownership	KSRTC
Ward Number	25
Project Area	Approx. area 1.62 acres
Survey Number	635-9(p), 636(p)

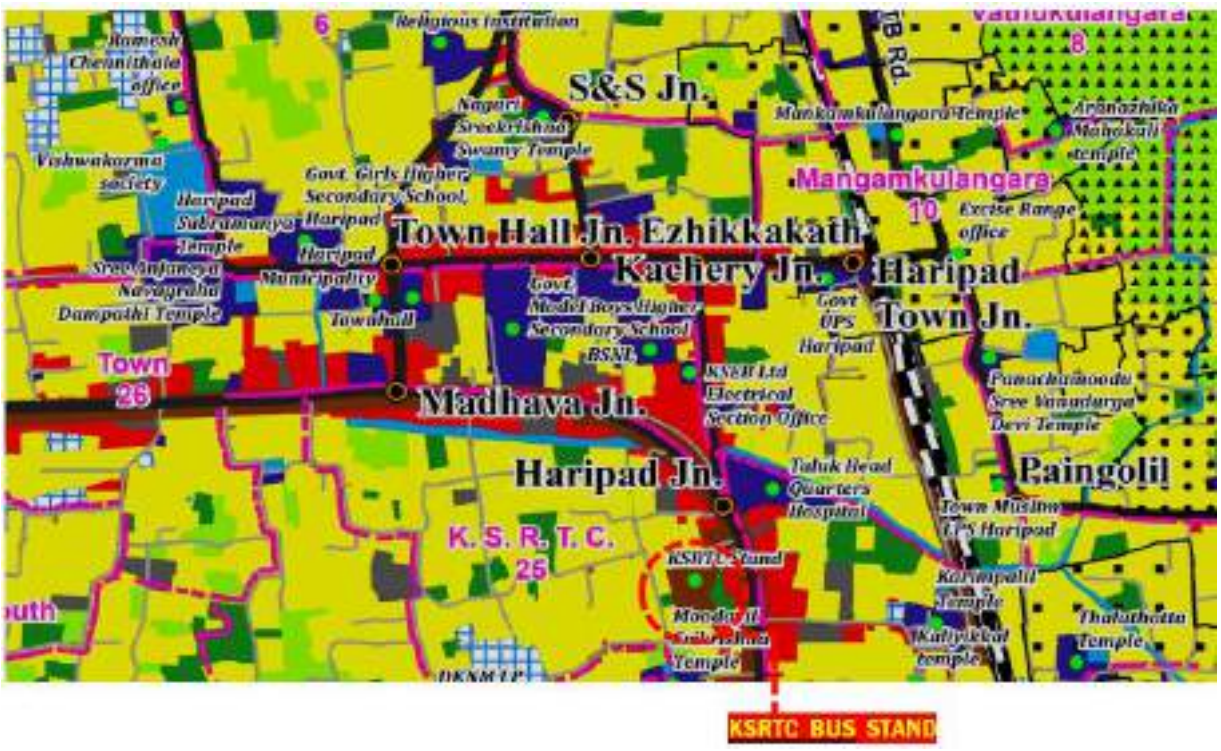


Figure 36.87: Location of KSRTC Bus stand, Haripad

3) Project Components

The various components that will form part of the project include:

1. **Demolition of Existing Structures**
   Removal of all structures to facilitate planned redevelopment and space utilisation.
2. **Comprehensive Site Replanning & Layout Redesign**
   Preparation of an integrated layout plan optimising bus bays, pedestrian movement, vehicular circulation, and service zones to reduce congestion.
3. **Circulation Improvement Plan (Vehicular & Pedestrian)**
   Redesign of internal roads, entry–exit points, and walkways to ensure safe, conflict-free movement of buses and passengers.
4. **Bus Stand Terminal Building with Public Amenities**
   Construction of a modern terminal building housing ticket counters, AC/non-AC waiting halls, toilets, cloakroom, drinking water points, and information desks.
5. **Canteen, Cafeteria & Commercial Facilities**
   Provision of hygienic food courts, small shops, and kiosks to serve daily commuters, tourists, and visitors.
6. **Administrative & Operational Workspaces**
   Dedicated office spaces for KSRTC administration, staff rooms, control rooms, and operational support facilities.
7. **Redesign of KSRTC Workshop & Maintenance Area**
   Reorganisation and upgrading of the workshop area for efficient bus maintenance, parking, and servicing operations.
8. **Redesign and Upgradation of Fuel Filling Station**
   Modernisation of the fuel filling station with safety upgrades, improved access, and operational efficiency.
9. **Barrier-Free Accessibility Infrastructure**
   Development of ramps, tactile pathways, accessible toilets, and priority seating for elderly and differently abled passengers.
10. **Passenger Information & Wayfinding Systems**
    Installation of digital display boards, route maps, announcement systems, and clear signage for easy navigation.
11. **Safety, Security & Surveillance Systems**
    Provision of CCTV cameras, adequate lighting, fire safety measures, and clearly demarcated pedestrian zones.
12. **Waste Management & Sanitation Systems**

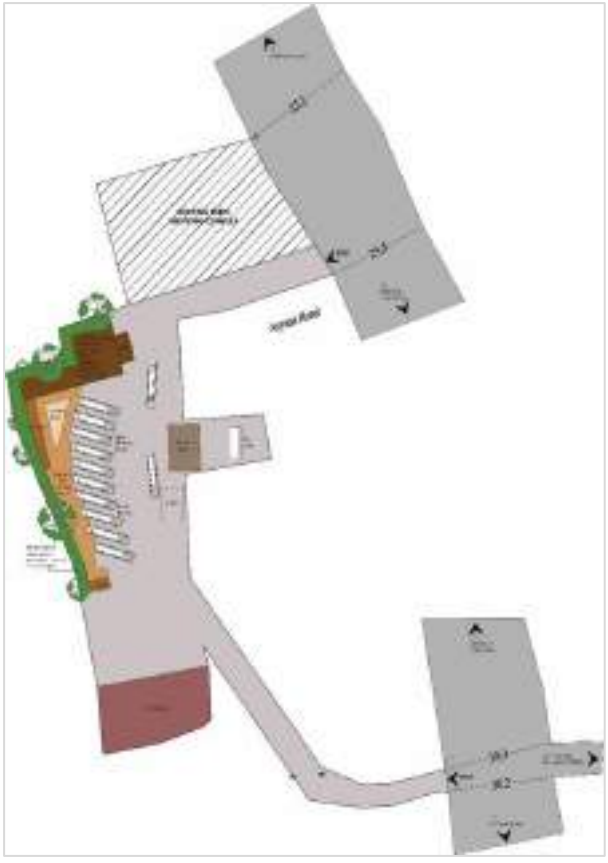


Figure 36.88 : Key plan of the conceptual Layout Proposed for Haripad KSRTC Bus Stand

Introduction of organised waste segregation, smart dustbins, drainage improvements, and regular sanitation mechanisms.

13. **Landscape Development & Passenger Comfort Areas**
    Development of shaded waiting areas, seating zones, green buffers, and pedestrian-friendly open spaces.
14. **Tourist Support & Information Facilities**
    Establishment of information kiosks and guidance facilities highlighting Haripad's temples, railway station, and key public destinations.
15. **External Services & Utility Upgradation**
    Improvement of water supply, power supply, drainage, stormwater management etc.

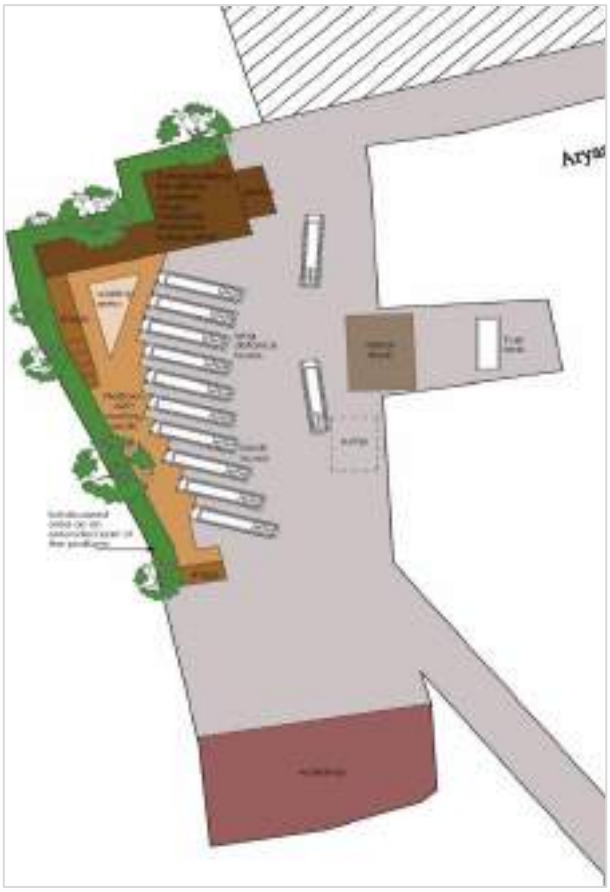


Figure 36.89 : Key plan of the conceptual Layout Proposed for Haripad KSRTC Bus Stand

4) Agencies Responsible

The project may be implemented by KSRTC directly or through any agency nominated by them. Support and coordination may also be sought from Haritha Kerala Mission (for greening works) and the Public Works Department (for pathways and related infrastructure). The feasibility of obtaining financial assistance from MLA/MP fund, Plan fund and KIIFB may be explored. Local bodies and PPPs may also play a role to ensure timely completion and modern facilities

5) Suggested Implementation Mechanism

The renovation of the KSRTC Bus Stand shall be implemented in a phased manner to ensure uninterrupted operations and smooth transition. In the first phase, site clearing, demolition of existing structures, and systematic relocation of ongoing activities and services shall be undertaken with temporary arrangements for bus operations and passenger facilities. The second phase shall focus on the construction of core infrastructure including the fuel filling station, workshop facilities, and the multi-storeyed public amenity building. In

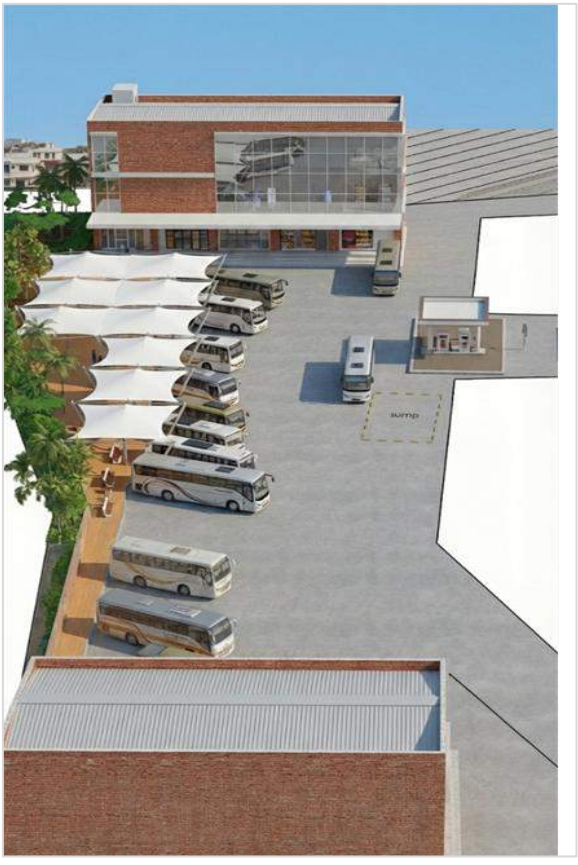


Figure 36.90 : Conceptual 3D generated using AI- Haripad KSRTC Bus Stand

the final phase, finishing works such as internal services, passenger information systems, landscaping, circulation markings, and overall beautification shall be completed, culminating in the commissioning of the upgraded bus terminal.

6) Other Associated Issues to be addressed

During the renovation of the KSRTC Bus Terminal ensure smooth execution and long-term functionality. These include managing traffic and passenger movement during construction, improving integration with the surrounding road network including NH-66, and resolving existing drainage and waterlogging concerns. Adequate attention must also be given to fire safety, emergency preparedness, environmental sustainability measures, regulation of vending activities, shifting of utilities, universal accessibility compliance, and planning for efficient operation and maintenance after project completion, with continuous stakeholder coordination to minimise public inconvenience.

7) Project Cost and Period

The proposed renovation of the KSRTC Bus Stand, Haripad, is estimated to cost approximately ₹6.00 - 6.50 crore. The estimate covers demolition, comprehensive layout redesign, construction of modern passenger amenities, circulation improvements, workshop and fuel station upgradation, and safety and utility enhancements. The cost is based on a conceptual design and is subject to revision during detailed design and execution stages

36.4.28 Town- Level Faecal Sludge Treatment Plant (FSTP) and Solid Waste Processing Facility near Choorellackal

1) Project Brief



The Faecal Sludge Treatment Plant (FSTP) and Solid Waste Treatment Facility project is envisioned as a critical town-level infrastructure initiative for Haripad Municipality. With the town experiencing steady growth in population, commercial activities, and residential density, the pressure on existing sanitation systems has increased significantly. Haripad currently lacks an integrated scientific system for treating sewage and managing solid waste, leading to environmental degradation, contamination of local water bodies, and public health concerns. This project proposes the development of a modern, environmentally compliant FSTP along with a supporting solid waste treatment unit capable of handling municipal waste streams efficiently. The facility will be equipped with advanced treatment technologies, segregation areas, waste processing systems, and secure disposal mechanisms. The intervention aims to ensure safe treatment of wastewater, reduction of pollution load, improvement in sanitation standards, and long-term environmental sustainability for the entire municipal area.

A conceptual layout plan and rough cost estimate has been prepared for accommodating the proposed Faecal Sludge Treatment Plant (FSTP) and Solid Waste Treatment Facility within the identified municipal land. However, the adequacy of the site area and final capacity requirements shall be confirmed through detailed surveys, technical investigations, and design refinements at the Detailed Project Report (DPR) stage and subsequent statutory approvals

Need for the Project

Haripad currently faces challenges in managing sewage and municipal solid waste due to the absence of a centralized treatment facility. Direct discharge of untreated sewage into drains and water bodies leads to water pollution, bad odour, and health risks. Increasing population and urban activities have intensified waste generation, making traditional disposal practices inadequate. Poor waste handling results in clogged drains, frequent flooding, and unhygienic living conditions. A scientifically designed FSTP is essential to meet environmental regulations and safeguard ecological assets. Establishing a solid waste treatment unit will promote segregation, recycling, resource recovery, and sustainable waste management practices. The project will significantly improve the town's environmental quality, public health indicators, and overall liveability.

Aim of the Project

The aim of the Faecal Sludge Treatment Plant (FSTP) and Solid Waste Treatment Facility project is to provide Haripad with a clean, safe, and sustainable sanitation system that treats wastewater responsibly while ensuring scientific management of solid waste. By reducing pollution, improving hygiene, and supporting environmental health, the project seeks to create a healthier and more liveable town for all residents.

Project Objectives

- To construct a modern Faecal Sludge Treatment Plant (FSTP) with adequate capacity to treat wastewater generated across Haripad Municipality.
- To establish a solid waste treatment facility with segregation, composting, recycling, and scientific disposal systems.
- To prevent the discharge of untreated sewage into canals, ponds, and natural drains, thereby protecting local water bodies.
- To reduce solid waste accumulation, roadside dumping, and environmental pollution through efficient waste processing.
- To adopt environmentally compliant treatment technologies aligned with CPCB and Kerala PCB norms.
- To improve public health by minimizing contamination, foul odour, vector breeding, and waterborne diseases.
- To support long-term urban sustainability through responsible resource recovery and reduced landfill dependency.
- To strengthen municipal service delivery and enhance the overall quality of life in Haripad.



Figure 36.91: Image showing the land identified for the proposed Faecal Sludge Treatment Plant and Solid Waste Treatment Facility at Choorelleckkal, Haripad

2) Location and Ownership

The Faecal Sludge Treatment Plant (FSTP) and Solid Waste Processing Facility is proposed on land identified and owned by the Haripad Municipality. The proposed site is located within an extensive paddy field, ensuring adequate buffer from dense residential areas and minimizing potential land use conflicts. The land parcel is under the ownership of the Municipality, thereby facilitating ease of project implementation. The site enjoys good road connectivity, enabling efficient transportation of municipal waste and unhindered access for operation and maintenance activities. The absence of residential buildings in the immediate vicinity further enhances the suitability of the location from environmental and public health perspectives.

Land Ownership	Haripad Municipality
Ward Number	11
Project Area	Approx. 85 Cents
Survey Number	460/1



Figure 36.92: Location of proposed Faecal Sludge Treatment Plant and Solid Waste Treatment Facility at Chooralackal

3) Project Components

Faecal Sludge Treatment Plant: The FSTP is designed for a period of 30 years. The projected population for the horizon year is computed as 31606. Considering water consumption @ 150lpcd and assuming sewerage generated as 80% of the water consumed, the sewerage load is computed to be 3.79MLD. Faecal sludge generated is expected to be 1% of the sewage load which is 37.9KLD. Hence it is desirable to design a FSTP of 38KLD capacity for Haripad Town. The project components of the proposed Faecal Sludge Treatment Plant are given below:

1. **Receiving Station:** The receiving station is the designated facility where desludging vehicles safely discharge collected faecal sludge into the treatment system.
2. **Pre-Treatment Unit:** The pre-treatment unit removes large solids, grit, plastics, and debris from the incoming sludge to protect downstream treatment processes.
3. **Primary Treatment Unit:** The primary treatment unit facilitates sedimentation and initial stabilization of sludge by separating settleable solids from liquid fractions.
4. **Secondary Treatment Unit:** The secondary treatment unit biologically treats the partially clarified liquid to reduce organic load, pathogens, and pollutants.

5. **Sludge Dewatering and Drying Unit:** This unit removes excess moisture from treated sludge through drying beds or mechanical systems to reduce volume and enable safe handling.
6. **Tertiary Treatment Unit:** The tertiary treatment unit provides final polishing and disinfection of treated effluent to ensure compliance with environmental discharge standards.
7. **Compost Yard:** The compost yard enables co-composting of dried sludge with organic waste to produce safe, nutrient-rich manure for reuse



Figure 36.93 : Faecal Sludge Treatment Plant and Solid Waste Treatment Facility at Choorelleckal (Proposed)- AI Generated illustration

Solid Waste Management Facility: As part of strengthening the solid waste management system in Haripad, primary emphasis is placed on waste minimisation, source segregation, and treatment at source. Households, commercial establishments, and institutions shall be encouraged and supported to reduce waste generation, segregate biodegradable and non-biodegradable waste at source, and adopt decentralised composting and other appropriate processing methods. The proposed Solid Waste Management Facility is therefore envisaged to handle the residual waste stream, ensuring scientific processing and management of the balance 100% of both biodegradable and non-biodegradable waste that is not treated at source, in compliance with prevailing environmental norms and sustainable waste management principles.

The projected waste generation of the horizon year is calculated as 13.9 tonnes/day. Applying the peak factor of 1.2 to account for seasonal surges the quantity of waste generated would be 16.68 tonnes/day. Hence it is required to have a Solid Waste Management facility that can handle waste of 17 tonnes/day. The project components of the Treatment facility are as given below:

1. **Waste Collection & Transportation Infrastructure:** This component ensures systematic door-to-door collection of segregated waste and its safe transport to the processing facility through appropriate vehicles and logistics systems.

2. **Segregation & Material Recovery Facility (MRF):** The MRF enables sorting, segregation, and storage of recyclable materials from collected waste to facilitate resource recovery and reduce landfill burden. This may be either recycled through in – situ process or handed over to agencies designated for the same.
3. **Organic Waste Processing Unit:** This unit processes biodegradable waste through composting or bio-methanation to produce compost or biogas, thereby minimizing environmental impact.
4. **Inert Waste Yard:** The inert waste yard provides a designated area for safe storage and management of non-biodegradable and non-recyclable waste prior to final disposal. The waste may be disposed off via Waste to Energy processing (incineration) or any other suitable technology.

4) Agencies Responsible

The project may be implemented by the Haripad Municipality either directly through its administrative and engineering wings or through an agency duly nominated/appointed by the Municipality for this purpose. Technical guidance, environmental compliance, and discharge standards shall be ensured in coordination with the Kerala State Pollution Control Board, particularly with respect to effluent quality, sludge disposal, and odour management. The guidance of Kerala Water Authority may also be sought for design, choosing a feasible technology and finalising the capacity of the FSTP facility. The feasibility of obtaining financial assistance from agencies such as IMPACT Kerala Limited, KIIFB, Suchitwa Mission, KSWMP (Kerala Solid Waste Management Project), KURDFC (Kerala Urban and Rural Development Finance Corporation) and MLACDF (Member of Legislative Assembly Constituency Asset Development Fund) may be explored. The possibility of developing the proposed facility through a PPP model may also be thought of.

5) Suggested Implementation Mechanism

The proposed Faecal Sludge Treatment Plant (FSTP) and Solid Waste Management (SWM) Facility for Haripad Town may be implemented under the overall supervision and ownership of Haripad Municipality. The Municipality shall act as the nodal agency responsible for land provision, statutory clearances, funding mobilisation, and monitoring, while construction and plant operations may be entrusted to a technically qualified agency selected through competitive tendering. Continuous monitoring, periodic performance review, environmental compliance as per applicable regulations, and structured integration with desludging operators and the municipal waste collection system shall form part of the governance framework to ensure efficient and sustainable functioning of the facilities.

6) Other Associated Issues to be addressed

In addition to core infrastructure, several associated issues must be addressed for the proposed FSTP and Solid Waste Management Facility of Haripad Municipality to ensure sustainability and public acceptance, including confirmation of land suitability with adequate buffer and flood safety, securing statutory environmental clearances, and ensuring strict compliance with the Solid Waste Management Rules and septage management guidelines. Measures for source segregation enforcement, scheduled desludging and operator regulation, user charge fixation for financial sustainability, and integration with existing municipal systems such as Haritha Karma Sena must be incorporated. Adequate provisions for odour control, leachate management, vector control, reliable power and water supply, worker health and safety,

monitoring and reporting mechanisms, grievance redressal, and scope for future capacity expansion are also essential to ensure efficient, environmentally compliant, and socially acceptable operation of the facilities.

7) Project Cost and Period

The cost of establishing a Faecal Sludge Treatment Plant (FSTP) of 38 KLD capacity would be around 1.9 crores (5 lakhs for every KLD capacity). Major capital costs construction of receiving stations, pre- treatment, primary treatment units, secondary treatment units, tertiary treatment units and developing compost yard.

The cost of establishing a Solid Waste Treatment facility of 17 tonnes/day capacity would be around 2.5 crores. Major cost components include civil works (Compost sheds, segregation area), Infrastructure (Water supply, electrification, drainage, gates), Processing system: (Vermi-beds, shredders, segregation lines), and other necessary equipments

Both the project may be implemented in three phases:

Table 36.75: Project Duration –Town- Level Faecal Sludge Treatment Plant (FSTP) and Solid Waste Processing Facility near Choorellackal

Project Duration –Town- Level Faecal Sludge Treatment Plant (FSTP) and Solid Waste Processing Facility near Choorellackal			
Sl. No.	**Project Phase**	**Solid Waste Treatment Facility**	**Faecal Sludge Treatment Plant**
1	Phase I (Approvals and procurement)	5 – 6 months	4 – 6 months
2	Phase II (Site preparation and Civil construction works)	5 – 6 months	3 – 4 months
3	Phase III (Equipment installation, Electrical, safety, and utility works, Landscape works)	2 – 3 months	2 – 3 months
	Total	**12 – 15 months**	**9 – 13 months**
** Project timelines are indicative and may vary based on site realities, approvals, resource availability, and implementation conditions*			



PART IV : ZONING REGULATIONS

CHAPTER
37

ZONING REGULATIONS



Zoning regulations form a core component of Haripad's spatial planning framework, guiding the orderly use and development of land across the Municipality. Delineating areas into different land use zones, ensures that growth is balanced, compatible and aligned with the town's long-term development vision. These regulations help manage urban expansion, reduce land-use conflicts and direct development toward suitable locations. In Haripad's context- characterized by its cultural assets, paddy fields, backwaters and mixed urban fabric- zoning also plays a crucial role in protecting natural resources, enhancing climate resilience and supporting sustainable, inclusive urban development. This chapter details the zoning approach that will guide Haripad's future growth in a structured, equitable and environmentally responsible manner.

37. ZONING REGULATIONS

37.1 Introduction

Zoning is a device of land use planning used in a Master Plan. The word is derived from the practice of designating permitted uses of land based on mapped zones which separate one set of land uses from another. Zoning Regulations are the means to achieve development of a use zone as envisaged in the Master Plan. In other words, Zoning Regulations are laws that define and restrict how to use a particular property coming under a Master Plan. Thus, it is the public regulation of land and building use to control the character of a place.

Adhering to the government order G.O.(Ms)No.195/2025/LSGD Dated 28-10-2025, the *'Master Plan for Haripad Town - 2045'* tries to adopt a flexible and inclusive zoning framework promoting mixed-use development through 'Inclusive Zoning with Negative List'. This Master Plan shall incorporate an inclusive zoning approach, wherein only negative list of non-permissible activities in each zone shall be specified. All compatible uses shall be allowed, wherever feasible, to promote flexibility in land use. Commercial and industrial activities shall also be encouraged within urban development areas, supporting economic diversification and employment generation.

The spatial details of the Municipality are documented in the proposed land use map. In order to clearly identify the land parcels with respect to survey details, the proposed land use information is also detailed in the module maps. The development regulation for Haripad Municipal area is presented in three sections. First is General Guidelines (37.2) which includes general provisions applicable to the entire Municipal area, and shall apply to all zones irrespective of the zoning regulations for individual zones. Second section includes Zone wise Land Use Regulations (37.3) ie, guidelines for each zone which includes specific regulation regarding prohibited uses applicable to that zone. Third section includes Zoning Regulations for Flood Prone Areas (37.4) that are aimed at reducing damages and losses to people and assets in the flood prone areas of the town.

37.2 General Guidelines

The general guidelines shall apply to all zones.

All future developments/ constructions shall be in conformity with the provisions of the *'Master Plan for Haripad Town – 2045'*, *'Kerala Municipality Building Rules (KMBR), 2019'* and other applicable statutes in force and their time-to time amendments unless otherwise specified in this regulation or in any detailed town planning scheme prepared and made in force within the framework of this Plan.

1) For the implementation and enforcement of the proposals envisaged in this Master Plan, areas have been zoned under various zones such as *'Residential Zone, Town Centre, Mixed Zone, Industrial Zone, Public and Semi-Public Zone, Traffic and Transportation Zone, Tourism Promotion Zone, Agro Tourism Promotion Zone, Environmental Conservation Zone, Wet Agriculture Zone, Recreational Zone, Detention/ Retention Basins, Wetland Park, Sacred Groves, Buffer Zone* and *Waterbodies'* for securing the most efficient and effective use of land in public interest. Details regarding the nature of 'Uses Prohibited' in each zone are given in

Table 37. 1. These regulations shall be enforced in conjunction with other specific provisions if any mentioned elsewhere in the Master Plan and in accordance with the other statutes applicable.

2) For reducing disaster risk, proposed land use and the developments in various flood prone areas are further modified by Flood prone area overlay regulations in Table 37. 2. Notwithstanding anything contained in the zoning regulations of the Master Plan, the additional regulations in 37.4 – Regulation for Flood Prone Areas (Overlay Zone) shall prevail.

3) *'Uses Prohibited'* are various objectionable uses in each zone which shall not be permitted under normal circumstances. For all that uses that does not fall under the Prohibited Uses under Table 37. 1 & permitted uses in Table 37. 2, the Municipal Secretary, Haripad Municipality (here in after referred to as Secretary) may grant permission for the said use/ construction subject to the provisions of *KMBR* in force and other applicable laws and regulations, provided that other clearances/ no objection certificates are available.

4) *'Uses Permitted'* in a zone cover the uses that can be normally accommodated in the relevant zone. Such uses may be permitted by the Secretary.

5) KMBR refers to the Kerala Municipality Building Rules in force at the time of submission of application for permit for building construction or land development.

6) If any land in a zone is put to *'Uses Prohibited'* as stated in Para 4, before coming into operation of this Master Plan, such use shall be termed as *'non-conforming use'*. A non-conforming use may be allowed to continue in its existing location, if they are lawfully established prior to the date of coming into operation of this Master Plan and essential repairs and maintenance for the structure may be permitted by the Secretary, provided that the said use create no adverse environmental influence in the zone. Addition, alteration or reconstruction, may be permitted for such uses by the Secretary, provided that the total built up area of such non-conforming use shall not exceed 1.5 times the existing built-up area, as per prevalent KMBR.

7) Zoning regulations are essentially intended to help the competent authority in taking decisions regarding granting or refusal of permits for land development and construction of buildings/ structures. Zoning regulations are not intended to prohibit existing uses that have been lawfully established, or Development Permit/ Building Permit/ Layout-Approval/ Approval for Sub- Division of Plot that have been obtained in any zone, prior to the enforcement of these regulations, unless otherwise specifically mentioned in this Master Plan.

8) Subject to the zoning regulations of the respective use zones, more than one use may be combined in a building/plot, provided that the area of individual uses shall be limited to that prescribed for each such use in the zoning regulations of the respective zone.

9) If different land use zones fall within a single plot, all uses permitted as per the zoning regulations of such land use zones may be permitted in the plot by the Secretary. However,

for the part of the plot which comes under *Waterbodies, Buffer Zone, Environmental Conservation Zone, Detention/Retention basins, Wetland Park* and *Sacred Groves* these provisions shall not be applicable.

10) Existing areas and structures of archaeological importance and religious uses may be permitted to continue in all zones and shall be treated as permitted uses.

11) Construction of single-family residential buildings shall be allowed with the concurrence of the District Town Planner in any piece of land which is marked as *Wet Agriculture* but not designated as paddy lands or wetlands under the *Kerala Conservation of Paddy land and Wetland Act.*

12) Provisions/ regulations under the *'Disaster Management Act 2005, The Ancient Monuments and Archaeological Sites and Remains Act 1958, Coastal Regulation Zone Notification 2019, Aircraft Act 1934, Environment Protection Act 1986,* and any other applicable statutes as amended from time to time shall prevail over the respective provisions of this Master Plan.

13) Silence Zone, as prescribed by the *'Noise Pollution (Regulation and Control) Rules, 2000'* as amended from time to time, shall be applicable to such areas under this Master Plan.

14) Operational constructions as defined in the '*Kerala Town and Country Planning Act, 2016*' shall be treated as permitted use in the Master Plan area.

15) Regulation of construction and land developments on the sides of new roads/ roads proposed for widening as per the Master Plan shall be governed by the distance from the centre line of the road, unless otherwise specified in the Master Plan or detailed town planning schemes in force or such detailed road alignment approved by the Government. If widening on one side of any stretch of the road is constrained due to the physical barriers of *Waterbodies*, railway land and protected archaeological monuments/sites, the road widening in that stretch shall be accounted from the other side.

16) In case of uncertainty in identifying the alignment and boundary of thodu, canal, river, existing public road, railway line, and in ambiguity to assess the boundaries of the same in the Proposed Land Use Maps, it shall be referred to the actual position on the ground as well as revenue records and decision taken by the Secretary in this regard shall be final.

17) The expansion of existing State/ Central/ Local Government institutions, State/ Central Public Sector Undertakings, industrial uses, educational institutions, healthcare institutions, and their ancillary uses may be permitted irrespective of the zoning regulations of the area in which they exist or are proposed to be expanded. However, this provision shall not be applicable in areas classified as *Waterbodies, Environmental Conservation Zone, Sacred Groves, Detention/Retention Basins, Wetland Park and Buffer Zone.*

18) Only the existing areas under Public and Semi-Public uses and Industrial uses are intended to be included under Public and Semi-Public Zone and Industrial Zone respectively. If any private property got included within such zones, the Secretary may, with the concurrence of the Town Planner, after verification of the revenue ownership documents, accord sanction for development by adopting the regulations of the surrounding land use zone in

the Proposed Land Use map, subject to the provisions as per applicable Acts, Rules and Government Orders in force in the State.

19) If public/Industrial activity ceases or do not exist in a private land, permitted uses in the surrounding land use zone shall be allowed in the plot with the concurrence of the Town Planner, if no records are available with the Municipality regarding any proposal for acquiring that particular land for any public/Industrial use at the time of application of building construction or land development.

20) Disaster Mitigation projects by competent authorities shall be permitted in all zones.

21) Construction of new critical Infrastructure facilities such as hospitals, bus terminals, railway stations and institutions of critical importance such as offices of district administration, Police stations, Fire stations, etc. shall not be permitted in Flood Prone Areas. However, Reconstruction or maintenance of existing authorized uses/ buildings/ addition of new blocks shall be permitted with adequate flood resilient measures with the concurrence of the Town Planner in a case-to-case basis.

22) For all Waterbodies demarcated in the official revenue records (such as rivers, streams, natural drains, canals, ponds etc), an area extending 2 meters from their boundary, or a distance equal to the width of the water body, whichever is less, shall be maintained as a "*No-Construction Zone*". In case of existing authorized buildings in these prohibited areas, only repair/reconstruction of the existing building limiting to the existing built-up area is permissible without enhancing the existing coverage of building.

23) Projects of Central/ State Government, Local Self Government Institutions, Public and Sector Undertakings and other Government Institutions may be permitted with the concurrence of the Town Planner in all built up Zones such as *Residential Zone, Town Centre, Mixed Zone, Public and Semi – Public Zone, Industrial Zone, Traffic and Transportation Zone, Tourism Promotion Zone, Agro Tourism Promotion Zone and Recreational Zone* if such uses are not included in the permitted uses as per the Zoning Regulations.

24) ATMs, Water Tanks, Electric Vehicle Charging Stations, Parking Plazas, Public Utility Buildings/ Structures, Waste management Units or municipal solid waste management systems and related uses, Playgrounds, Turfs and Parks may be treated as permitted use in all zones except in *Waterbodies, Buffer Zone, Environmental Conservation Zone, Sacred groves, Detention/Retention Basins and Wetland Park.*

25) Transmission/ Telecommunication Towers, Mobile Towers, Wireless Stations, may be treated as permitted use in all zones except in *Waterbodies, Buffer Zone and Sacred groves.*

26) The cadastral data (survey no. & revenue boundaries) incorporated in the Master Plan have been collected from the Department of Survey and Land Records. During the preparation of the Plan, the resurvey sketch and Lithomap (cadastral) maps were compiled and geo-referenced. However, the survey numbers and boundaries recorded in the official revenue records shall be deemed final and authoritative.

27) The land specially demarcated for certain projects as Special Zones may be procured as per the provisions of The Kerala Town and Country Planning Act 2016, by Haripad Municipality or line departments or other agencies concerned/ private developer/ other organisations with the concurrence of Municipal Council of Haripad Municipality. If the proceedings to procure such land had not been initiated within 7 years from the date of sanctioning of this Master Plan, the areas so specifically demarcated may be released and assigned to the land use zone specified in 36.3.22 by the Secretary, based on the application for the building permit received.

28) Uses Permitted in Mixed Zone, (ie, uses which are not included under the Prohibited uses in Mixed Zone) may also be permitted in the Residential Zone and Town Centre by the Secretary, if not allowed otherwise as per the zoning regulations applicable, on both sides of the roads with existing or proposed access width of 12m or more.

29) Large-scale Development Projects in an area of not less than 0.5 ha and exceeding an investment of more than Rs. 50 crores, which provide direct employment (after commissioning of the project) to at least 250 people, may be permitted in all zones other than *Waterbodies*, *Environmental Conservation Zone*, *Sacred Groves*, *Detention/Retention Basins and Wetland Park* and *Buffer Zone*. A committee chaired by the Secretary (Local Self Government Department), and with members Director, Local Self Government Department (Urban), the Chief Town Planner (Convenor) of the Local Self-Government Department (Planning), the District Town Planner in charge of the planning area and the Municipal Secretary constituted by the Government for this purpose shall recommend for the grant of approval, subject to satisfying the following conditions and the Secretary shall comply the same while issuing permit.

    a. The project developer shall submit the "Feasibility Report" and the Environmental Impact Assessment Report to the Committee Convener at least 15 days before the scheduled Committee meeting.

    b. All the clearances of the concerned State and Central agencies shall be submitted to the Committee by the developer.

    c. Adequate provision shall be allocated in the project for all infrastructure facilities such as water supply, sewage treatment, solid waste management, etc. Separate systems for management of solid waste and sewage shall be provided and maintained by the developer at his cost.

    d. The developer shall submit a memorandum of understanding to the Municipal Secretary, pertaining to the implementation of the above-mentioned arrangements.

    e. The minimum width of the accessible road should be 10 m, or as directed by the committee.

    f. 10% of land allocated for large-scale industrial projects, or as much area as the committee recommends, shall be set aside for affordable housing units, that consist of residences with a built-up size of not more than 60 m^2.

30) The Government shall have the power to issue clarifications in respect of technical interpretations, if any, required on any of the provisions of the Master Plan in consultation with the Chief Town Planner concerned of the Local Self Government Department (Planning).

37.3 Zone wise Land Use Regulations

Table 37. 1: Zone wise Land Use Regulations

37.3.1	**Residential Zone**
	Uses Prohibited
a	KMBR Group B (Educational), Group C (Medical / Hospital) uses with Floor Space Index (F.S.I) greater than 1.5. Group D (Assembly), Group D1 (Assembly) Use with Floor Space Index (F.S.I) greater than 1.2. Group E (Office), Group F (Mercantile / Commercial) uses with Floor Space Index (F.S.I) greater than 1.5. Group H (Storage) use with Floor Space Index (F.S.I) greater than 2.
	KMBR Group G1 & Group G2 Industrial Uses except those included under the white and green category of the prevailing statutes of Kerala Pollution Control Board. KMBR Group G1 Industrial Uses included under the orange category of the prevailing statutes of Kerala Pollution Control Board except automobile service stations, Automobile wash stalls, Furniture making units, Oil mills. KMBR Group G2 Industrial Uses those included under red category of the prevailing statutes of Kerala Pollution Control Board. KMBR Group G3 Uses with Floor Space Index (F.S.I) greater than 1.0 and Coverage greater than 40%.
	KMBR Group I (Hazardous) except automobile fuel filling station, Crematorium, Burial ground, Vault, Wood and timber yards.
	Group J (Multiplex Complex) Uses.
37.3.2	**Town Centre**
	Uses Prohibited
a	Group B (Educational), Group C (Medical / Hospital) Use with Floor Space Index (F.S.I) greater than 1.2. Group E Uses with with Floor Space Index (F.S.I) greater than 2.0. Group H (Storage) Use with Floor Space Index (F.S.I) greater than 1.5.
	KMBR Group G1 Uses with Floor Space Index (F.S.I) greater than 1.0. KMBR Group G2 Uses. KMBR Group G3 Uses with Floor Space Index (F.S.I) greater than 1.0.
	KMBR Group I (Hazardous) except automobile fuel filling station.
37.3.3	**Mixed Zone**

	Uses Prohibited
a	KMBR Group G1 & G3 Uses with Floor Space Index (F.S.I) greater than 2.0. KMBR Group G2 Industrial Uses those included under red category of the prevailing statutes of Kerala Pollution Control Board except coir manufacturing.
	KMBR Group I (Hazardous) except automobile fuel filling station.
37.3.4	**Industrial Zone**
	Uses Prohibited
a	KMBR Group A (Residential), Group A1 (Special Residential) Use with Floor Space Index (F.S.I) greater than 1.2. KMBR Group B (Educational), Group C (Medical / Hospital), Group D (Assembly), Group D1 (Assembly), Group J (Multiplex Complex) Uses.
	Group E (Office), Group F (Mercantile / Commercial), Group H (Storage) with Floor Space Index (F.S.I) greater than 1.5.
	KMBR Group I (Hazardous) except automobile fuel filling stations, wood and timber yards, Saw mill.
37.3.5	**Public & Semi-Public Zone**
	Uses Prohibited
a	KMBR Group G1 & G2, G3 Uses.
	KMBR Group H (Storage) with Floor Space Index (F.S.I) greater than 1.5.
	KMBR Group I (Hazardous) Uses except automobile fuel filling station.
37.3. 6	**PS 01- Karimpalil Palace Renovation**
	Uses Prohibited
a	All construction activities except Structural strengthening, façade restoration, and adaptive interior redesigning of the existing building, Restoration of timber elements, roofing tiles, verandahs, and courtyards, Conservation-oriented MEP retrofitting (wiring, lighting, drainage).
b	All uses except Visitor Information and Facilitation Centre, Cultural Plaza and Amphitheatre, Mini Library and Interpretation Gallery, Cloakroom and Baggage Storage Facility, Sleeping Pods / Transit Accommodation Zone, Café and Retail Kiosk Zone, EV Charging Stations and Bicycle Rental Hub, Signages, Landscaping, Parking facilities, Public amenities, Comfort stations.
37.3. 7	**PS 02- Haripad Cultural Centre**
	Uses Prohibited
a	All construction activities except Structural strengthening, façade restoration, and adaptive interior redesigning of the existing building, Restoration of timber elements, roofing tiles, verandahs, and courtyards, Conservation-oriented MEP retrofitting (wiring, lighting, drainage).
b	All uses except Open-air amphitheatre, Community Hall, Museum, Souvenir shops, Traditional restaurant/refreshment court serving local cuisine, Tourist

	information & facilitation centre with digital kiosks, Traditional restaurant/refreshment court serving local cuisine. Tourist information & facilitation centre with digital kiosks, Landscaping, Parking facilities, Waste Management Facilities, Comfort stations.
37.3. 8	**PS 03- Pilgrim Amenity Centre**
	Uses Prohibited
a	All uses except the site development/ construction required for the construction of a pilgrim amenity centre and its incidental uses.
37.3.9	**PS 04 - Waste Treatment Plant**
	Uses Prohibited
a	All uses except the site development/ construction required for the construction of solid or liquid waste treatment facilities and its incidental uses.
37.3.10	**Traffic & Transportation Zone**
	Uses Prohibited
a	All uses except Transport Terminals, Associated Constructions, Travel Stations, Residential Uses in connection with Transport Terminals, Staff Quarters, Guest Houses, Lodges connected with Transport Terminals, Tourist Homes, Shops / Restaurants / Canteen / Office / Trade & Commercial Spaces, Waste Treatment Units, Fuel Filling Stations.
37.3. 11	**Tourism Promotion Zone**
	Uses Prohibited
a	KMBR Group B (Educational), Group C (Medical / Hospital), Group D (Assembly), Group D1 (Assembly), Group E (Office), Group F (Mercantile / Commercial), Group H (Storage) Uses with Floor Space Index (F.S.I) greater than 1.2.
	KMBR Group I (Hazardous) Except automobile fuel filling station.
	Group J (Multiplex Complex) Uses with Floor Space Index (F.S.I) greater than 1.5.
	KMBR Group G1 Industrial Uses except those included under the white and green category of the prevailing statutes of Kerala Pollution Control Board KMBR Group G2, & G3 Uses.
37.3.12	**Agro Tourism Promotion Zone**
	Uses Prohibited
a	All uses, except Residential / Commercial Buildings upto 10m height and Tourism based amenities, supporting facilities and public utility areas and buildings. KMBR Group G1 & Group G2 Uses with Floor Space Index (F.S.I) greater than 1.0 or Coverage greater than 35%.
37.3.13	**Environmental Conservation Zone**
	Uses Prohibited

a	All uses, except Paddy cultivation/ Agriculture/ Horticulture/ floriculture/ Fodder cultivation, Fish Farms/ Seed Farms/ Wells and Irrigation Ponds without any building construction, Pump House, Temporary structures related to farm tourism promotion and related activities, Waste treatment facilities.
37.3. 14	**Wet Agriculture**
	Uses Prohibited
a	All uses, except Paddy cultivation/ Agriculture/ Horticulture/ floriculture/ Fodder cultivation, Fish Farms/ Seed Farms/ Wells and Irrigation Ponds without any building construction, Pump House and Building constructions or land developments in conformity with '*The Kerala Conservation of Paddy land and Wetland Act, 2008*' in force in lands designated as paddy lands or wetlands under the said act.
37.3. 15	**Recreational Zone**
	Uses Prohibited
a	All uses, except Comfort Station, Cafeteria, incidental uses to open recreational activities.
37.3. 16	**Detention/ Retention Basins**
	Uses Prohibited
a	All uses except Construction/site development required for construction/excavation of water-holding basins, side protection walls, wet agriculture, aquaculture, pisci-culture.
37.3. 17	**Wetland Park**
	Uses Prohibited
a	All uses except Eco Walk Ways, Retention/ Detention basins, water treatment facilities, Park, Play Grounds, Swimming Pools, Open Air Stadium, Open Air Theatre, Zoological and Botanical Garden.
37.3. 18	**Sacred Groves**
	Uses Prohibited
a	Construction/ Reconstruction/ Site Development and cutting of trees.
37.3. 19	**Buffer Zone - for waterbodies asper Clause 22 of 36.2 General Guidelines**
	Uses Prohibited
a	All uses except mangroves cultivation/ restoration/protection and other plantation of native species.
37.3. 20	**Waterbodies**
	Uses Prohibited
a	All uses except the following
	Restoration and rejuvenation of waterbodies.
	Bridges, side protection walls/retaining walls, bathing ghats, floating jetty, pump houses, irrigation ponds based on community level requirements.
	Traditional fishing and allied activities undertaken by local communities.

	Activities related to tourism like water sports, spot fishing, aquaculture without affecting and altering the natural environment, parks may also be permitted.
37.3. 21	**Special Zone**
	For the implementation of the projects proposed in the Master Plan, the following areas have been demarcated as Special Zones. The said land is reserved for the uses specified in the respective zones. It is intended to make the land available for the said project either through land acquisition or other suitable methods. Furthermore, this land cannot be utilized for other developments within the time limit stipulated in Clause 27 of General Guidelines.
	SZ - A – Private Bus Stand
	If the project is not materialized within a period of 7 years from the date of sanctioning of this Master Plan, the area shall be deemed as a part of the Town Centre.
	Uses Prohibited
a	All uses except the site development/ construction required for the construction of a Private Bus Stand and its incidental uses including shops/ Commercial establishments.

37.4 Zoning Regulations for Flood Prone Areas (Overlay Zone)

Flood Prone Areas are areas which are exposed to floods as indicated in the 50–year return probability flood maps published by KSDMA. This map is part of the proposed land use map as an overlay.

Areas likely to be inundated to a depth up to 0.6m is categorised as Flood Prone Area I. Areas likely to be inundated to a depth of more than 0.6m and up to 1.5m is categorised as Flood prone area II and the areas likely to be inundated to a depth of more than 1.5m is categorised as Flood prone area III.

For reducing flood risk, permissible developments in various land use zones (Table 37. 1) are further modified by regulations for flood prone area given in Table 37. 2. These modified regulations are aimed at reducing damages and losses to people and assets in the flood prone areas published by KSDMA. These regulations must be read in conjunction with the zoning regulations in Table 37. 1 and wherever a conflict occurs the modified regulations in Table 37. 2 shall prevail.

Table 37. 2: Zoning Regulations for Flood Prone Area

	Permitted Uses/ Activities in Flood Prone Area
1.	All existing authorized uses will be permitted to continue including their maintenance and strengthening works. However, such constructions may adopt adequate Flood Resilient Measures.
2.	Expansion of existing buildings to the upper floors under permitted uses in 36.3 of the respective land use zones will be allowed. However, such constructions may adopt adequate Flood Resilient Measures.
3.	Agriculture, Horticulture, Pisciculture, Fodder cultivation and other types of cultivation including social forestry.

4.	Ancillary structures to the above including Pump house, Well, Irrigation Pond and Granary for temporary storage.
5.	Parks and other organised recreational open areas with essential ancillary structures.
6.	Constructions in Flood Prone Areas I, II and III as in the Proposed Land Use Plan, shall complying the conditions specified below under Sl. No. a to g
a	All new constructions/ additions to upper floors shall have an open balcony /open passage/a terrace in the upper floors or an open stair connecting the upper floors to the ground facing the yard abutting the adjoining street to facilitate easy evacuation.
b	All new buildings or addition of upper floors shall have a minimum of 50% of the roof terrace kept open to sky, which shall be accessible to facilitate easy evacuation.
c	Height of compound wall shall not exceed 1.5 meter and no sharp–edged projections shall be fixed on the compound walls or gates.
d	No portion of open space shall be paved. However, only 25% of the total open space in the plot may be paved if required, with suitable materials enabling percolation of rain water.
e	Construction/Reconstruction of toilets with Septic tanks having control valves/ non return valves and inspection chamber is mandatory for every new building, if sewerage connectivity is not available.
f	Electrical points shall be provided above 1.2 m from finished floor level
g	Essential utility services shall be provided with suitable flood proofing.
7(1)	**Flood Prone Area I (Inundation Depth less than 0.6 m)**
	All new buildings or additions in the ground floor shall be built on a plinth height of 60cm from the surrounding ground level.
7(2)	**Flood Prone Area II (Inundation Depth greater than 0.6 m and upto 1.5m)**
	All new buildings or additions in the ground floor shall be built on a plinth height of 1.20m from the surrounding ground level.
	Basement floors are not allowed for any use other than parking.
7(3)	**Flood Prone Area III (Inundation Depth greater than 1.5 m)**
	All new buildings or additions in the ground floor shall be built on a plinth height of 1.80m from the surrounding ground level.
	Basement floors are not allowed for any use.

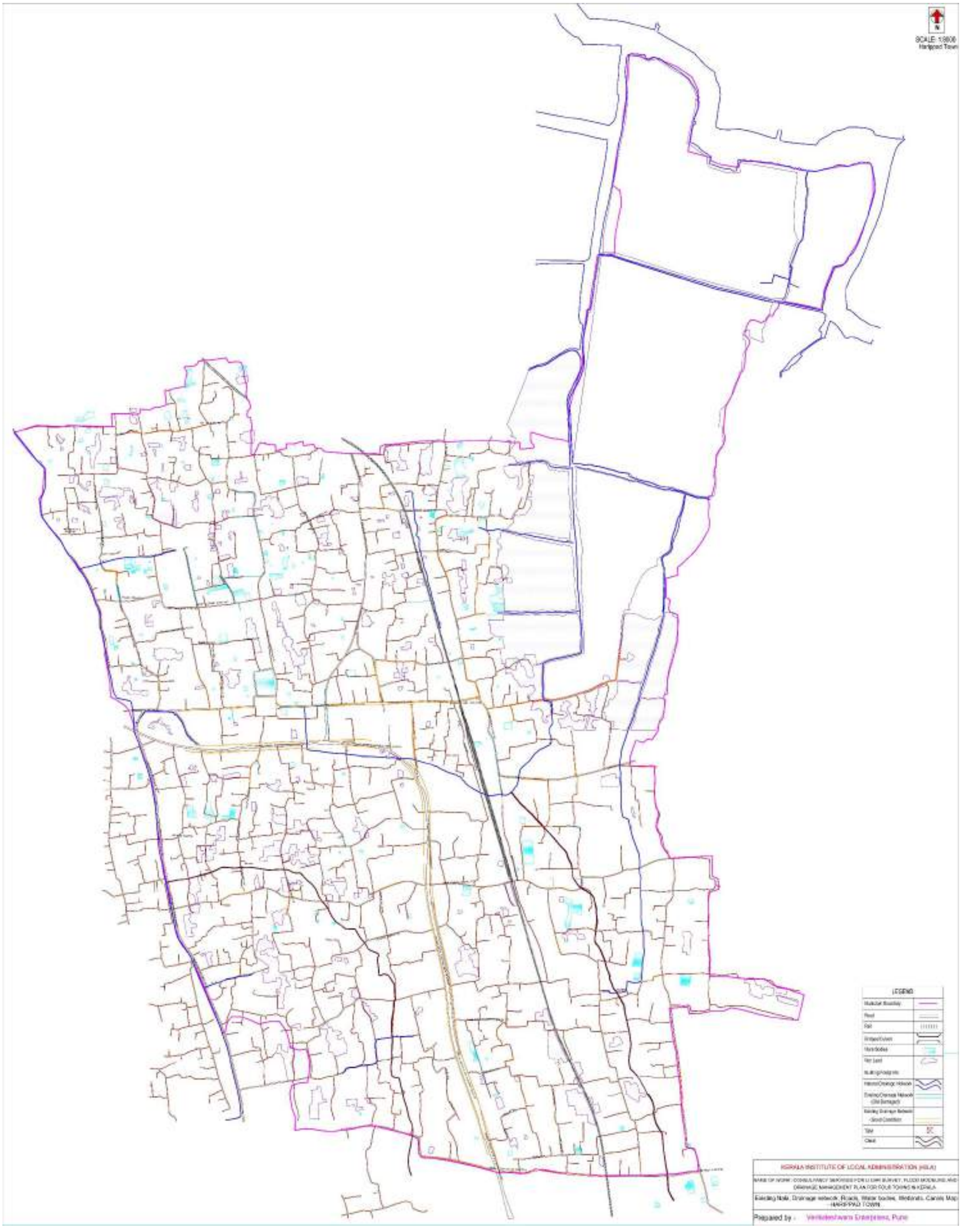


MASTER PLAN FOR HARIPAD TOWN - 2045

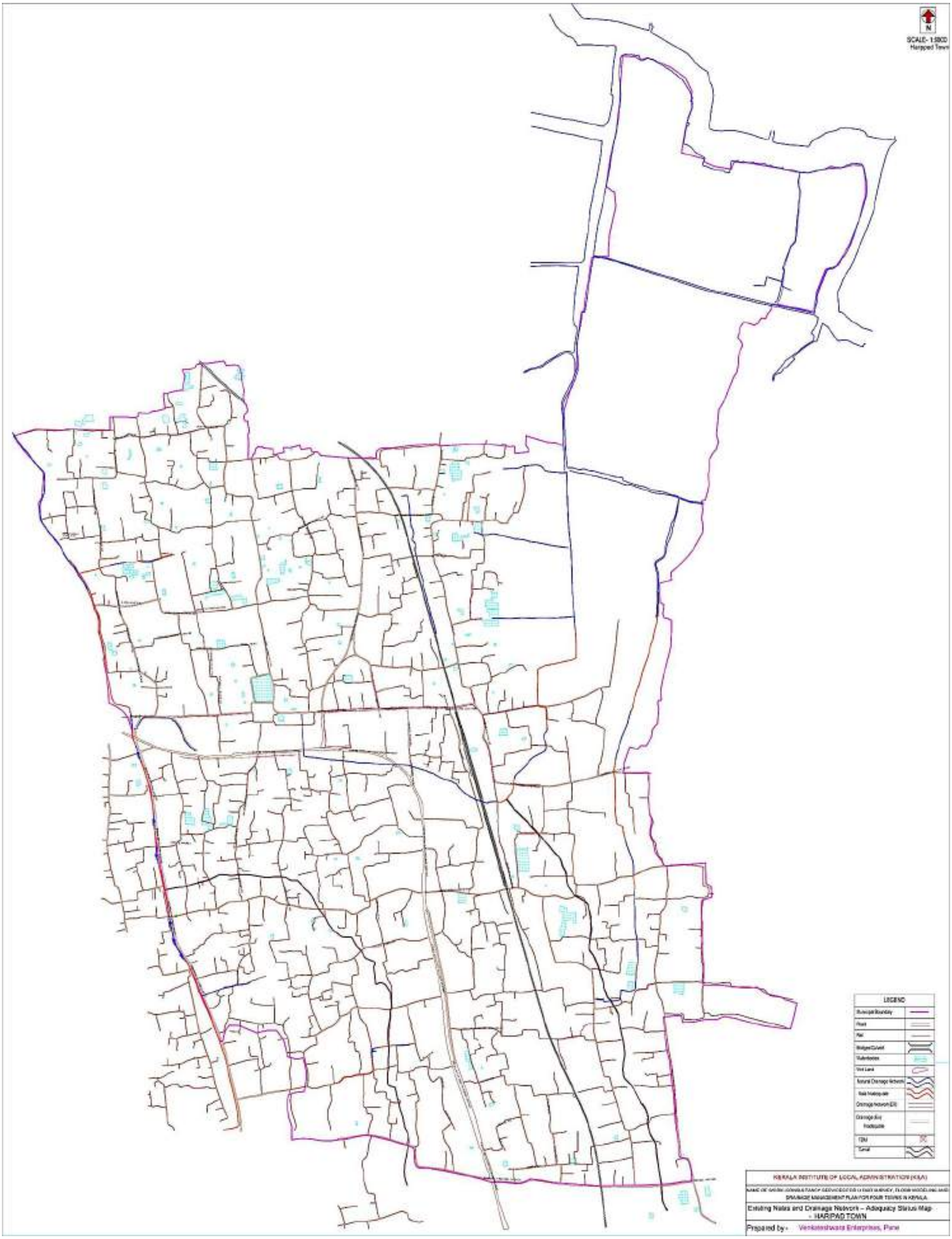
ANNEXURE

ANNEXURE I	:	**EXISTING DRAINAGE NETWORK MAP- HARIPAD**
ANNEXURE II	:	**EXISTING DRAINAGE NETWORK OF HARIPAD – ADEQUACY STATUS MAP**
ANNEXURE III	:	**STORMWATER MANAGEMENT PLAN MAP - HARIPAD**
ANNEXURE IV	:	**DESIGN AND ADEQUACY CHCEK STATEMENT FOR EXISTING NALA IN HARIPAD**
ANNEXURE V	:	**HARIPPAD PROPOSED STORM WATER DRAIN (NALA) STATEMENT**
ANNEXURE VI	:	**HARIPPAD ROAD SIDE DRAIN REPORT**

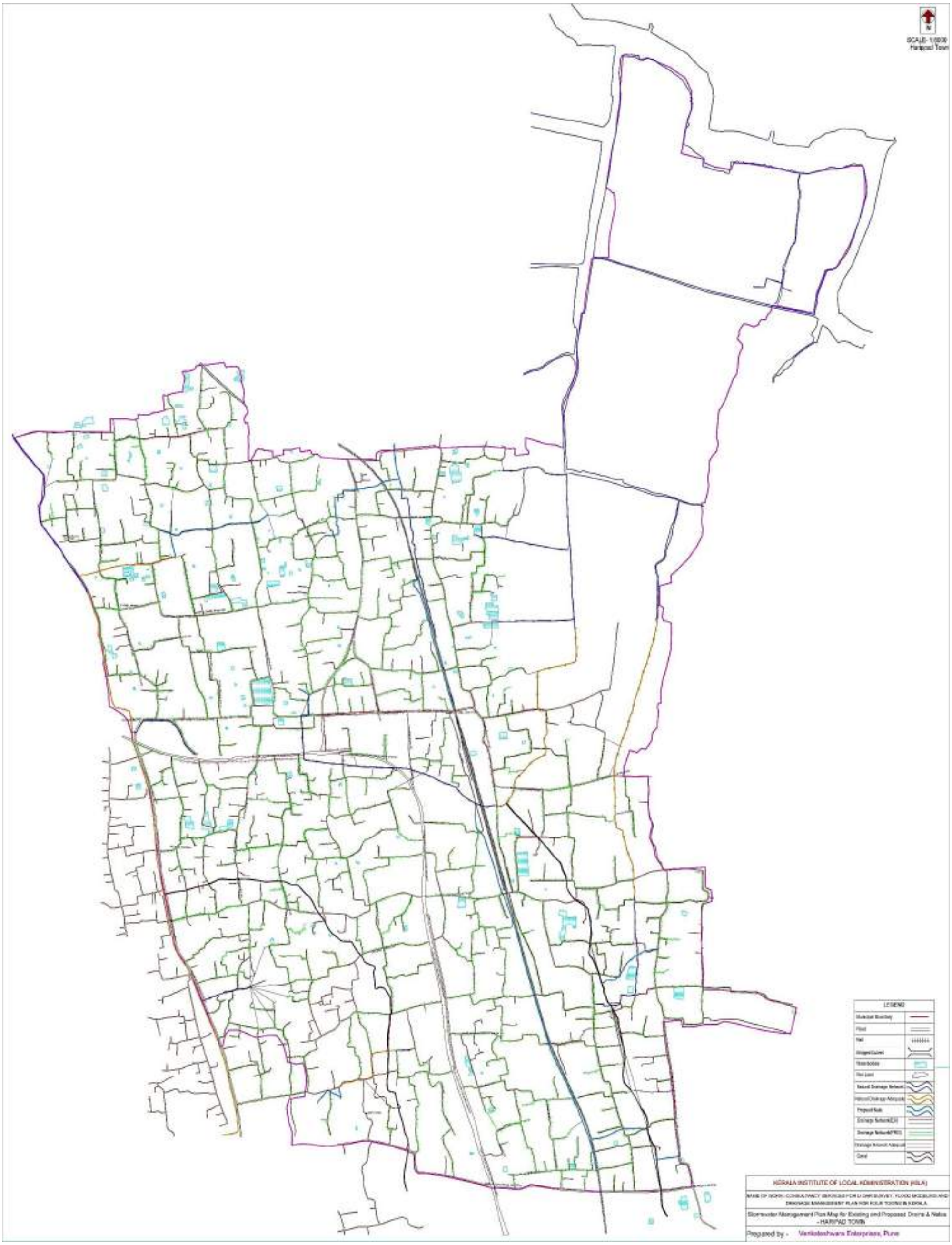
ANNEXURE I: EXISTING DRAINAGE NETWORK MAP- HARIPAD



ANNEXURE II : EXISTING DRAINAGE NETWORK OF HARIPAD – ADEQUACY STATUS MAP



ANNEXURE III : STORMWATER MANAGEMENT PLAN MAP - HARIPAD



ANNEXURE IV : DESIGN AND ADEQUACY CHCEK STATEMENT FOR EXISTING NALA IN HARIPAD

				Existing Nala													Adequate Design Nala									
ID	Label	Start Node	Stop Node	Invert (Start) (m)	Invert (Stop) (m)	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	System Drainage Area (m^2)	Manning' s n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	Flow (m^3/s)	Flow / Capacity (Design) (%)	Section Type	Material	Adequacy Check	Manning' s n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	Flow (m^3/s)	Flow / Capacity (Design) (%)	Span (m)	Rise (m)	Section Type	Material	Adequacy Check
10217	Nala-1	CB-449	CB-448	1.27	1.26	2	2	72.49	12.67	1,01,012.20	0.03	0.17	3.9	0.61	15.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.17	3.9	0.61	15.7			Irregular Channel	Natural stream, clean	Adequate
10219	Nala-1	CB-448	CB-447	1.26	1.25	2	2	99.93	13.98	1,30,881.90	0.03	0.16	4.2	0.78	18.5	Irregular Channel	Natural stream, clean	Adequate	0.03	0.16	4.2	0.78	18.5			Irregular Channel	Natural stream, clean	Adequate
10221	Nala-1	CB-447	CB-446	1.25	1.24	2	2	99.97	14.39	1,50,445.00	0.03	0.17	3.53	0.89	25.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.17	3.53	0.89	25.3			Irregular Channel	Natural stream, clean	Adequate
10223	Nala-1	CB-446	CB-445	1.24	1.23	2	2	100.34	12.72	1,70,944.50	0.03	0.19	10.95	1.01	9.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.19	10.95	1.01	9.3			Irregular Channel	Natural stream, clean	Adequate
10225	Nala-1	CB-445	CB-444	1.23	1.22	2	2	100	13.67	3,94,041.90	0.03	0.26	3.12	2.34	74.9	Irregular Channel	Natural stream, clean	Adequate	0.03	0.26	3.12	2.34	74.9			Irregular Channel	Natural stream, clean	Adequate
10227	Nala-1	CB-444	CB-443	1.22	1.21	2	2	100.22	13.44	3,96,439.80	0.03	0.26	3.07	2.35	76.5	Irregular Channel	Natural stream, clean	Adequate	0.03	0.26	3.07	2.35	76.5			Irregular Channel	Natural stream, clean	Adequate
10229	Nala-1	CB-443	CB-442	1.21	1.2	2	2	100.1	12.85	4,77,599.80	0.03	0.28	8.94	2.83	31.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.28	8.94	2.83	31.7			Irregular Channel	Natural stream, clean	Adequate
10231	Nala-1	CB-442	CB-441	1.2	1.19	2	2	100.45	29.39	4,93,635.60	0.03	0.21	3.59	2.93	81.5	Irregular Channel	Natural stream, clean	Adequate	0.03	0.21	3.59	2.93	81.5			Irregular Channel	Natural stream, clean	Adequate
10233	Nala-1	CB-441	CB-440	1.19	1.18	2	2	99.94	20.48	5,29,213.70	0.03	0.24	3.59	3.14	87.4	Irregular Channel	Natural stream, clean	Adequate	0.03	0.24	3.59	3.14	87.4			Irregular Channel	Natural stream, clean	Adequate
10235	Nala-1	CB-440	CB-439	1.18	1.17	2	2.52	99.76	11.31	5,42,460.80	0.03	0.31	4.46	3.22	72.2	Irregular Channel	Natural stream, clean	Adequate	0.03	0.31	4.46	3.22	72.2			Irregular Channel	Natural stream, clean	Adequate
10237	Nala-1	CB-439	CB-438	1.17	1.16	2.52	2	99.99	31.05	14,53,641.70	0.03	0.31	11.23	8.62	76.8	Irregular Channel	Natural stream, clean	Adequate	0.03	0.31	11.23	8.62	76.8			Irregular Channel	Natural stream, clean	Adequate
10239	Nala-1	CB-438	CB-437	1.16	1.15	2	2	100.24	32.66	14,92,636.20	0.03	0.45	4.7	8.85	188.4	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.45	9.38	8.85	94.4	10	1.5	Rectangular Channel	Brick in mortar	Adequate
10241	Nala-1	CB-437	CB-436	1.15	1.14	2	2	99.8	33.61	16,48,386.10	0.03	0.35	8.24	9.78	118.6	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.35	9.91	9.78	98.6	10.5	1.5	Rectangular Channel	Brick in mortar	Adequate
10243	Nala-1	CB-436	CB-435	1.14	1.13	2	2	100.41	33.08	16,55,580.70	0.03	0.5	4.67	9.82	210.4	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.5	9.88	9.82	99.4	10.5	1.5	Rectangular Channel	Brick in mortar	Adequate
10245	Nala-1	CB-435	CB-434	1.13	1.12	2	2	99.38	33.23	16,62,185.30	0.03	0.41	6.5	9.86	151.7	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.41	9.93	9.86	99.2	10.5	1.5	Rectangular Channel	Brick in mortar	Adequate
10247	Nala-1	CB-434	CB-433	1.12	1.11	2	2	101.3	32.99	18,19,640.80	0.03	0.59	4.14	10.79	260.9	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.59	10.9	10.79	99	11	1.55	Rectangular Channel	Brick in mortar	Adequate
10249	Nala-1	CB-433	CB-432	1.11	1.1	2	2.22	99.11	33.07	19,48,729.60	0.03	0.45	7.23	11.56	159.8	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.45	11.67	11.56	99	11.6	1.55	Rectangular Channel	Brick in mortar	Adequate
10251	Nala-1	CB-432	CB-431	1.1	1.09	2.22	2	101.34	32.77	19,52,717.00	0.03	0.52	5.77	11.58	200.8	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.52	11.76	11.58	98.5	11.8	1.55	Rectangular Channel	Brick in mortar	Adequate
10253	Nala-1	CB-431	CB-430	1.09	1.08	2	2.26	98.12	32.63	19,89,570.70	0.03	0.44	7.9	11.8	149.5	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.44	11.95	11.8	98.8	11.8	1.55	Rectangular Channel	Brick in mortar	Adequate
10255	Nala-1	CB-430	CB-429	1.08	1.07	2.26	2	100.28	29.58	21,96,086.00	0.03	0.37	21.59	13.05	60.5	Irregular Channel	Natural stream, clean	Adequate	0.015	0.37	13.23	13.05	98.5	12.5	1.6	Rectangular Channel	Brick in mortar	Adequate
10257	Nala-1	CB-429	CB-428	1.07	1.06	2	2	100.49	34.08	22,40,452.00	0.03	0.41	10.37	13.29	128.2	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.41	13.33	13.29	99.7	12.6	1.6	Rectangular Channel	Brick in mortar	Adequate
10259	Nala-1	CB-428	CB-427	1.06	1.05	2	2	99.05	32.14	22,85,086.20	0.03	0.37	14.33	13.55	94.6	Irregular Channel	Natural stream, clean	Adequate	0.015	0.37	13.65	13.55	99.3	12.8	1.6	Rectangular Channel	Brick in mortar	Adequate
10261	Nala-1	CB-427	CB-426	1.05	1.04	2	2	101.14	33.02	23,03,038.70	0.03	0.49	8.21	13.66	166.5	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.49	13.74	13.66	99.5	13	1.6	Rectangular Channel	Brick in mortar	Adequate
10263	Nala-1	CB-426	CB-425	1.04	1.03	2	2	99.33	32.99	23,17,271.10	0.03	0.45	9.77	13.74	140.7	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.45	13.86	13.74	99.2	13	1.6	Rectangular Channel	Brick in mortar	Adequate
10265	Nala-1	CB-425	CB-424	1.03	1.02	2	2	99.96	32.9	26,26,098.10	0.03	0.46	11.58	15.58	134.5	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.46	15.87	15.58	98.1	14.8	1.6	Rectangular Channel	Brick in mortar	Adequate
10267	Nala-1	CB-424	CB-423	1.02	1.01	2	2	102.14	33.19	26,44,512.70	0.03	0.38	15.99	15.69	98.1	Irregular Channel	Natural stream, clean	Adequate	0.015	0.38	15.7	15.69	99.9	14.8	1.6	Rectangular Channel	Brick in mortar	Adequate
10269	Nala-1	CB-423	CB-422	1.01	1	2	2	97.86	33.07	26,60,591.70	0.03	0.43	13.06	15.78	120.9	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.43	16.04	15.78	98.4	14.8	1.6	Rectangular Channel	Brick in mortar	Adequate
10271	Nala-1	CB-422	CB-421	1	0.99	2	2.19	98.67	26.33	28,24,129.80	0.03	0.43	23.82	16.75	70.3	Irregular Channel	Natural stream, clean	Adequate	0.015	0.43	17.03	16.75	98.4	15	1.65	Rectangular Channel	Brick in mortar	Adequate
10273	Nala-1	CB-421	CB-420	0.99	0.98	2.19	2	100.86	33.75	28,30,046.40	0.03	0.51	10.72	16.79	156.7	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.51	16.84	16.79	99.7	15	1.65	Rectangular Channel	Brick in mortar	Adequate
10275	Nala-1	CB-420	CB-419	0.98	0.97	2	2	100.74	33.74	28,32,677.20	0.03	0.5	11.31	16.8	148.5	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.5	16.85	16.8	99.7	15	1.65	Rectangular Channel	Brick in mortar	Adequate
10277	Nala-1	CB-419	CB-418	0.97	0.96	2	1.52	100.05	34.23	28,34,025.60	0.03	0.43	14.51	16.81	115.9	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.43	16.91	16.81	99.4	15	1.65	Rectangular Channel	Brick in mortar	Adequate
10279	Nala-1	CB-418	CB-417	0.96	0.92	1.52	1.84	100.88	24.5	29,77,549.70	0.03	0.69	24.2	17.66	73	Irregular Channel	Natural stream, clean	Adequate	0.015	0.69	18.03	17.66	97.9	16	1.65	Rectangular Channel	Brick in mortar	Adequate
10281	Nala-1	CB-417	CB-416	0.92	0.9	1.84	2	98.49	27.54	29,83,172.70	0.03	0.54	19.05	17.69	90	Irregular Channel	Natural stream, clean	Adequate	0.015	0.54	18.25	17.69	97	16	1.65	Rectangular Channel	Brick in mortar	Adequate
10283	Nala-1	CB-416	CB-415	0.9	0.8	2	1.66	100.37	13	29,92,981.30	0.03	1.17	31.84	17.75	55.8	Irregular Channel	Natural stream, clean	Adequate	0.015	1.17	18.76	17.75	94.6	16	1.65	Rectangular Channel	Brick in mortar	Adequate
10285	Nala-1	CB-415	CB-414	0.8	0.78	1.66	1.74	100.18	32.97	30,52,799.90	0.03	0.58	14.35	18.11	126.2	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.58	19.53	18.11	92.7	16	1.65	Rectangular Channel	Brick in mortar	Adequate
10287	Nala-1	CB-414	CB-413	0.78	0.76	1.74	1.87	99.92	32.99	30,87,513.60	0.03	0.7	10.59	18.31	173	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.7	19.56	18.31	93.6	16	1.65	Rectangular Channel	Brick in mortar	Adequate
10289	Nala-1	CB-413	CB-412	0.76	0.72	1.87	1.5	99.63	32.46	36,20,438.00	0.03	0.75	17.76	21.47	120.9	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.75	26.64	21.47	80.6	16	2	Rectangular Channel	Brick in mortar	Adequate
10291	Nala-1	CB-412	CB-411	0.72	0.7	1.5	1.75	101.01	32.95	36,41,511.50	0.03	0.7	14	21.6	154.3	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.7	26.46	21.6	81.6	16	2	Rectangular Channel	Brick in mortar	Adequate
10293	Nala-1	CB-411	CB-410	0.7	0.68	1.75	2.52	99.17	32.73	36,51,937.40	0.03	0.75	12.52	21.66	173	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.75	26.7	21.66	81.1	16	2	Rectangular Channel	Brick in mortar	Adequate
10295	Nala-1	CB-410	CB-409	0.68	0.67	2.52	1.5	100.07	33.79	36,90,602.00	0.03	0.76	8.71	21.89	251.2	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.76	26.58	21.89	82.3	16	2	Rectangular Channel	Brick in mortar	Adequate
10297	Nala-1	CB-409	CB-408	0.67	0.65	1.5	1.9	101.66	33.87	37,02,600.20	0.03	0.76	12.69	21.96	173.1	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.76	26.37	21.96	83.3	16	2	Rectangular Channel	Brick in mortar	Adequate
10299	Nala-1	CB-408	CB-407	0.65	0.63	1.9	1.8	98.21	33.58	37,85,407.10	0.03	0.67	15.94	22.45	140.8	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.67	26.83	22.45	83.7	16	2	Rectangular Channel	Brick in mortar	Adequate
10301	Nala-1	CB-407	CB-406	0.63	0.62	1.8	1.5	100.84	32.71	38,02,470.90	0.03	0.67	11.34	22.55	198.9	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.67	26.48	22.55	85.2	16	2	Rectangular Channel	Brick in mortar	Adequate
10303	Nala-1	CB-406	CB-405	0.62	0.61	1.5	1.5	99.8	33.22	38,98,931.50	0.03	0.71	10.61	23.13	218	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.71	26.62	23.13	86.9	16	2	Rectangular Channel	Brick in mortar	Adequate
10305	Nala-1	CB-405	O-214	0.61	0.6	1.5	2.81	99.32	35.04	39,07,867.80	0.03	0.52	17.78	23.18	130.4	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.52	26.7	23.18	86.8	16	2	Rectangular Channel	Brick in mortar	Adequate

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8507	Nala-1 C	CB-51	CB-50	1.26	1.24	2.44	2.21	100.13	32.06	7,06,024.40	0.03	0.31	3.6	4.18	116	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.31	4.42	4.18	94.5	6	1.4	Rectangular Channel	Brick in mortar	Adequate
8509	Nala-1 C	CB-50	CB-49	1.24	1.23	2.21	2.47	100.06	31.29	7,36,715.00	0.03	0.24	4.41	4.37	99.1	Irregular Channel	Natural stream, clean	Adequate	0.015	0.24	4.43	4.37	98.7	6	1.4	Rectangular Channel	Brick in mortar	Adequate
8511	Nala-1 C	CB-49	CB-48	1.23	1.22	2.47	2.57	99.85	31	7,65,589.40	0.03	0.27	3.74	4.54	121.5	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.27	4.68	4.54	97.1	6	1.45	Rectangular Channel	Brick in mortar	Adequate
8513	Nala-1 C	CB-48	CB-47	1.22	1.21	2.57	2.65	100.08	27.77	7,80,413.10	0.03	0.25	7.61	4.63	60.8	Irregular Channel	Natural stream, clean	Adequate	0.015	0.25	4.67	4.63	99.1	6	1.45	Rectangular Channel	Brick in mortar	Adequate
8515	Nala-1 C	CB-47	CB-46	1.21	1.2	2.65	2	100.3	31.81	7,80,413.10	0.03	0.25	4.39	4.63	105.5	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.25	4.67	4.63	99.2	6	1.45	Rectangular Channel	Brick in mortar	Adequate
8517	Nala-1 C	CB-46	O-161	1.2	1.19	2	2	92.69	30.66	8,99,110.20	0.03	0.29	4.66	5.33	114.4	Irregular Channel	Natural stream, clean	Inadequate	0.015	0.29	5.35	5.33	99.7	6.5	1.45	Rectangular Channel	Brick in mortar	Adequate

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8534	Nala-1 A	CB-56	CB-55	1.55	1.49	3	3.19	104.77	11.33	4,70,239.40	0.03	0.5	2.82	2.79	99	Irregular Channel	Natural stream, clean	Adequate
8536	Nala-1 A	CB-55	CB-54	1.49	1.4	3.19	3.18	99.93	5.1	5,10,327.20	0.03	0.81	3.17	3.03	95.4	Irregular Channel	Natural stream, clean	Adequate
8538	Nala-1 A	CB-54	O-159	1.4	1.32	3.18	2.2	99.85	5.23	5,15,669.00	0.03	0.78	6.28	3.06	48.7	Irregular Channel	Natural stream, clean	Adequate

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8965	Nala-1 B	CB-201	CB-200	3.21	3.15	4.23	4.15	15.37	2.04	2,707.50	0.03	0.22	4.17	0.02	0.4	Irregular Channel	Natural stream, clean	Adequate
8967	Nala-1 B	CB-200	CB-199	3.15	2.25	4.15	3.25	99.74	2.08	3,387.80	0.03	0.31	7.36	0.02	0.3	Irregular Channel	Natural stream, clean	Adequate
8969	Nala-1 B	CB-199	CB-198	2.25	1.9	3.25	3.05	100.37	2.27	11,496.30	0.03	0.37	6.18	0.07	1.1	Irregular Channel	Natural stream, clean	Adequate
8971	Nala-1 B	CB-198	CB-197	1.9	1.8	3.05	3.04	99.75	2.44	18,752.80	0.03	0.3	2.77	0.11	4	Irregular Channel	Natural stream, clean	Adequate
8973	Nala-1 B	CB-197	CB-196	1.8	1.7	3.04	3.5	99.94	2.5	25,503.90	0.03	0.34	2.38	0.15	6.4	Irregular Channel	Natural stream, clean	Adequate
8975	Nala-1 B	CB-196	O-160	1.7	0.8	3.5	2	93.16	2.25	33,308.00	0.03	0.77	13.15	0.2	1.5	Irregular Channel	Natural stream, clean	Adequate

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3778	Nala-2	CB-357	CB-120	2.42	2.4	3.5	3.43	68.13	8.74	3,15,228.60	0.03	0.39	5.14	1.87	36.4	Irregular Channel	Natural stream, clean	Adequate	0.03	0.39	5.14	1.87	36.4			Irregular Channel	Natural stream, clean	Adequate
8549	Nala-2	CB-120	CB-119	2.4	2.35	3.43	4.44	100.18	6.31	3,47,707.40	0.03	0.54	6.72	2.06	30.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.54	6.72	2.06	30.7			Irregular Channel	Natural stream, clean	Adequate
8551	Nala-2	CB-119	CB-118	2.35	2.3	4.44	3.35	99.71	6.07	3,55,278.10	0.03	0.55	20.43	2.11	10.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.55	20.43	2.11	10.3			Irregular Channel	Natural stream, clean	Adequate
8553	Nala-2	CB-118	CB-117	2.3	2.2	3.35	3.26	99.91	15.7	4,00,690.70	0.03	0.49	29.16	2.38	8.1	Irregular Channel	Natural stream, clean	Adequate	0.03	0.49	29.16	2.38	8.1			Irregular Channel	Natural stream, clean	Adequate
8555	Nala-2	CB-117	CB-116	2.2	2.1	3.26	3.29	100.11	7.1	4,06,381.40	0.03	0.67	15.36	2.41	15.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.67	15.36	2.41	15.7			Irregular Channel	Natural stream, clean	Adequate
8557	Nala-2	CB-116	CB-115	2.1	2.08	3.29	3.2	99.8	10.72	4,14,671.60	0.03	0.35	3.69	2.46	66.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.35	3.69	2.46	66.7			Irregular Channel	Natural stream, clean	Adequate
8559	Nala-2	CB-115	CB-114	2.08	1.98	3.2	3.3	100.12	7.24	5,43,303.30	0.03	0.75	3.52	3.22	91.5	Irregular Channel	Natural stream, clean	Adequate	0.03	0.75	3.52	3.22	91.5			Irregular Channel	Natural stream, clean	Adequate
8561	Nala-2	CB-114	CB-113	1.98	1.95	3.3	3.19	100.07	20.13	5,86,956.20	0.03	0.36	7.67	3.48	45.4	Irregular Channel	Natural stream, clean	Adequate	0.03	0.36	7.67	3.48	45.4			Irregular Channel	Natural stream, clean	Adequate
8563	Nala-2	CB-113	CB-112	1.95	1.9	3.19	4	100.06	13.2	5,96,057.90	0.03	0.49	6.65	3.54	53.2	Irregular Channel	Natural stream, clean	Adequate	0.03	0.49	6.65	3.54	53.2			Irregular Channel	Natural stream, clean	Adequate
8565	Nala-2	CB-112	CB-111	1.9	1.8	4	3.53	99.84	6.28	6,98,127.80	0.03	0.87	8.75	4.14	47.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.87	8.75	4.14	47.3			Irregular Channel	Natural stream, clean	Adequate
8567	Nala-2	CB-111	CB-110	1.8	1.75	3.53	2.95	98.59	10.81	8,36,804.00	0.03	0.62	14.07	4.96	35.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.62	14.07	4.96	35.3			Irregular Channel	Natural stream, clean	Adequate
8569	Nala-2	CB-110	CB-109	1.75	1.7	2.95	2.58	100.22	18.7	8,49,276.90	0.03	0.5	8.87	5.04	56.8	Irregular Channel	Natural stream, clean	Adequate	0.03	0.5	8.87	5.04	56.8			Irregular Channel	Natural stream, clean	Adequate
8571	Nala-2	CB-109	CB-108	1.7	1.65	2.58	4.1	101.09	18.5	9,32,567.40	0.03	0.52	13.83	5.53	40	Irregular Channel	Natural stream, clean	Adequate	0.03	0.52	13.83	5.53	40			Irregular Channel	Natural stream, clean	Adequate
9448	Nala-2	CB-108	CB-278	1.65	1.6	4.1	3.61	72.72	12.68	9,47,225.50	0.03	0.57	33.29	5.62	16.9	Irregular Channel	Natural stream, clean	Adequate	0.03	0.57	33.29	5.62	16.9			Irregular Channel	Natural stream, clean	Adequate
9449	Nala-2	CB-278	CB-107	1.6	1.59	3.61	3.43	27.28	20.11	22,26,177.80	0.03	0.79	24.65	13.2	53.6	Irregular Channel	Natural stream, clean	Adequate	0.03	0.79	24.65	13.2	53.6			Irregular Channel	Natural stream, clean	Adequate
8575	Nala-2	CB-107	CB-106	1.59	1.5	3.43	3.33	100.28	19.06	22,34,225.10	0.03	0.89	16.91	13.25	78.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.89	16.91	13.25	78.3			Irregular Channel	Natural stream, clean	Adequate
9284	Nala-2	CB-106	CB-228	1.5	1.47	3.33	2.9	68.34	31.3	22,36,050.20	0.03	0.66	10.47	13.26	126.7	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.88	13.46	13.26	98.5	6	1.5	Rectangular Channel	Brick in mortar	Adequate
9285	Nala-2	CB-228	CB-105	1.47	1.45	2.9	2.7	31.53	31.38	23,24,881.00	0.03	0.68	12.79	13.79	107.8	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.9	14.11	13.79	97.7	6.2	1.5	Rectangular Channel	Brick in mortar	Adequate
8579	Nala-2	CB-105	CB-104	1.45	1.4	2.7	3.27	100.09	31.36	23,38,031.80	0.03	0.84	8.05	13.87	172.3	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.9	14	13.87	99	6.2	1.5	Rectangular Channel	Brick in mortar	Adequate
8581	Nala-2	CB-104	CB-103	1.4	1.35	3.27	3.19	100.12	20.15	23,67,364.30	0.03	0.73	16.77	14.04	83.7	Irregular Channel	Natural stream, clean	Adequate	0.015	1.9	14.25	14.04	98.5	6.3	1.5	Rectangular Channel	Brick in mortar	Adequate
8583	Nala-2	CB-103	CB-102	1.35	1.3	3.19	3.35	99.92	29.93	24,75,515.20	0.03	0.63	20.36	14.68	72.1	Irregular Channel	Natural stream, clean	Adequate	0.015	1.92	14.78	14.68	99.3	6.5	1.5	Rectangular Channel	Brick in mortar	Adequate
8585	Nala-2	CB-102	CB-101	1.3	1	3.35	2.58	100.01	19.66	24,86,781.20	0.03	1.28	43.02	14.75	34.3	Irregular Channel	Natural stream, clean	Adequate	0.015	1.92	14.77	14.75	99.8	6.5	1.5	Rectangular Channel	Brick in mortar	Adequate
8587	Nala-2	CB-101	CB-100	1	0.95	2.58	3.09	99.89	20.38	25,25,916.90	0.03	0.74	28.4	14.98	52.8	Irregular Channel	Natural stream, clean	Adequate	0.015	1.46	15.26	14.98	98.2	7.5	1.75	Rectangular Channel	Brick in mortar	Adequate
8589	Nala-2	CB-100	CB-99	0.95	0.9	3.03	2.37	100.12	32.13	25,39,368.60	0.03	1.02	6.5	15.06	231.6	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.46	15.24	15.06	98.8	7.5	1.75	Rectangular Channel	Brick in mortar	Adequate
8591	Nala-2	CB-99	CB-98	0.9	0.85	2.37	2.4	99.86	33.31	25,66,223.00	0.03	0.67	13.22	15.22	115.1	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.47	15.26	15.22	99.7	7.5	1.75	Rectangular Channel	Brick in mortar	Adequate
8593	Nala-2	CB-98	CB-97	0.85	0.8	2.4	1.91	100.22	31.36	26,28,493.30	0.03	0.71	12.89	15.59	121	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.46	16.38	15.59	95.2	8	1.75	Rectangular Channel	Brick in mortar	Adequate
8595	Nala-2	CB-97	CB-96	0.8	0.75	1.91	1.99	100.33	31.87	26,76,830.30	0.03	1.03	7.07	15.88	224.6	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.47	16.37	15.88	97	8	1.75	Rectangular Channel	Brick in mortar	Adequate
8597	Nala-2	CB-96	CB-95	0.75	0.7	1.99	1.92	99.94	32.16	27,23,249.80	0.03	1.11	6.41	16.15	252.1	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.48	16.4	16.15	98.5	8	1.75	Rectangular Channel	Brick in mortar	Adequate
8599	Nala-2	CB-95	CB-94	0.7	0.65	1.92	1.91	99.9	32.28	28,06,414.40	0.03	0.82	11.09	16.63	150	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.49	16.86	16.63	98.6	8.2	1.75	Rectangular Channel	Brick in mortar	Adequate
8601	Nala-2	CB-94	CB-93	0.65	0.6	1.91	2.08	99.68	32.01	29,13,059.60	0.03	1.03	8.12	17.28	212.9	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.49	17.57	17.28	98.3	8.5	1.75	Rectangular Channel	Brick in mortar	Adequate
8603	Nala-2	CB-93	CB-92	0.6	0.57	2.08	2.29	99.8	31.9	29,70,396.10	0.03	0.8	9.96	17.62	176.9	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.49	18.25	17.62	96.5	8.8	1.75	Rectangular Channel	Brick in mortar	Adequate
8959	Nala-2	CB-92	CB-91	0.57	0.52	2.29	2.52	100.41	67.85	30,30,010.30	0.03	0.49	26.09	17.97	68.9	Irregular Channel	Natural stream, clean	Adequate	0.015	1.49	18.66	17.97	96.3	9	1.75	Rectangular Channel	Brick in mortar	Adequate
8960	Nala-2	CB-91	CB-90	0.52	0.5	2.52	2.1	99.66	62.41	32,07,327.90	0.03	0.4	46.69	19.02	40.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.4	46.69	19.02	40.7			Irregular Channel	Natural stream, clean	Adequate
8607	Nala-2	CB-90	CB-89	0.5	0.48	2.1	2.17	100.17	62.44	32,85,572.70	0.03	0.4	34.61	19.49	56.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.4	34.61	19.49	56.3			Irregular Channel	Natural stream, clean	Adequate
8609	Nala-2	CB-89	CB-88	0.48	0.46	2.17	2.57	99.94	61.74	32,85,572.70	0.03	0.4	43.16	19.49	45.2	Irregular Channel	Natural stream, clean	Adequate	0.03	0.4	43.16	19.49	45.2			Irregular Channel	Natural stream, clean	Adequate
8611	Nala-2	CB-88	CB-87	0.46	0.4	2.57	2	99.88	51.42	34,53,822.30	0.03	0.61	130.95	20.49	15.6	Irregular Channel	Natural stream, clean	Adequate	0.03	0.61	130.95	20.49	15.6			Irregular Channel	Natural stream, clean	Adequate
8613	Nala-2	CB-87	CB-86	0.4	0.38	2	1.82	100.13	58.98	36,85,551.20	0.03	0.43	47.89	21.86	45.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.43	47.89	21.86	45.7			Irregular Channel	Natural stream, clean	Adequate
8615	Nala-2	CB-86	CB-85	0.38	0.34	1.82	1.93	100	57.99	36,85,551.20	0.03	0.53	36.36	21.86	60.1	Irregular Channel	Natural stream, clean	Adequate	0.03	0.53	36.36	21.86	60.1			Irregular Channel	Natural stream, clean	Adequate
8617	Nala-2	CB-85	CB-84	0.34	0.32	1.93	2.23	100.08	65.86	37,75,004.70	0.03	0.41	28.46	22.39	78.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.41	28.46	22.39	78.7			Irregular Channel	Natural stream, clean	Adequate
8619	Nala-2	CB-84	CB-204	0.32	0.3	2.23	1.5	92.48	61.36	37,75,004.70	0.03	0.44	52.9	22.39	42.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.44	52.9	22.39	42.3			Irregular Channel	Natural stream, clean	Adequate
9109	Nala-2	CB-204	Nala_OF2	0.3	0.2	1.5	1.5	6.92	35.36	40,70,858.40	0.03	1.98	456.07	24.2	5.3	Irregular Channel	Natural stream, clean	Adequate	0.03	1.98	456.07	24.2	5.3			Irregular Channel	Natural stream, clean	Adequate

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8897	Nala-2 A	CB-179	CB-178	1.05	0.92	2.71	2.13	99.89	8.7	86,094.40	0.03	0.36	30.56	0.51	1.7	Irregular Channel	Natural stream, clean	Adequate
8899	Nala-2 A	CB-178	CB-177	0.92	0.75	2.13	2.17	99.95	12.49	86,094.40	0.03	0.34	24.43	0.51	2.1	Irregular Channel	Natural stream, clean	Adequate
8901	Nala-2 A	CB-177	CB-176	0.75	0.62	2.17	2.45	99.82	12.55	86,094.40	0.03	0.31	26.87	0.51	1.9	Irregular Channel	Natural stream, clean	Adequate
8903	Nala-2 A	CB-176	CB-175	0.62	0.58	2.45	2.51	100.16	13.21	1,77,317.80	0.03	0.28	24.37	1.05	4.3	Irregular Channel	Natural stream, clean	Adequate
8905	Nala-2 A	CB-175	O-167	0.58	0.55	2.51	2	96.18	9.66	1,77,317.80	0.03	0.3	17.28	1.05	6.1	Irregular Channel	Natural stream, clean	Adequate

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8919	Nala-2 B	CB-187	CB-186	1.25	1.15	3.03	2.61	100.05	2.45	23,690.20	0.03	0.33	6.83	0.14	2.1	Irregular Channel	Natural stream, clean	Adequate
8921	Nala-2 B	CB-186	CB-185	1.15	0.9	2.61	2.17	99.97	5.23	23,690.20	0.03	0.32	18.49	0.14	0.8	Irregular Channel	Natural stream, clean	Adequate
8923	Nala-2 B	CB-185	CB-184	0.9	0.75	2.17	2.19	99.82	6.09	1,08,608.80	0.03	0.47	19.7	0.64	3.3	Irregular Channel	Natural stream, clean	Adequate
8925	Nala-2 B	CB-184	CB-183	0.75	0.61	2.19	2.09	99.94	16.87	1,08,608.80	0.03	0.31	43.84	0.64	1.5	Irregular Channel	Natural stream, clean	Adequate
8927	Nala-2 B	CB-183	CB-182	0.61	0.5	2.09	2	100.28	21	2,15,428.40	0.03	0.35	44.46	1.28	2.9	Irregular Channel	Natural stream, clean	Adequate
8929	Nala-2 B	CB-182	O-168	0.5	0.41	2	1.75	84	21.07	2,31,728.90	0.03	0.35	51.17	1.37	2.7	Irregular Channel	Natural stream, clean	Adequate

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8943	Nala-2 C	CB-193	CB-192	0.71	0.65	1.92	1.81	100.26	5.71	1,41,847.10	0.03	0.41	4.28	0.84	19.7	Irregular Channel	Natural stream, clean	Adequate
8945	Nala-2 C	CB-192	CB-190	0.65	0.53	1.81	1.72	99.93	5.38	1,41,847.10	0.03	0.52	7.52	0.84	11.2	Irregular Channel	Natural stream, clean	Adequate
8947	Nala-2 C	CB-190	CB-189	0.53	0.41	1.72	2.22	100.03	10.02	1,96,306.50	0.03	0.46	14.72	1.16	7.9	Irregular Channel	Natural stream, clean	Adequate
8949	Nala-2 C	CB-189	CB-204	0.41	0.3	2.22	1.5	98.87	17.36	2,30,645.50	0.03	0.39	60.69	1.37	2.3	Irregular Channel	Natural stream, clean	Adequate

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8862	Nala-3	CB-173	CB-172	2.8	2.36	4	4.19	69.02	1.87	4,550.40	0.03	0.33	30.61	0.03	0.1	Irregular Channel	Natural stream, clean	Adequate
8864	Nala-3	CB-172	CB-171	2.36	1.36	4.19	3.44	100.13	2.11	7,882.80	0.03	0.45	36.24	0.05	0.1	Irregular Channel	Natural stream, clean	Adequate
8866	Nala-3	CB-171	CB-170	1.36	1.3	3.44	2.65	99.95	2.37	13,673.40	0.03	0.23	21.86	0.08	0.4	Irregular Channel	Natural stream, clean	Adequate
8868	Nala-3	CB-170	CB-169	1.3	1.25	2.65	1.92	99.78	3.05	63,498.70	0.03	0.36	2.82	0.38	13.4	Irregular Channel	Natural stream, clean	Adequate
8870	Nala-3	CB-169	CB-166	1.25	1.2	2.92	2.91	100.46	19.4	5,35,512.70	0.03	0.41	40.96	3.18	7.8	Irregular Channel	Natural stream, clean	Adequate
8872	Nala-3	CB-166	CB-165	1.2	1.14	2.91	2.34	99.83	20.88	5,92,020.60	0.03	0.43	96.82	3.51	3.6	Irregular Channel	Natural stream, clean	Adequate
8874	Nala-3	CB-165	CB-164	1.14	1.1	2.34	2.09	99.86	11.31	6,01,192.50	0.03	0.49	46.25	3.57	7.7	Irregular Channel	Natural stream, clean	Adequate
8876	Nala-3	CB-164	CB-163	1.1	1	2.09	2	99.25	23.7	6,08,478.00	0.03	0.49	11.74	3.61	30.7	Irregular Channel	Natural stream, clean	Adequate
8878	Nala-3	CB-163	CB-162	1	0.9	2	2	100.46	20.89	6,16,726.40	0.03	0.51	14.06	3.66	26	Irregular Channel	Natural stream, clean	Adequate

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9253	Nala-4	CB-160	CB-221	2	1.8	3.06	3.49	98.85	3.72	16,354.70	0.03	0.3	7.89	0.1	1.2	Irregular Channel	Natural stream, clean	Adequate	0.03	0.3	7.89	0.1	1.2			Irregular Channel	Natural stream, clean	Adequate
9254	Nala-4	CB-221	CB-159	1.8	1.6	3.49	3.15	67.18	5.25	6,53,955.80	0.03	1.27	10.75	3.88	36.1	Irregular Channel	Natural stream, clean	Adequate	0.03	1.27	10.75	3.88	36.1			Irregular Channel	Natural stream, clean	Adequate
8743	Nala-4	CB-159	CB-158	1.6	1.2	3.15	3	99.94	5.46	7,76,344.50	0.03	1.46	15.85	4.6	29	Irregular Channel	Natural stream, clean	Adequate	0.03	1.46	15.8	4.6	29.1			Irregular Channel	Natural stream, clean	Adequate
8745	Nala-4	CB-158	CB-157	1.2	1.1	3	2.92	100.09	6.34	7,84,110.20	0.03	0.91	4.66	4.65	99.9	Irregular Channel	Natural stream, clean	Adequate	0.03	0.91	4.66	4.65	99.9			Irregular Channel	Natural stream, clean	Adequate
8747	Nala-4	CB-157	CB-156	1.1	1.07	2.92	3	100	32.73	8,45,028.80	0.03	0.34	5.02	5.01	100.3	Irregular Channel	Natural stream, clean	Adequate	0.03	0.34	5.03	5.01	99.7			Irregular Channel	Natural stream, clean	Adequate
9322	Nala-4	CB-156	CB-241	1.07	1.05	3	2.9	58.33	29.63	8,60,533.10	0.03	0.37	6.96	5.1	73.4	Irregular Channel	Natural stream, clean	Adequate	0.03	0.37	6.94	5.1	73.6			Irregular Channel	Natural stream, clean	Adequate
9323	Nala-4	CB-241	CB-155	1.05	1	2.9	2.84	41.88	21.46	11,45,024.20	0.03	0.69	13.1	6.82	52	Irregular Channel	Natural stream, clean	Adequate	0.03	0.69	13.1	6.82	52			Irregular Channel	Natural stream, clean	Adequate
8751	Nala-4	CB-155	CB-154	1	0.9	2.84	2.75	100.01	20.15	11,49,902.00	0.03	0.67	8.67	6.82	78.7	Irregular Channel	Natural stream, clean	Adequate	0.03	0.67	8.67	6.82	78.7			Irregular Channel	Natural stream, clean	Adequate
8753	Nala-4	CB-154	CB-153	0.9	0.85	2.75	1.93	99.91	30.98	11,77,057.50	0.03	0.46	10.06	6.98	69.4	Irregular Channel	Natural stream, clean	Adequate	0.03	0.46	10.06	6.98	69.4			Irregular Channel	Natural stream, clean	Adequate
8755	Nala-4	CB-153	CB-152	0.85	0.83	1.93	2.21	100.05	29.03	11,92,480.60	0.03	0.36	9.25	7.07	76.5	Irregular Channel	Natural stream, clean	Adequate	0.03	0.36	9.25	7.07	76.5			Irregular Channel	Natural stream, clean	Adequate
8757	Nala-4	CB-152	CB-151	0.83	0.8	2.21	2.83	99.96	26.98	14,01,221.60	0.03	0.66	4.35	8.31	191.1	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.22	8.52	8.31	97.6	5.8	1.5	Rectangular Channel	Brick in mortar	Adequate
8759	Nala-4	CB-151	CB-150	0.8	0.78	2.83	2	99.82	19.67	14,46,201.80	0.03	0.46	26.43	8.58	32.5	Irregular Channel	Natural stream, clean	Adequate	0.015	1.23	8.69	8.58	98.7	5.9	1.5	Rectangular Channel	Brick in mortar	Adequate
8761	Nala-4	CB-150	CB-149	0.78	0.75	2	1.5	100.08	30.42	14,46,201.80	0.03	0.43	8.87	8.58	96.7	Irregular Channel	Natural stream, clean	Adequate	0.015	1.23	8.85	8.58	97	6	1.5	Rectangular Channel	Brick in mortar	Adequate
8763	Nala-4	CB-149	CB-148	0.75	0.73	1.5	1.48	99.78	24.12	15,02,470.20	0.03	1.55	1.04	8.91	858.7	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.24	9.03	8.91	98.7	6.1	1.5	Rectangular Channel	Brick in mortar	Adequate
8765	Nala-4	CB-148	CB-147	0.73	0.71	1.48	1.15	100.08	30.5	15,02,470.20	0.03	1.13	1.5	8.91	593.9	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.24	9.01	8.91	98.9	6.1	1.5	Rectangular Channel	Brick in mortar	Adequate
8767	Nala-4	CB-147	CB-146	0.71	0.69	1.15	1.37	99.96	30.55	19,35,145.80	0.03	1.04	2.63	11.48	436.3	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.29	11.54	11.48	99.5	7.6	1.5	Rectangular Channel	Brick in mortar	Adequate
8769	Nala-4	CB-146	CB-145	0.69	0.67	1.37	2.08	100.04	30.31	19,53,301.80	0.03	1.27	1.93	11.59	599.8	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.28	11.87	11.59	97.6	7.8	1.5	Rectangular Channel	Brick in mortar	Adequate
8771	Nala-4	CB-145	CB-144	0.67	0.6	2.08	1.51	100.57	26.34	19,71,280.10	0.03	1	5.95	11.69	196.5	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.28	11.84	11.69	98.7	7.8	1.5	Rectangular Channel	Brick in mortar	Adequate
8773	Nala-4	CB-144	CB-143	0.6	0.5	1.51	1.8	99.89	20.24	20,39,197.20	0.03	0.84	21.23	12.1	57	Irregular Channel	Natural stream, clean	Adequate	0.015	1.29	12.22	12.1	99	8	1.5	Rectangular Channel	Brick in mortar	Adequate
8775	Nala-4	CB-143	CB-142	0.5	0.4	1.8	1.92	100	29.33	21,03,567.50	0.03	0.73	24.12	12.48	51.7	Irregular Channel	Natural stream, clean	Adequate	0.015	1.3	12.55	12.48	99.4	8.2	1.5	Rectangular Channel	Brick in mortar	Adequate
8777	Nala-4	CB-142	CB-141	0.4	0.35	1.92	1.27	100.12	32.31	21,03,567.50	0.03	0.57	13.45	12.48	92.8	Irregular Channel	Natural stream, clean	Adequate	0.015	1.33	12.97	12.48	96.2	8.2	1.5	Rectangular Channel	Brick in mortar	Adequate
8779	Nala-4	CB-141	CB-140	0.35	0.3	1.27	1.04	100	26.01	23,03,787.40	0.03	1.54	3.24	13.66	421.6	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.35	13.85	13.66	98.6	8.7	1.5	Rectangular Channel	Brick in mortar	Adequate
8781	Nala-4	CB-140	CB-139	0.3	0.25	1.04	1.32	100.32	30.39	23,03,787.40	0.03	2.53	1.27	13.66	1,072.10	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.35	13.83	13.66	98.8	8.7	1.5	Rectangular Channel	Brick in mortar	Adequate
8783	Nala-4	CB-139	CB-138	0.25	0.2	1.32	1.33	99.82	31.81	23,73,593.20	0.03	1.05	5.61	14.08	251.1	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.36	14.22	14.08	99	8.9	1.5	Rectangular Channel	Brick in mortar	Adequate
8785	Nala-4	CB-138	CB-137	0.2	0.17	1.33	1.25	100.07	26.34	23,73,593.20	0.03	1.21	3.92	14.08	359.6	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.35	14.37	14.08	98	9	1.5	Rectangular Channel	Brick in mortar	Adequate
8787	Nala-4	CB-137	CB-136	0.17	0.16	1.25	1.25	99.83	31.29	24,54,610.10	0.03	1.29	1.9	14.56	764.7	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.36	14.74	14.56	98.8	9.2	1.5	Rectangular Channel	Brick in mortar	Adequate
8789	Nala-4	CB-136	CB-203	0.16	0.11	1.25	2	100.01	31.8	25,04,627.00	0.03	1.2	4.93	14.86	301.5	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.37	14.9	14.86	99.7	9.3	1.5	Rectangular Channel	Brick in mortar	Adequate
8791	Nala-4	CB-203	CB-205	0.11	0.06	2	1.71	100.15	31.64	25,04,627.00	0.03	0.97	7	14.86	212.2	Irregular Channel	Natural stream, clean	Inadequate	0.015	1.37	14.89	14.86	99.8	9.3	1.5	Rectangular Channel	Brick in mortar	Adequate
9113	Nala-4	CB-205	Nala_OF4	0.06	0.02	1.71	1.7	5.56	26.46	25,67,255.90	0.03	1.5	27.57	15.23	55.2	Irregular Channel	Natural stream, clean	Adequate	0.015	2.27	32.29	15.23	47.2	9.3	1.5	Rectangular Channel	Brick in mortar	Adequate
9797	Nala-5	CB-359	CB-360	2.6	2.5	4.03	3.58	87.91	3.52	1,99,923.10	0.03	0.69	1.56	1.19	75.9	Irregular Channel	Natural stream, clean	Adequate	0.013	1.23	3.23	1.19	36.7	2	1.2	Rectangular Channel	Concrete	Adequate
9798	Nala-5	CB-360	CB-255	2.5	2.45	3.58	3.37	99.93	12.35	2,07,714.50	0.03	0.36	1.08	1.23	114	Irregular Channel	Natural stream, clean	Inadequate	0.013	0.93	2.15	1.23	57.3	2	1.2	Rectangular Channel	Concrete	Adequate
9489	Nala-5	CB-255	CB-286	2.45	2.39	3.37	3.18	99.33	11.02	2,40,186.20	0.03	0.39	1.88	1.42	75.6	Irregular Channel	Natural stream, clean	Adequate	0.013	1.04	2.36	1.42	60.4	2	1.2	Rectangular Channel	Concrete	Adequate
9620	Nala-5	CB-286	CB-299	2.39	2.31	3.18	3.05	100.58	9.93	3,39,176.00	0.03	1.14	0.52	2.01	384.5	Irregular Channel	Natural stream, clean	Inadequate	0.013	1.26	2.71	2.01	74.2	2	1.2	Rectangular Channel	Concrete	Adequate
9627	Nala-5	CB-299	CB-330	2.31	2.3	3.05	3.11	99.74	12.09	3,96,433.60	0.03	0.63	0.57	2.35	413.3	Irregular Channel	Natural stream, clean	Inadequate	0.013	1.49	3.2	2.35	73.4	2	1.2	Rectangular Channel	Concrete	Adequate
9625	Nala-5	CB-330	CB-287	2.3	2.25	3.11	3	99.78	11.94	4,93,625.50	0.03	1.23	0.61	2.93	480.6	Irregular Channel	Natural stream, clean	Inadequate	0.013	1.95	4.27	2.93	68.5	2	1.2	Rectangular Channel	Concrete	Adequate

ANNEXURE V : HARIPPAD PROPOSED STORM WATER DRAIN (NALA) STATEMENT

ID	Label	Start Node	Stop Node	Invert (Start) (m)	Invert (Stop) (m)	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	System Drainage Area (sqm)	Manning' s n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow (m^3/s)	Flow / Capacity (Design) (%)	Span (m)	Rise (m)	Section Type	Material
9936	Nala-1 C1	CB-385	CB-386	1.55	1.5	2.5	2.84	61.38	2.8	1,66,512.50	0.013	1.06	0.99	0.99	0.99	99.9	1.1	1.0	Rectangular Channel	Concrete
9937	Nala-1 C1	CB-386	CB-387	1.5	1.45	2.84	3.17	52.09	2.74	1,73,217.50	0.013	0.93	1.07	1.03	1.03	95.7	1.1	1.0	Rectangular Channel	Concrete
9938	Nala-1 C1	CB-387	CB-388	1.45	1.4	3.17	3.56	43.57	3.1	2,79,409.80	0.013	1.14	1.68	1.66	1.66	98.8	1.5	1.0	Rectangular Channel	Concrete
9939	Nala-1 C1	CB-388	CB-389	1.4	1.38	3.56	3.02	55.15	3.9	2,83,961.50	0.013	0.73	1.7	1.68	1.68	99.2	2.2	1.1	Rectangular Channel	Concrete
9940	Nala-1 C1	CB-389	CB-390	1.38	1.37	3.02	2.5	45.4	4.35	2,92,634.40	0.013	0.75	1.76	1.74	1.74	98.4	2.5	1.2	Rectangular Channel	Concrete
9941	Nala-1 C1	CB-390	CB-391	1.37	1.36	2.5	2.63	41.63	4.33	3,01,159.40	0.013	0.78	1.84	1.79	1.79	97	2.5	1.2	Rectangular Channel	Concrete
9942	Nala-1 C1	CB-391	CB-392	1.36	1.35	2.63	2.5	49.72	4.49	3,07,824.30	0.013	0.74	1.9	1.83	1.83	96	2.5	1.3	Rectangular Channel	Concrete
9943	Nala-1 C1	CB-392	CB-314	1.35	1.33	2.5	2.5	34.28	4.18	4,14,909.40	0.013	1.17	3.24	2.46	2.46	76	2.5	1.3	Rectangular Channel	Concrete
9555	Nala-1 C1	CB-314	CB-313	1.33	1.28	2.5	2.38	236.34	4.97	4,14,909.40	0.013	0.81	2.47	2.46	2.46	99.6	2.8	1.4	Rectangular Channel	Concrete
9556	Nala-1 C1	CB-312	CB-313	1.5	1.28	2.5	2.38	64.35	1.78	37,494.20	0.013	1.07	3.02	0.22	0.22	7.4	1.5	1.0	Rectangular Channel	Concrete
9557	Nala-1 C1	CB-313	CB-51	1.28	1.26	2.38	2.44	140.57	5.55	5,57,803.00	0.013	0.87	3.68	3.31	3.31	90	4	1.5	Rectangular Channel	Concrete
9902	Nala-B	CB-375	CB-376	2.7	2.45	4	4	70.2	2.76	59,155.90	0.013	1.09	8	0.35	0.35	4.4	2.5	1.3	Rectangular Channel	Concrete
10110	Nala-B	CB-376	CB-403	2.45	2.44	4	3.81	60.02	3.99	1,65,065.80	0.013	0.53	1.52	0.98	0.98	64.3	2.5	1.3	Rectangular Channel	Concrete
10111	Nala-B	CB-403	O-206	2.44	2.43	3.81	3.5	94.87	4.02	1,70,586.30	0.013	0.53	1.52	1.01	1.01	66.4	2.5	1.3	Rectangular Channel	Concrete
9531	Nala-3 A	CB-304	CB-305	2.66	2.1	3.76	3.2	76.52	1.26	32,200.50	0.013	1.45	2.6	0.19	0.19	7.3	1	1	Rectangular Channel	Concrete
9533	Nala-3 A	CB-305	CB-306	2.1	2	3.2	3	49.57	2.17	1,42,265.20	0.013	1.44	1.37	0.84	0.84	61.5	1	1	Rectangular Channel	Concrete
9535	Nala-3 A	CB-306	CB-307	2	1.95	3	3.32	31.59	2.31	1,46,381.50	0.013	1.32	1.21	0.87	0.87	71.5	1	1	Rectangular Channel	Concrete
9537	Nala-3 A	CB-307	CB-308	1.95	1.9	3.32	3.39	37.64	2.42	1,48,170.40	0.013	1.24	1.11	0.88	0.88	79	1	1	Rectangular Channel	Concrete
9539	Nala-3 A	CB-308	CB-309	1.9	1.82	3.39	3	110.91	3.02	2,03,577.80	0.013	1.07	1.21	1.21	1.21	99.5	1.4	1	Rectangular Channel	Concrete
9541	Nala-3 A	CB-309	CB-310	1.82	1.77	3	3.02	92.78	3.21	2,12,887.50	0.013	0.98	1.27	1.26	1.26	99.7	1.6	1	Rectangular Channel	Concrete
9970	Nala-3 A	CB-310	CB-396	1.77	1.7	3.02	3.1	58.6	2.81	2,14,527.70	0.013	1.3	1.85	1.27	1.27	68.9	1.6	1	Rectangular Channel	Concrete
9971	Nala-3 A	CB-396	CB-397	1.7	1.6	3.1	3	142.72	3.1	2,19,748.00	0.013	1.08	1.43	1.3	1.3	91.4	1.6	1	Rectangular Channel	Concrete
9972	Nala-3 A	CB-397	CB-398	1.6	1.55	3	2.59	36.39	2.81	2,33,362.50	0.013	1.41	2	1.38	1.38	69.3	1.6	1	Rectangular Channel	Concrete
9973	Nala-3 A	CB-398	CB-399	1.55	1.4	2.59	2.3	66.84	2.75	2,78,276.90	0.013	1.77	2.55	1.65	1.65	64.6	1.6	1	Rectangular Channel	Concrete
9979	Nala-3 A	CB-399	CB-400	1.4	0.75	2.3	2	45.95	2.2	2,93,479.80	0.013	3.43	6.41	1.74	1.74	27.2	1.6	1	Rectangular Channel	Concrete
9740	Nala-3 B	CB-347	CB-348	2.81	2.79	4.17	3.73	116.22	2.41	50,416.80	0.013	0.44	0.68	0.3	0.3	44.1	1.5	1	Rectangular Channel	Concrete
9741	Nala-3 B	CB-348	CB-349	2.79	1.85	3.73	3.2	135.25	1.78	54,867.00	0.013	1.55	4.31	0.33	0.33	7.5	1.5	1	Rectangular Channel	Concrete
9742	Nala-3 B	CB-349	CB-350	1.85	1.75	3.2	2.79	83.42	3.11	2,89,462.00	0.013	1.42	1.79	1.72	1.72	95.9	1.5	1	Rectangular Channel	Concrete
9750	Nala-3 B	CB-350	CB-351	1.75	1.65	2.79	3.08	134.39	3.42	2,91,802.00	0.013	1.19	1.77	1.73	1.73	97.7	1.8	1	Rectangular Channel	Concrete
9751	Nala-3 B	CB-351	CB-352	1.65	1.55	3.08	2.5	138.72	3.47	2,99,718.70	0.013	1.18	1.78	1.78	1.78	99.8	1.8	1	Rectangular Channel	Concrete
9752	Nala-3 B	CB-352	CB-353	1.55	1.45	2.5	2.58	89.59	3.35	3,35,913.10	0.013	1.09	2.22	1.99	1.99	89.9	1.8	1	Rectangular Channel	Concrete
9753	Nala-3 B	CB-353	CB-354	1.45	1.38	2.58	2.89	52.4	3.29	3,45,865.90	0.013	1.12	2.42	2.05	2.05	84.6	1.8	1	Rectangular Channel	Concrete
9754	Nala-3 B	CB-354	CB-355	1.38	1.34	2.89	2.7	35.69	3.39	3,48,514.70	0.013	1.13	2.22	2.07	2.07	93.1	1.8	1	Rectangular Channel	Concrete

ID	Label	Start Node	Stop Node	Invert (Start) (m)	Invert (Stop) (m)	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	System Drainage Area (sqm)	Manning' s n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow (m^3/s)	Flow / Capacity (Design) (%)	Span (m)	Rise (m)	Section Type	Material
9760	Nala-3 B	CB-355	CB-356	1.34	1.3	2.7	2.9	25.11	3.28	3,76,663.20	0.013	1.22	2.65	2.23	2.23	84.4	1.8	1	Rectangular Channel	Concrete
9761	Nala-3 B	CB-356	CB-169	1.3	1.25	2.9	2.92	34.47	3.59	4,67,031.80	0.013	1.38	2.89	2.77	2.77	95.8	1.8	1.1	Rectangular Channel	Concrete
9988	Nala-3 B1	CB-162	CB-395	0.9	0.85	2	2	56.88	4.57	6,31,711.50	0.013	1.52	3.78	3.75	3.75	99.1	2.8	1.1	Rectangular Channel	Concrete
9965	Nala-3 B1	CB-395	CB-400	0.85	0.75	2	2	58.33	4.32	7,15,326.10	0.013	1.99	5.28	4.24	4.24	80.4	2.8	1.1	Rectangular Channel	Concrete
9966	Nala-3 B1	CB-400	CB-394	0.75	0.6	2	2	63.78	4.54	10,11,788.60	0.013	2.46	6.18	6	6	97	2.8	1.1	Rectangular Channel	Concrete
9955	Nala-3 B1	CB-394	CB-393	0.6	0.25	2	2	110.38	4.37	10,19,628.30	0.013	2.74	7.18	6.05	6.05	84.2	2.8	1.1	Rectangular Channel	Concrete
9956	Nala-3 B1	CB-393	O-196	0.25	0.2	2	2	28.3	4.74	10,24,396.30	0.013	2.23	6.47	6.08	6.08	93.9	2.8	1.3	Rectangular Channel	Concrete

ANNEXURE VI : HARIPPAD ROAD SIDE DRAIN REPORT

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
1305	0 (Polyline)-619	MH-839	MH-838	2.62	2.43	1.91	1.72	35.86	0.84	0.011	1.27	0.71	0.09	12.6	59.2	4,520.00	Box	Concrete	0.61	0.61
3580	0 (Polyline)-618	MH-838	MH-1632	2.43	2.37	1.72	1.66	50	1.57	0.011	0.96	0.31	0.28	89.5	74.2	14,453.60	Box	Concrete	0.61	0.61
2598	0 (Polyline)-617	MH-1632	MH-1172	2.37	2.64	1.66	1.64	50	2.07	0.011	0.81	0.52	0.42	80.5	73.7	22,787.00	Box	Concrete	1.22	0.61
1834	0 (Polyline)-616	MH-1172	MH-1171	2.64	2.52	1.64	1.61	50	2.12	0.011	0.83	0.52	0.46	87.2	74	26,036.90	Box	Concrete	1.22	0.61
3355	0 (Polyline)-615	MH-1171	MH-1097	2.52	2.7	1.61	1.59	50	2.17	0.011	0.84	0.52	0.49	92.8	73.7	29,308.60	Box	Concrete	1.22	0.61
1713	0 (Polyline)-614	MH-1097	MH-1096	2.7	2.63	1.59	1.56	50	2.2	0.011	0.85	0.92	0.51	55.2	48.6	32,517.90	Box	Concrete	1.22	0.91
2080	0 (Polyline)-613	MH-1096	MH-1323	2.63	2.32	1.56	1.31	50	1.66	0.011	1.93	2.94	0.52	17.7	62.6	34,979.10	Box	Concrete	1.22	0.91
3189	0 (Polyline)-620	MH-1949	MH-1950	2.81	2.98	2.1	2.08	50	1.78	0.011	0.75	0.36	0.3	81.4	52.2	14,978.80	Box	Concrete	0.91	0.61
3610	0 (Polyline)-621	MH-1950	MH-132	2.98	2.87	2.08	2.06	39.06	1.97	0.011	0.77	0.52	0.35	67.7	41.3	18,949.90	Box	Concrete	1.22	0.61
5225	CO-5	MH-132	MH-1939	2.87	2.71	2.06	2	17.41	1.62	0.011	1.49	1.35	0.37	27.1	40.1	20,490.50	Box	Concrete	1.22	0.61
653	0 (Polyline)-612	MH-411	MH-410	3.1	2.75	2.39	2.04	17.84	0.82	0.011	2.34	1.35	0.15	11.1	42.9	7,636.10	Box	Concrete	0.61	0.61
4730	0 (Polyline)-611	MH-410	MH-1939	2.75	2.71	2.04	2	50	1.43	0.011	0.78	0.27	0.2	73.6	50.8	9,948.00	Box	Concrete	0.61	0.61
5224	0 (Polyline)-610(2)	MH-1939	MH-1323	2.71	2.32	2	1.31	36.65	1.52	0.011	3.05	3.21	0.57	17.6	80.5	31,914.60	Box	Concrete	1.22	0.61
5223	0 (Polyline)-610(1)	MH-1323	MH-1938	2.32	2.19	1.31	1.18	13.35	1.77	0.011	2.94	4.02	0.99	24.7	84.9	67,852.90	Box	Concrete	1.22	0.91
4812	0 (Polyline)-609	MH-1938	MH-2583	2.19	2.18	1.18	1.16	50	2.82	0.011	1.01	1.22	1	82.3	93.4	68,640.50	Box	Concrete	1.52	0.91
4602	0 (Polyline)-608	MH-2583	O-3	2.18	2.07	1.16	-2.25	50	1.77	0.011	5.33	14.2	1	7.1	280.4	70,918.70	Box	Concrete	1.52	0.91
371	0 (Polyline)-627	MH-225	MH-224	2.85	2.8	2.14	2.09	9.53	0.83	0.011	1.18	0.67	0.08	11.8	22.8	4,015.50	Box	Concrete	0.61	0.61
2382	0 (Polyline)-626	MH-224	MH-1421	2.8	2.61	2.09	1.9	50	0.93	0.011	1.26	0.6	0.12	20	40.3	6,162.80	Box	Concrete	0.61	0.61
2237	0 (Polyline)-625	MH-1421	MH-1420	2.61	2.73	1.9	1.87	50	1.52	0.011	0.65	0.22	0.18	84.5	46.9	9,605.80	Box	Concrete	0.61	0.61
2603	0 (Polyline)-624	MH-1420	O-1	2.73	2.11	1.87	-2.3	50	0.78	0.011	4.31	2.79	0.22	8	371.8	12,557.80	Box	Concrete	0.61	0.61
5045	0 (Polyline)-606	MH-2731	MH-724	2.21	2.1	1.5	1.39	50	0.79	0.011	0.69	0.44	0.04	8.5	93.8	1,896.20	Box	Concrete	0.61	0.61
1132	0 (Polyline)-607	MH-724	MH-234	2.1	2.66	1.39	1.18	32.01	0.79	0.011	0.19	0.78	0.07	8.9	119.3	3,752.10	Box	Concrete	0.61	0.61
799	0 (Polyline)-581	MH-506	MH-505	2.77	2.98	2.06	2.05	21.56	0.75	0.011	0.31	0.22	0.01	6.2	54.4	681.8	Box	Concrete	0.61	0.61
4657	0 (Polyline)-579	MH-2604	MH-1362	2.99	3.16	2.28	2.25	50	1.07	0.011	0.52	0.22	0.07	33.9	31.3	3,707.70	Box	Concrete	0.61	0.61
2144	0 (Polyline)-580	MH-1362	MH-505	3.16	2.98	2.25	2.05	43.57	0.95	0.011	1.43	0.67	0.15	22.1	42.5	8,057.80	Box	Concrete	0.61	0.61
3353	0 (Polyline)-582	MH-505	MH-2028	2.98	2.95	2.05	2.02	50	1.54	0.011	0.66	0.22	0.19	86.2	47.3	10,472.20	Box	Concrete	0.61	0.61
4309	0 (Polyline)-583	MH-2028	MH-318	2.95	2.55	2.02	1.84	38.4	1.07	0.011	1.6	0.66	0.22	33.8	39.3	13,493.50	Box	Concrete	0.61	0.61
513	0 (Polyline)-584	MH-318	MH-167	2.55	2.68	1.84	1.49	24.95	1.16	0.011	2.3	1.94	0.26	13.3	72.3	15,943.50	Box	Concrete	0.91	0.61
4108	0 (Polyline)-600	MH-2375	MH-166	2.22	2.36	1.51	1.49	40.09	0.96	0.011	0.14	0.22	0.05	23.4	102.6	2,560.50	Box	Concrete	0.61	0.61
282	0 (Polyline)-601	MH-166	MH-167	2.36	2.68	1.49	1.49	17.34	1.06	0.011	0.16	0.22	0.06	26.8	104.8	3,821.80	Box	Concrete	0.61	0.61
5005	0 (Polyline)-585	MH-167	MH-359	2.68	3.02	1.49	1.47	34.17	1.9	0.011	0.55	0.36	0.31	84.8	105.5	21,831.00	Box	Concrete	0.91	0.61
575	0 (Polyline)-586	MH-359	MH-360	3.02	2.82	1.47	1.45	30.69	1.99	0.011	0.43	0.52	0.32	61.9	106.2	23,871.40	Box	Concrete	1.22	0.61
3237	0 (Polyline)-602	MH-1975	MH-1041	2.97	2.91	2.26	2.2	50	0.88	0.011	0.63	0.33	0.05	15.7	23.4	2,614.30	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
1625	0 (Polyline)-603	MH-1041	MH-360	2.91	2.82	2.2	1.45	40.24	0.78	0.011	2.06	1.32	0.11	8.3	65.6	5,894.40	Box	Concrete	0.61	0.61
2053	0 (Polyline)-587	MH-360	MH-1308	2.82	2.86	1.45	1.43	42.58	2.14	0.011	0.55	0.52	0.41	78.8	107.3	31,872.50	Box	Concrete	1.22	0.61
2972	0 (Polyline)-594	MH-1835	MH-882	3.2	3.11	2.49	2.4	50	1.09	0.011	1	0.41	0.15	36.2	43.1	7,424.40	Box	Concrete	0.61	0.61
1376	0 (Polyline)-595	MH-882	MH-883	3.11	3.29	2.4	2.37	50	1.6	0.011	0.69	0.36	0.22	59.8	38.7	11,446.10	Box	Concrete	0.91	0.61
4257	0 (Polyline)-596	MH-883	MH-1543	3.29	2.57	2.37	1.86	50	1.18	0.011	2.04	1.65	0.25	15	46.2	13,893.60	Box	Concrete	0.91	0.61
2442	0 (Polyline)-597	MH-1543	MH-1544	2.57	2.99	1.86	1.83	50	1.73	0.011	0.73	0.36	0.27	75.7	59	15,757.50	Box	Concrete	0.91	0.61
4869	0 (Polyline)-598	MH-1544	MH-1865	2.99	2.95	1.83	1.81	50	1.85	0.011	0.77	0.36	0.33	89.9	48.3	19,940.40	Box	Concrete	0.91	0.61
3030	0 (Polyline)-599	MH-1865	MH-1308	2.95	2.86	1.81	1.43	49.09	1.53	0.011	1.98	2.04	0.38	18.5	72.9	24,667.70	Box	Concrete	1.22	0.61
4158	0 (Polyline)-588	MH-1308	MH-623	2.86	2.21	1.43	1.2	50	1.85	0.011	0.99	1.6	0.73	45.9	121.6	59,617.10	Box	Concrete	1.22	0.61
978	0 (Polyline)-589	MH-623	MH-234	2.21	2.66	1.2	1.18	27.89	2.65	0.011	0.94	0.92	0.75	81.1	91.1	62,148.00	Box	Concrete	1.22	0.91
386	0 (Polyline)-590	MH-234	MH-126	2.66	2.85	1.18	1.18	9.97	2.71	0.011	0.95	1.22	0.79	64.9	91.6	66,640.00	Box	Concrete	1.52	0.91
222	0 (Polyline)-591	MH-126	O-4	2.85	2.21	1.18	1.18	64.78	3.34	0.011	0.57	0.38	0.79	210.1	91.1	66,941.20	Box	Concrete	1.52	0.91
359	0 (Polyline)-2039	MH-217	MH-216	3.43	3.5	2.72	2.71	15.38	1.58	0.011	0.68	0.36	0.21	57.2	52.7	10,520.50	Box	Concrete	0.91	0.61
4556	0 (Polyline)-2038	MH-216	MH-2370	3.5	3.27	2.71	2.56	43.9	1.38	0.011	1.53	0.95	0.33	34.3	64.6	16,857.60	Box	Concrete	0.91	0.61
4097	0 (Polyline)-2037	MH-2370	MH-2200	3.27	3.28	2.7	2.54	50	1.57	0.011	1.72	0.93	0.52	55.6	61.1	27,260.30	Box	Concrete	0.91	0.61
3718	0 (Polyline)-2036	MH-2200	MH-1143	3.28	3.41	2.54	2.5	48.3	2.21	0.011	1.05	0.64	0.64	99.4	60	34,475.70	Box	Concrete	1.22	0.61
1788	0 (Polyline)-2035	MH-1143	MH-1142	3.41	2.95	2.5	1.94	51.7	1.63	0.011	2.71	2.43	0.68	27.9	82.7	38,219.90	Box	Concrete	1.22	0.61
4024	0 (Polyline)-1828	MH-2340	MH-1820	3.82	3.52	3.11	2.81	63.73	0.83	0.011	1.16	0.66	0.08	11.5	36.3	3,871.40	Box	Concrete	0.61	0.61
2941	0 (Polyline)-1829	MH-1820	MH-1821	3.52	3.67	2.81	2.79	50	1.46	0.011	0.64	0.22	0.17	77.2	49.1	8,828.30	Box	Concrete	0.61	0.61
4436	0 (Polyline)-1830	MH-1821	MH-2289	3.67	3.22	2.79	2.51	50	1.11	0.011	1.81	0.72	0.27	37.9	49.6	15,493.40	Box	Concrete	0.61	0.61
3907	0 (Polyline)-1831	MH-2289	MH-1033	3.22	3.14	2.51	2.43	50	1.59	0.011	1.22	0.65	0.38	58.5	48.6	22,059.90	Box	Concrete	0.91	0.61
1613	0 (Polyline)-1832	MH-1033	MH-1034	3.14	3.45	2.43	1.73	39.95	1.48	0.011	2.7	3.08	0.43	13.8	96.1	25,710.10	Box	Concrete	1.22	0.61
4079	0 (Polyline)-1904	MH-933	MH-2365	3.77	3.57	1.72	1.7	50	1.05	0.011	0.19	0.22	0.07	32	159	3,499.60	Box	Concrete	0.61	0.61
5284	0 (Polyline)-1903(2)	MH-2365	MH-1034	3.57	3.45	1.73	1.72	26.47	1.16	0.011	0.25	0.22	0.09	43.8	155.5	6,088.20	Box	Concrete	0.61	0.61
4188	0 (Polyline)-1900	MH-236	MH-2413	3.53	3.5	2.26	2.23	50	1.45	0.011	0.62	0.36	0.15	41.7	74.1	7,662.30	Box	Concrete	0.91	0.61
4729	0 (Polyline)-1901	MH-2413	MH-2429	3.5	3.57	2.23	2.21	50	1.88	0.011	0.73	0.52	0.29	55.6	77.1	15,747.20	Box	Concrete	1.22	0.61
4229	0 (Polyline)-1902	MH-2429	MH-2430	3.57	3.6	2.21	2.18	50	2.05	0.011	0.8	0.52	0.41	77.6	79.3	23,320.10	Box	Concrete	1.22	0.61
5283	0 (Polyline)-1903(1)	MH-2430	MH-1034	3.6	3.45	2.18	1.73	23.53	1.47	0.011	2.77	3.24	0.42	13	117.1	25,703.30	Box	Concrete	1.22	0.61
4292	0 (Polyline)-2031	MH-1034	MH-2454	3.45	3.49	1.76	1.73	49.18	2.67	0.011	0.61	1.22	0.84	69.4	101.4	58,627.00	Box	Concrete	1.52	0.91
4882	0 (Polyline)-2032	MH-2454	MH-2421	3.49	3.31	1.78	1.76	50	2.71	0.011	0.97	1.22	0.87	71.6	97.6	63,634.10	Box	Concrete	1.52	0.91
4209	0 (Polyline)-2033	MH-2421	MH-2422	3.31	3.12	1.81	1.78	50	2.79	0.011	1	1.22	0.94	77.5	93.8	71,288.50	Box	Concrete	1.52	0.91

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
4283	0 (Polyline)-2034	MH-2422	MH-1142	3.12	2.95	1.94	1.81	50	2.07	0.011	1.85	2.13	0.95	44.6	84	74,127.10	Box	Concrete	1.22	0.91
9927	CO-414	MH-1142	O-193	2.95	2.73	2.1	1.8	22.31	1.85	0.011	3.72	4.6	1.44	31.3	68.6	1,14,699.20	Box	Concrete	1.2	0.9
5286	0 (Polyline)-1905(2)	MH-451	MH-934	4.04	3.8	1.69	1.67	28.37	1.27	0.011	0.32	0.22	0.12	55.5	272	6,073.40	Box	Concrete	0.61	0.61
4564	0 (Polyline)-1906	MH-934	MH-637	3.8	3.72	1.67	1.65	50	1.43	0.011	0.43	0.22	0.16	74.2	273.7	8,725.30	Box	Concrete	0.61	0.61
1000	0 (Polyline)-1907	MH-637	O-103	3.72	2.64	3	1.9	28.51	0.91	0.011	3.84	1.9	0.35	18.3	75.5	21,023.40	Box	Concrete	0.61	0.61
518	0 (Polyline)-1814	MH-322	MH-321	4.03	3.85	3.32	3.03	13.85	0.66	0.011	1.01	1.4	0.01	1	28.1	711.4	Box	Concrete	0.61	0.61
4791	0 (Polyline)-2178	MH-2647	MH-2648	3.8	3.9	3.09	3.06	50	1.47	0.011	0.64	0.22	0.17	77.9	56.3	8,520.90	Box	Concrete	0.61	0.61
4939	0 (Polyline)-2179	MH-2648	MH-1083	3.9	3.8	3.06	3.04	50	1.66	0.011	0.71	0.36	0.24	67.1	52.9	13,153.90	Box	Concrete	0.91	0.61
5293	0 (Polyline)-2180(1)	MH-1083	MH-321	3.8	3.85	3.04	3.03	14.37	1.69	0.011	0.72	0.36	0.25	70.2	50.8	14,631.00	Box	Concrete	0.91	0.61
5294	0 (Polyline)-2180(2)	MH-321	MH-1084	3.85	3.77	3.03	3.01	35.64	1.73	0.011	0.73	0.36	0.27	74.8	44.5	15,887.00	Box	Concrete	0.91	0.61
3289	0 (Polyline)-2181	MH-1084	MH-433	3.77	3.32	3.01	2.61	50	1.26	0.011	2.06	1.46	0.33	22.7	43.7	20,217.20	Box	Concrete	0.91	0.61
689	0 (Polyline)-2182	MH-433	O-18	3.32	3.57	2.61	2.6	22.54	2.03	0.011	0.79	0.52	0.39	75.1	42.2	24,617.40	Box	Concrete	1.22	0.61
4705	0 (Polyline)-2214	MH-2620	MH-907	2.95	3.57	2.24	2.21	50	1.03	0.011	0.51	0.22	0.06	30	86	3,279.60	Box	Concrete	0.61	0.61
1415	0 (Polyline)-2215	MH-907	MH-908	3.57	3.69	2.21	2.2	37.24	1.23	0.011	0.58	0.22	0.11	51.4	89.1	6,101.20	Box	Concrete	0.61	0.61
808	0 (Polyline)-2078	MH-512	MH-511	3.86	4.13	3.15	3.14	21.91	0.88	0.011	0.42	0.22	0.03	16	21.5	1,749.50	Box	Concrete	0.61	0.61
4441	0 (Polyline)-2077	MH-511	MH-2121	4.13	3.66	3.14	2.95	50	0.87	0.011	1.13	0.59	0.09	15.2	26.9	4,755.70	Box	Concrete	0.61	0.61
5282	0 (Polyline)-2076(2)	MH-2121	MH-908	3.66	3.69	2.95	2.2	15.36	1.07	0.011	3.39	3.61	0.25	6.9	61.3	13,736.50	Box	Concrete	0.91	0.61
5281	0 (Polyline)-2076(1)	MH-908	MH-1414	3.69	3.47	2.2	2.18	34.64	2	0.011	0.78	0.52	0.37	71.2	91.2	21,670.80	Box	Concrete	1.22	0.61
2226	EXI-2075	MH-1414	MH-1413	3.47	3.52	2.18	2.15	50	2.07	0.011	0.81	0.52	0.42	80.4	93.3	25,477.40	Box	Concrete	1.22	0.61
3157	EXI-2074	MH-1413	MH-1932	3.52	3.77	2.15	2.13	50	2.15	0.011	0.84	0.52	0.48	90.8	95.5	30,580.50	Box	Concrete	1.22	0.61
4683	EXI-2073	MH-1932	MH-1234	3.77	3.64	2.13	2.1	50	2.22	0.011	0.86	0.92	0.52	56.8	65.3	35,340.80	Box	Concrete	1.22	0.91
1933	EXI-2072	MH-1234	MH-1233	3.64	3.36	2.1	2.08	50	2.28	0.011	0.88	0.92	0.56	61.3	66.3	39,530.70	Box	Concrete	1.22	0.91
2937	EXI-2071	MH-1233	MH-1818	3.36	3.49	2.08	2.05	50	2.3	0.011	0.88	0.92	0.58	63.4	67.2	42,392.70	Box	Concrete	1.22	0.91
3169	0 (Polyline)-2070	MH-1818	MH-1077	3.49	2.87	2.05	1.86	50	1.78	0.011	1.87	2.53	0.64	25.3	78	48,276.40	Box	Concrete	1.22	0.91
5252	0 (Polyline)-2069(2)	MH-1077	O-194	2.87	3.01	1.86	1.86	6.49	2.17	0.011	1.08	1.18	0.63	53.4	88.7	48,276.40	Box	Concrete	1.22	0.91
5047	0 (Polyline)-2058	MH-2732	MH-2347	3.54	3.25	2.83	2.54	50	0.89	0.011	1.44	0.74	0.12	16.4	56.6	6,133.80	Box	Concrete	0.61	0.61
4041	0 (Polyline)-2059	MH-2347	MH-2348	3.25	3.49	2.54	2.52	50	1.79	0.011	0.75	0.36	0.3	82.6	82.3	15,630.40	Box	Concrete	0.91	0.61
4908	0 (Polyline)-2060	MH-2348	MH-2427	3.49	3.62	2.52	2.49	50	2.09	0.011	0.81	0.52	0.43	82.1	83.8	23,651.30	Box	Concrete	1.22	0.61
5253	0 (Polyline)-2061(1)	MH-2427	MH-2637	3.62	3.64	2.49	2.48	26.44	2.16	0.011	0.84	0.52	0.48	91.6	84.9	27,880.00	Box	Concrete	1.22	0.61
435	0 (Polyline)-1813	MH-267	MH-266	3.75	3.85	3.04	3.03	11.63	1.14	0.011	0.55	0.22	0.09	41	50.6	4,486.20	Box	Concrete	0.61	0.61
2448	0 (Polyline)-1812	MH-266	MH-1547	3.85	3.84	3.03	3.01	50	1.38	0.011	0.62	0.22	0.15	67.9	47.9	7,547.20	Box	Concrete	0.61	0.61
4763	0 (Polyline)-1811	MH-1547	MH-2637	3.84	3.64	3.01	2.48	50	1.01	0.011	2.28	0.99	0.28	27.8	65.2	15,190.90	Box	Concrete	0.61	0.61
5254	0 (Polyline)-2061(2)	MH-2637	MH-2428	3.64	3.73	2.48	2.47	23.56	2.54	0.011	0.95	0.92	0.76	82.7	56.2	45,591.00	Box	Concrete	1.22	0.91
4831	0 (Polyline)-2062	MH-2428	MH-2536	3.73	3.63	2.47	2.44	50	2.6	0.011	0.96	0.92	0.81	87.7	49.8	49,539.60	Box	Concrete	1.22	0.91
4490	0 (Polyline)-2063	MH-2536	MH-527	3.63	3.33	2.44	2.32	50	2.03	0.011	1.75	2.04	0.86	42.2	42.5	55,502.60	Box	Concrete	1.22	0.91
9946	0 (Polyline)-2064(1)	MH-527	O-195	3.33	3.35	2.32	1.86	17.44	1.58	0.011	3.94	6.68	0.86	12.9	64.8	57,191.90	Box	Concrete	1.22	0.91

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3290	0 (Polyline)-1908	MH-1998	MH-1999	3.17	2.54	2.46	1.83	50	0.78	0.011	1.68	1.09	0.09	8.1	68.4	4,452.50	Box	Concrete	0.61	0.61
3351	0 (Polyline)-1909	MH-1999	MH-2027	2.54	3.18	1.83	1.8	50	1.63	0.011	0.41	0.36	0.23	62.4	117.1	11,756.70	Box	Concrete	0.91	0.61
3859	0 (Polyline)-1910	MH-2027	MH-1071	3.18	3.12	1.8	1.78	50	2.02	0.011	0.52	0.52	0.38	73.4	119.2	22,125.90	Box	Concrete	1.22	0.61
5249	0 (Polyline)-1911(1)	MH-1071	MH-2211	3.12	3	1.78	1.42	29.83	1.52	0.011	0.59	2.56	0.44	17.3	148.7	27,924.70	Box	Concrete	1.22	0.61
5250	0 (Polyline)-1911(2)	MH-2211	FO-17	3	3	1.42	1.18	5.78	2.27	0.011	3.05	25.53	0.47	1.8	98.4	30,901.80	Box	Concrete	2.13	1.22
3316	0 (Polyline)-2217	MH-2012	MH-2013	2.94	3.32	2.23	2.2	50	1.45	0.011	0.64	0.22	0.16	76.1	68	8,325.90	Box	Concrete	0.61	0.61
3691	0 (Polyline)-2218	MH-2013	MH-1917	3.32	3.16	2.2	2.18	50	1.75	0.011	0.74	0.36	0.28	77.4	67.8	15,170.20	Box	Concrete	0.91	0.61
3128	0 (Polyline)-2219	MH-1917	MH-1724	3.16	3.27	2.18	2.15	50	2	0.011	0.78	0.52	0.37	70.5	68.1	21,111.10	Box	Concrete	1.22	0.61
2761	0 (Polyline)-2220	MH-1724	MH-1725	3.27	3.32	2.15	2.13	50	2.24	0.011	0.87	0.92	0.54	58.8	44	32,909.30	Box	Concrete	1.22	0.91
3980	0 (Polyline)-2221	MH-1725	MH-247	3.32	3.1	2.13	2.09	39.66	2.09	0.011	1.09	1.24	0.58	46.7	39.6	37,127.30	Box	Concrete	1.22	0.91
406	0 (Polyline)-2222	MH-247	MH-248	3.1	3.03	2.09	2.02	21.71	1.79	0.011	1.68	2.28	0.58	25.5	40.8	38,726.40	Box	Concrete	1.22	0.91
5255	0 (Polyline)-2025(1)	MH-2031	MH-248	3.1	3.03	2.39	2.02	39.14	0.98	0.011	2.08	0.94	0.23	24.7	53.2	11,743.60	Box	Concrete	0.61	0.61
5256	0 (Polyline)-2025(2)	MH-248	MH-2032	3.03	2.8	2.02	1.79	10.86	1.58	0.011	3.55	6	0.78	13	61.3	52,288.70	Box	Concrete	1.22	0.91
4714	0 (Polyline)-2026	MH-2032	MH-2006	2.8	3.18	1.79	1.77	50	2.6	0.011	0.96	0.92	0.81	87.6	78.3	54,253.10	Box	Concrete	1.22	0.91
3306	0 (Polyline)-2027	MH-2006	MH-2007	3.18	2.76	1.77	1.74	50	2.67	0.011	0.97	0.92	0.86	93.4	78.3	59,669.30	Box	Concrete	1.22	0.91
3327	0 (Polyline)-2028	MH-2007	MH-2018	2.76	2.88	1.74	1.72	50	2.76	0.011	0.99	1.22	0.93	76.7	78.8	66,913.90	Box	Concrete	1.52	0.91
3690	0 (Polyline)-2029	MH-2018	MH-617	2.88	2.44	1.72	1.43	50	2.06	0.011	2.36	4.14	0.97	23.5	95.1	72,130.50	Box	Concrete	1.52	0.91
969	0 (Polyline)-2030	MH-617	FO-16	2.44	2.5	1.43	1.18	24.74	1.98	0.011	0.73	5.45	1.01	18.6	131.9	76,183.30	Box	Concrete	1.52	0.91
5062	0 (Polyline)-1912	MH-2737	MH-2087	2.75	2.5	2.04	1.48	56.39	1.01	0.011	2.22	0.96	0.27	28.4	114.7	13,851.30	Box	Concrete	0.61	0.61
3481	0 (Polyline)-1913	MH-2087	MH-2088	2.5	2.5	1.48	1.46	54.79	2.03	0.011	0.5	0.5	0.37	74.6	159.9	19,278.60	Box	Concrete	1.22	0.61
3550	0 (Polyline)-1914	MH-2088	MH-1968	2.5	2.5	1.46	1.18	39.89	1.55	0.011	0.53	1.95	0.39	20.2	182.6	22,310.40	Box	Concrete	1.22	0.61
3224	0 (Polyline)-1915	MH-1968	MH-1607	2.5	2.5	1.18	0.96	38.02	1.61	0.011	0.62	1.76	0.46	26.2	220.8	28,106.40	Box	Concrete	1.22	0.61
2552	0 (Polyline)-1916	MH-1607	MH-677	2.5	2.53	1.75	1.7	59.86	2.04	0.011	0.69	0.68	0.52	76.2	110.3	33,251.40	Box	Concrete	1.22	0.61
5263	0 (Polyline)-1917(1)	MH-677	MH-147	2.53	2.62	0.94	0.93	16.25	2.21	0.011	0.46	0.91	0.51	56.1	158.9	35,232.10	Box	Concrete	1.22	0.91
4103	0 (Polyline)-2082	MH-2373	MH-147	3.06	2.62	2.35	0.93	56.68	0.67	0.011	1.33	1.53	0.02	1.6	123.3	1,257.70	Box	Concrete	0.61	0.61
5264	0 (Polyline)-1917(2)	MH-147	O-133	2.62	2.5	0.93	0.93	12.29	2.23	0.011	0.48	0.92	0.53	57.9	159.4	37,494.20	Box	Concrete	1.22	0.91
909	0 (Polyline)-686	MH-579	MH-578	3.35	2.99	2.64	2.28	26.19	0.67	0.011	0.97	1.12	0.02	1.6	24.8	920	Box	Concrete	0.61	0.61
2913	0 (Polyline)-681	MH-1805	MH-1584	3.28	3.09	2.57	2.38	50	1.07	0.011	1.46	0.6	0.2	33.7	48.6	10,250.10	Box	Concrete	0.61	0.61
2514	0 (Polyline)-682	MH-1584	MH-1585	3.09	3.6	2.38	2.35	50	1.97	0.011	0.77	0.52	0.35	67.8	59.6	18,454.70	Box	Concrete	1.22	0.61
2816	0 (Polyline)-683	MH-1585	MH-1252	3.6	3.42	2.35	2.33	50	2.09	0.011	0.81	0.52	0.43	82.2	56.7	23,634.70	Box	Concrete	1.22	0.61
1963	0 (Polyline)-684	MH-1252	MH-578	3.42	2.99	2.33	2.28	49.53	1.94	0.011	1.05	0.73	0.46	63.7	48.2	26,849.70	Box	Concrete	1.22	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
945	0 (Polyline)-685	MH-578	MH-602	2.99	2.61	2.28	1.9	26.57	1.53	0.011	2.68	2.8	0.5	17.9	56.3	30,291.00	Box	Concrete	1.22	0.61
2097	0 (Polyline)-2216	MH-1333	MH-1332	3.44	2.77	2.73	2.06	43.14	0.7	0.011	1.29	1.2	0.04	2.9	34.2	1,775.20	Box	Concrete	0.61	0.61
3751	0 (Polyline)-2204	MH-2215	MH-2042	3.33	3.03	2.62	2.32	50	0.74	0.011	1.01	0.76	0.04	5.2	34.6	2,004.60	Box	Concrete	0.61	0.61
3382	0 (Polyline)-2205	MH-2042	MH-2043	3.03	3.19	2.32	2.29	50	1.75	0.011	0.74	0.36	0.28	77.5	54.3	14,844.60	Box	Concrete	0.91	0.61
3454	0 (Polyline)-2206	MH-2043	MH-621	3.19	2.92	2.29	2.21	50	1.53	0.011	1.18	0.65	0.34	51.7	52.3	18,784.90	Box	Concrete	0.91	0.61
5247	0(Polyline)-2207(1)(1)	MH-621	MH-1332	2.92	2.77	2.21	2.06	13.21	1.34	0.011	2.68	1.73	0.52	30.2	54.9	30,340.80	Box	Concrete	0.91	0.61
5248	0(Polyline)-2207(1)(2)	MH-1332	MH-602	2.77	2.61	2.06	1.9	14.05	1.37	0.011	2.76	1.72	0.58	33.9	63.7	33,971.00	Box	Concrete	0.91	0.61
5246	0 (Polyline)-2207(2)	MH-602	O-8	2.61	2	1.9	1.64	9.96	1.63	0.011	4.27	3.82	1.08	28.2	95.8	65,843.70	Box	Concrete	1.22	0.61
4961	0 (Polyline)-2272	MH-2703	MH-2693	3.32	3.2	2.61	2.49	50	0.91	0.011	0.94	0.46	0.09	19	34.9	4,405.70	Box	Concrete	0.61	0.61
4934	0 (Polyline)-2273	MH-2693	MH-2694	3.2	3.07	2.49	2.36	50	1.05	0.011	1.2	0.5	0.16	32.1	50.2	8,520.70	Box	Concrete	0.61	0.61
5050	0 (Polyline)-2274	MH-2694	MH-2517	3.07	3.07	2.36	2.33	50	1.63	0.011	0.7	0.36	0.23	63	58.6	12,523.30	Box	Concrete	0.91	0.61
4447	0 (Polyline)-2275	MH-2517	MH-2518	3.07	3.02	2.33	2.31	50	1.7	0.011	0.72	0.36	0.26	72	57.5	15,264.00	Box	Concrete	0.91	0.61
5070	0 (Polyline)-2276	MH-2518	MH-1367	3.02	3.24	2.31	2.28	50	1.82	0.011	0.76	0.36	0.31	86.1	47	19,483.90	Box	Concrete	0.91	0.61
2152	0 (Polyline)-2277	MH-1367	MH-1368	3.24	3.05	2.28	1.42	47.09	1.45	0.011	2.6	3.17	0.37	11.5	102.5	24,304.70	Box	Concrete	1.22	0.61
4971	0 (Polyline)-737	MH-2707	MH-2345	2.97	2.91	2.26	2.2	50	1.15	0.011	0.8	0.31	0.13	42.3	51.6	6,697.10	Box	Concrete	0.61	0.61
4034	0 (Polyline)-738	MH-2345	MH-494	2.91	3.09	2.2	2.18	50	1.65	0.011	0.71	0.36	0.24	65.7	51.8	12,706.50	Box	Concrete	0.91	0.61
782	0 (Polyline)-739	MH-494	MH-495	3.09	2.77	2.18	1.75	21.86	1.14	0.011	2.55	2.26	0.26	11.5	87.1	14,784.90	Box	Concrete	0.91	0.61
4156	0 (Polyline)-803	MH-2401	MH-769	3.27	3.17	2.56	2.46	50	0.98	0.011	0.94	0.42	0.1	24.7	32.9	5,284.20	Box	Concrete	0.61	0.61
1200	0 (Polyline)-804	MH-769	MH-770	3.17	3.46	2.46	1.8	34.35	0.86	0.011	2.5	1.34	0.19	14.2	78.4	10,056.20	Box	Concrete	0.61	0.61
3097	EXI-2296	MH-1901	MH-1902	2.68	2.83	1.97	1.94	50	1.37	0.011	0.39	0.22	0.14	66.8	107.6	7,307.20	Box	Concrete	0.61	0.61
3578	0 (Polyline)-2297	MH-1902	MH-193	2.83	3.19	1.94	1.92	50	1.68	0.011	0.45	0.36	0.25	68.7	109.8	14,070.40	Box	Concrete	0.91	0.61
323	EXI-2298	MH-193	MH-194	3.19	3.5	1.92	1.91	9.28	1.67	0.011	0.44	0.36	0.24	67.2	111.1	15,266.70	Box	Concrete	0.91	0.61
4857	0 (Polyline)-723	MH-2670	MH-2332	3.68	3.68	2.97	2.94	50	1.2	0.011	0.58	0.22	0.1	48.2	36	5,274.30	Box	Concrete	0.61	0.61
4009	0 (Polyline)-724	MH-2332	MH-2224	3.68	3.5	2.94	2.79	43.6	1.01	0.011	1.31	0.57	0.16	27.8	32.6	8,663.10	Box	Concrete	0.61	0.61
5275	0 (Polyline)-725(1)	MH-2224	MH-194	3.5	3.5	2.79	1.91	17.64	0.78	0.011	3.3	2.15	0.17	7.9	72	9,486.10	Box	Concrete	0.61	0.61
5276	0 (Polyline)-725(2)	MH-194	MH-2219	3.5	3.79	1.91	1.9	39.22	2.04	0.011	0.54	0.52	0.4	76.6	112	25,617.20	Box	Concrete	1.22	0.61
3759	0 (Polyline)-726	MH-2219	MH-2220	3.79	3.85	1.9	1.87	50	2.13	0.011	0.83	0.92	0.46	50	76.5	31,201.60	Box	Concrete	1.22	0.91
5042	0 (Polyline)-727	MH-2220	MH-2463	3.85	3.55	1.87	1.85	50	2.26	0.011	0.87	0.92	0.55	59.9	78.3	38,825.30	Box	Concrete	1.22	0.91
4315	0 (Polyline)-728	MH-2463	MH-1293	3.55	3.56	1.85	1.82	50	2.35	0.011	0.9	0.92	0.62	67.5	79.9	45,323.60	Box	Concrete	1.22	0.91
5273	0 (Polyline)-729(1)	MH-1293	MH-770	3.56	3.46	1.82	1.8	33.33	2.38	0.011	0.91	0.92	0.64	69.9	81	48,734.20	Box	Concrete	1.22	0.91
5274	0 (Polyline)-729(2)	MH-770	MH-1294	3.46	3.31	1.8	1.8	16.67	2.55	0.011	0.95	0.92	0.77	83.7	81.6	59,777.10	Box	Concrete	1.22	0.91
4675	0 (Polyline)-730	MH-1294	MH-2610	3.31	3.24	1.8	1.77	50	2.56	0.011	0.95	0.92	0.77	83.9	82.1	60,696.70	Box	Concrete	1.22	0.91
5271	0 (Polyline)-731(1)	MH-2610	MH-495	3.24	2.77	1.77	1.75	32.61	2.55	0.011	0.95	0.92	0.77	83.5	82.8	62,431.70	Box	Concrete	1.22	0.91
5272	0 (Polyline)-731(2)	MH-495	MH-2651	2.77	3.16	1.75	1.75	17.39	2.77	0.011	1	1.22	0.94	77.6	83.3	77,928.30	Box	Concrete	1.52	0.91
4800	0 (Polyline)-732	MH-2651	MH-2652	3.16	2.5	1.75	1.49	50	2.08	0.011	2.24	3.88	0.95	24.4	97.2	78,901.20	Box	Concrete	1.52	0.91
5022	0 (Polyline)-733	MH-2652	MH-2671	2.5	2.88	1.49	1.47	50	2.81	0.011	0.71	1.22	0.98	80.9	112.6	82,758.80	Box	Concrete	1.52	0.91

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4861	0 (Polyline)-734	MH-2671	MH-2325	2.88	2.98	1.47	1.44	50	2.84	0.011	0.73	1.22	1.02	83.6	113.4	88,509.60	Box	Concrete	1.52	0.91
3993	0 (Polyline)-735	MH-2325	MH-1368	2.98	3.05	1.44	1.42	47.45	2.88	0.011	0.77	1.22	1.06	87.2	114.2	95,553.80	Box	Concrete	1.52	0.91
2122	0 (Polyline)-736	MH-1368	O-15	3.05	2.55	1.42	0.47	43.51	2.51	0.011	0.82	12.13	1.58	13	165.6	1,47,221.50	Box	Concrete	2.13	0.91
5259	0 (Polyline)-2195(1)	MH-1554	MH-156	2.64	3.05	1.93	1.91	45.95	1.69	0.011	0.72	0.36	0.25	69.9	49.5	12,855.90	Box	Concrete	0.91	0.61
1442	0 (Polyline)-2197	MH-926	MH-925	3.18	3.1	2.47	2.39	37.44	0.85	0.011	0.79	0.43	0.06	13.5	21.9	2,926.20	Box	Concrete	0.61	0.61
4331	0 (Polyline)-2196	MH-925	MH-156	3.1	3.05	2.39	1.91	54.05	0.83	0.011	1.6	0.91	0.11	11.7	35.4	5,601.30	Box	Concrete	0.61	0.61
267	0 (Polyline)-2281	MH-156	MH-157	3.05	3.19	1.91	1.91	8.02	2.01	0.011	0.79	0.52	0.38	72.4	45.8	20,514.30	Box	Concrete	1.22	0.61
2384	0 (Polyline)-2021	MH-1509	MH-1510	3.14	3.11	2.43	2.34	44.66	0.96	0.011	0.95	0.44	0.1	23.3	37.6	5,160.60	Box	Concrete	0.61	0.61
5262	0 (Polyline)-2081(2)	MH-448	MH-1510	3.05	3.11	2.34	2.34	8.46	0.69	0.011	0.21	0.22	0.01	2.3	42.2	253.3	Box	Concrete	0.61	0.61
4264	0 (Polyline)-2080	MH-1510	MH-2441	3.11	3.28	2.34	2.31	61.08	1.26	0.011	0.59	0.22	0.12	54.1	36.4	6,145.80	Box	Concrete	0.61	0.61
5258	0 (Polyline)-2079(2)	MH-2441	MH-157	3.28	3.19	2.31	1.91	22.58	0.83	0.011	2.27	1.29	0.15	11.7	37.5	8,704.90	Box	Concrete	0.61	0.61
5257	0 (Polyline)-2079(1)	MH-157	O-14	3.19	3.07	1.91	-0.12	27.42	1.41	0.011	4.68	6.36	0.55	8.6	213.2	31,690.50	Box	Concrete	1.22	0.61
5043	0 (Polyline)-2278	MH-2730	MH-2356	3.47	3.2	2.76	2.49	50	0.87	0.011	1.35	0.71	0.11	15	37.7	5,383.50	Box	Concrete	0.61	0.61
4060	0 (Polyline)-2279	MH-2356	MH-174	3.2	3.25	2.49	2.47	33.51	1.52	0.011	0.65	0.22	0.18	84.2	42.9	9,491.10	Box	Concrete	0.61	0.61
294	0 (Polyline)-2280	MH-174	MH-175	3.25	3.23	2.47	2.2	25.34	1.16	0.011	2.03	1.69	0.23	13.8	41	12,740.30	Box	Concrete	0.91	0.61
4978	0 (Polyline)-2017	MH-2709	MH-1231	3.31	3.25	2.6	2.54	50	1.17	0.011	0.86	0.33	0.15	44.6	37.6	7,408.40	Box	Concrete	0.61	0.61
1930	0 (Polyline)-2018	MH-1231	MH-1232	3.25	2.93	2.54	2.22	50	0.95	0.011	1.65	0.77	0.17	21.8	42.2	8,976.30	Box	Concrete	0.61	0.61
4735	0 (Polyline)-2019	MH-1232	MH-175	2.93	3.23	2.22	2.2	50.82	1.57	0.011	0.67	0.36	0.2	55.7	51.5	11,024.30	Box	Concrete	0.91	0.61
706	0 (Polyline)-2020	MH-175	O-13	3.23	3.07	2.2	1.76	17.23	1.22	0.011	3.46	2.59	0.5	19.2	83.7	28,874.40	Box	Concrete	0.91	0.61
3636	0 (Polyline)-2022	MH-2162	MH-286	2.97	2.79	2.26	2.08	50	0.94	0.011	1.24	0.58	0.13	21.5	66	6,381.10	Box	Concrete	0.61	0.61
465	0 (Polyline)-2023	MH-286	O-12	2.79	2.04	2.08	1.86	10.78	0.94	0.011	2.85	1.35	0.28	20.9	98.5	14,823.70	Box	Concrete	0.61	0.61
3556	0 (Polyline)-753	MH-2124	MH-1123	3.14	3.05	2.43	2.34	50	0.85	0.011	0.76	0.42	0.05	13.2	43.4	2,781.80	Box	Concrete	0.61	0.61
1758	0 (Polyline)-754	MH-1123	MH-643	3.05	3.1	2.34	2.31	50	1.23	0.011	0.58	0.22	0.11	51.3	50.5	5,913.90	Box	Concrete	0.61	0.61
1009	0 (Polyline)-755	MH-643	MH-233	3.1	2.95	2.31	2.24	28.57	0.99	0.011	1.09	0.48	0.13	26.6	55.5	7,344.00	Box	Concrete	0.61	0.61
3624	0 (Polyline)-758	MH-2156	MH-251	3.1	3.2	2.39	2.37	42.4	1.22	0.011	0.58	0.22	0.11	50.2	49.5	5,485.30	Box	Concrete	0.61	0.61
412	0 (Polyline)-759	MH-251	MH-155	3.2	3.11	2.37	2.29	18.69	0.94	0.011	1.31	0.62	0.13	21	55.6	7,019.10	Box	Concrete	0.61	0.61
1502	0 (Polyline)-742	MH-963	MH-624	3.23	3.24	2.52	2.49	50	1.1	0.011	0.54	0.22	0.08	36.7	30.4	4,013.90	Box	Concrete	0.61	0.61
980	0 (Polyline)-743	MH-624	MH-154	3.24	3.17	2.49	2.3	28.21	0.83	0.011	1.4	0.8	0.09	11.4	44.7	5,024.50	Box	Concrete	0.61	0.61
3633	0 (Polyline)-749	MH-2161	MH-616	3.08	3.02	2.37	2.31	50	0.88	0.011	0.63	0.32	0.05	16.3	55.9	2,660.50	Box	Concrete	0.61	0.61
967	0 (Polyline)-750	MH-616	MH-154	3.02	3.17	2.31	2.3	27.61	1.04	0.011	0.51	0.22	0.07	30.9	61.1	3,606.60	Box	Concrete	0.61	0.61
264	0 (Polyline)-744	MH-154	MH-155	3.17	3.11	2.3	2.29	7.11	1.44	0.011	0.64	0.22	0.16	74.4	61.9	9,095.40	Box	Concrete	0.61	0.61

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2605	EXI-745	MH-155	MH-232	3.11	3	2.29	2.27	50	1.8	0.011	0.75	0.36	0.31	84.2	59.9	17,492.00	Box	Concrete	0.91	0.61
383	EXI-746	MH-232	MH-233	3	2.95	2.27	2.24	14	1.48	0.011	1.22	0.69	0.32	45.8	59.3	19,333.30	Box	Concrete	0.91	0.61
2352	0 (Polyline)-756	MH-233	MH-335	2.95	3.03	2.24	2.22	50	2.16	0.011	0.84	0.52	0.48	92.3	55.3	29,706.50	Box	Concrete	1.22	0.61
539	0 (Polyline)-757	MH-335	O-11	3.03	2.67	2.22	1.29	21.7	1.47	0.011	4.17	4.84	0.64	13.3	83.2	41,892.00	Box	Concrete	1.22	0.61
2813	0 (Polyline)-707	MH-1751	MH-1752	3	3.19	2.29	2.26	50	1.38	0.011	0.62	0.22	0.15	67.8	46.9	7,416.40	Box	Concrete	0.61	0.61
4539	0 (Polyline)-708	MH-1752	MH-230	3.19	3.15	2.26	2.24	37.92	1.6	0.011	0.69	0.36	0.22	59.6	37.7	11,714.80	Box	Concrete	0.91	0.61
380	0 (Polyline)-709	MH-230	MH-231	3.15	2.74	2.24	1.41	22.69	1.08	0.011	3.05	3.12	0.24	7.8	62.4	13,730.70	Box	Concrete	0.91	0.61
3837	0 (Polyline)-698	MH-2258	MH-2047	3.05	2.7	2.34	1.99	50	0.88	0.011	1.56	0.81	0.13	15.8	44.3	6,456.80	Box	Concrete	0.61	0.61
3394	0 (Polyline)-699	MH-2047	MH-708	2.7	2.71	1.99	1.96	50	1.58	0.011	0.68	0.36	0.21	57.5	62.2	10,847.50	Box	Concrete	0.91	0.61
1108	0 (Polyline)-700	MH-708	MH-709	2.71	2.8	1.96	1.95	31.5	1.64	0.011	0.7	0.36	0.23	63.8	63.1	12,804.80	Box	Concrete	0.91	0.61
1716	0 (Polyline)-2198	MH-1098	MH-1099	3.17	2.95	2.46	2.24	50	0.9	0.011	1.28	0.64	0.11	17.5	29.7	5,688.10	Box	Concrete	0.61	0.61
3258	0 (Polyline)-2199	MH-1099	MH-1986	2.95	2.69	2.24	1.98	50	1	0.011	1.56	0.68	0.19	27.1	46.6	9,684.90	Box	Concrete	0.61	0.61
5269	0 (Polyline)-2200(1)	MH-1986	MH-709	2.69	2.8	1.98	1.95	23.12	1.39	0.011	1.05	0.64	0.23	35.7	60.9	12,287.10	Box	Concrete	0.91	0.61
5270	0 (Polyline)-2200(2)	MH-709	MH-2575	2.8	2.65	1.95	1.94	26.88	2.14	0.011	0.83	0.52	0.47	89.2	62.2	26,845.30	Box	Concrete	1.22	0.61
4583	0 (Polyline)-2201	MH-2575	MH-2048	2.65	2.72	1.94	1.91	50	2.19	0.011	0.85	0.52	0.5	95.8	53.2	29,681.00	Box	Concrete	1.22	0.61
3396	0 (Polyline)-2202	MH-2048	MH-427	2.72	2.66	1.91	1.65	50	1.68	0.011	2	1.7	0.56	32.6	54.3	34,798.90	Box	Concrete	1.22	0.61
680	0 (Polyline)-2203	MH-427	MH-428	2.66	2.81	1.65	1.56	19.58	1.71	0.011	1.9	2.75	0.57	20.8	47.7	36,813.70	Box	Concrete	1.22	0.91
258	0 (Polyline)-706	MH-151	MH-150	2.75	2.58	2.04	1.87	21.9	0.74	0.011	1.12	0.85	0.04	5.2	25.9	2,218.00	Box	Concrete	0.61	0.61
4515	0 (Polyline)-705	MH-150	MH-2343	2.58	2.79	1.87	1.86	35.06	1.21	0.011	0.58	0.22	0.11	49.3	35.5	5,478.30	Box	Concrete	0.61	0.61
5266	0 (Polyline)-704(2)	MH-2343	MH-428	2.79	2.81	1.86	1.56	41.95	0.93	0.011	1.71	0.81	0.17	20.7	55.8	9,101.30	Box	Concrete	0.61	0.61
5265	0 (Polyline)-704(1)	MH-428	MH-2257	2.81	2.7	1.56	1.55	19.45	2.5	0.011	0.94	0.92	0.73	79.2	52	47,340.20	Box	Concrete	1.22	0.91
3834	0 (Polyline)-703	MH-2257	MH-1922	2.7	2.44	1.55	1.43	38.6	1.88	0.011	1.82	2.3	0.74	32	57.4	48,764.50	Box	Concrete	1.22	0.91
5268	0 (Polyline)-702(2)	MH-1922	MH-231	2.44	2.74	1.43	1.41	40.74	2.55	0.011	0.95	0.92	0.77	83.6	63.1	51,724.20	Box	Concrete	1.22	0.91
5267	0 (Polyline)-702(1)	MH-231	MH-1740	2.74	2.71	1.41	1.4	14.77	2.79	0.011	1	1.22	0.97	79.6	62.2	66,812.90	Box	Concrete	1.52	0.91
2789	0 (Polyline)-701	MH-1740	O-10	2.71	2.21	1.4	-0.75	41.46	1.81	0.011	5.06	12.4	1.1	8.9	182.2	76,805.10	Box	Concrete	1.52	0.91
4146	0 (Polyline)-793	MH-2395	MH-1942	2.22	2.13	1.51	1.42	50.18	0.84	0.011	0.77	0.43	0.05	12.8	98.8	2,766.70	Box	Concrete	0.61	0.61
3178	0 (Polyline)-794	MH-1942	MH-1943	2.13	2.14	1.42	1.39	50	1.34	0.011	0.37	0.22	0.14	63.3	107.9	7,301.30	Box	Concrete	0.61	0.61
4014	0 (Polyline)-795	MH-1943	MH-2232	2.14	2.4	1.39	1.37	50	1.54	0.011	0.5	0.22	0.19	86.8	109.6	11,293.70	Box	Concrete	0.61	0.61
3783	0 (Polyline)-796	MH-2232	MH-1981	2.4	2.22	1.37	1.34	50	1.61	0.011	0.4	0.36	0.22	61.1	111.4	14,745.60	Box	Concrete	0.91	0.61
3250	0 (Polyline)-797	MH-1981	MH-1982	2.22	2.43	1.34	1.32	50	1.7	0.011	0.47	0.36	0.26	71.5	113.7	18,631.20	Box	Concrete	0.91	0.61
3979	0 (Polyline)-798	MH-1982	MH-304	2.43	2	1.32	1.29	55.54	1.78	0.011	0.5	0.34	0.28	80.7	115.4	21,412.70	Box	Concrete	0.91	0.61
3702	0 (Polyline)-2011	MH-3112	MH-2191	3.22	2.91	2.17	2.15	61.56	1.13	0.011	0.21	0.19	0.08	40.4	114.1	3,986.40	Box	Concrete	0.61	0.61
4401	0 (Polyline)-2012	MH-2191	MH-1760	2.91	2.91	2.2	2.17	50	1.52	0.011	0.49	0.22	0.18	83.6	108.2	11,885.80	Box	Concrete	0.61	0.61
2830	0 (Polyline)-2013	MH-1760	MH-650	2.91	3.07	2.27	2.2	50	1.5	0.011	1.12	0.37	0.3	81.5	96	21,339.00	Box	Concrete	0.61	0.61
10010	0 (Polyline)-2014(1)	MH-650	MH-3113	3.07	3.07	2.32	2.28	25.59	1.61	0.011	1.22	0.39	0.37	95.1	79.1	27,001.20	Box	Concrete	0.61	0.61
10011	0 (Polyline)-2014(2)	MH-3113	MH-1772	3.07	3.07	2.28	2.25	11.21	1.51	0.011	1.45	0.48	0.4	82.9	79.2	29,223.60	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
10014	0 (Polyline)-791(2)	MH-1772	MH-3114	3.07	3.01	2.36	1.89	49.39	1.19	0.011	2.49	0.94	0.44	46.5	79.7	32,375.30	Box	Concrete	0.61	0.61
10016	CO-439	MH-3114	MH-3115	3.01	3.29	2.2	1.8	46.41	1.32	0.011	2.3	1.45	0.43	29.8	55	32,375.30	Box	Concrete	0.9	0.6
10018	CO-440	MH-3115	MH-3116	3.29	2.91	1.8	1.7	55	1.66	0.011	1.35	0.67	0.46	69.3	56.1	34,976.00	Box	Concrete	0.9	0.6
10019	CO-441	MH-3116	MH-304	2.91	2	1.7	1.29	46.09	1.33	0.011	2.38	1.47	0.46	31.5	84	36,062.20	Box	Concrete	0.9	0.6
492	0 (Polyline)-799	MH-304	MH-305	2	2.28	1.29	1.27	6.6	1.68	0.011	1.27	1.03	0.71	68.9	120	58,198.90	Box	Concrete	0.91	0.61
1578	0 (Polyline)-760	MH-1012	MH-1011	3.49	3.58	2.78	2.76	38.38	1.07	0.011	0.53	0.22	0.07	34.3	55.7	3,752.10	Box	Concrete	0.61	0.61
1299	0 (Polyline)-770	MH-835	MH-834	3.72	3.72	3.01	3	37.89	1.53	0.011	0.66	0.22	0.18	84.9	65.6	9,285.10	Box	Concrete	0.61	0.61
3473	0 (Polyline)-769	MH-834	MH-1734	3.72	3.64	3	2.93	48.97	1.48	0.011	1.09	0.36	0.29	79.3	58.1	15,275.00	Box	Concrete	0.61	0.61
5280	0 (Polyline)-768(2)	MH-1734	MH-1011	3.64	3.58	2.93	2.76	3.03	0.86	0.011	4.32	2.28	0.34	14.7	54.1	18,477.10	Box	Concrete	0.61	0.61
5279	0 (Polyline)-768(1)	MH-1011	MH-1733	3.58	3.55	2.76	2.73	48.04	2.11	0.011	0.82	0.52	0.45	85.2	49.8	24,600.50	Box	Concrete	1.22	0.61
4727	0 (Polyline)-767	MH-1733	MH-2628	3.55	3.14	2.73	2.43	50	1.63	0.011	2.03	1.81	0.51	28.1	46.5	29,658.10	Box	Concrete	1.22	0.61
4859	0 (Polyline)-766	MH-2628	MH-2231	3.14	2.95	2.43	1.94	50	1.63	0.011	2.59	2.33	0.65	27.8	70.9	38,506.50	Box	Concrete	1.22	0.61
3779	0 (Polyline)-765	MH-2231	MH-2230	2.95	3.42	1.94	1.91	50	2.56	0.011	0.95	0.92	0.78	84.2	60	46,936.70	Box	Concrete	1.22	0.91
5377	0 (Polyline)-764(2)	MH-2230	MH-2662	3.42	3	1.91	1.89	44.41	2.59	0.011	0.96	0.92	0.8	87.2	56.6	51,169.10	Box	Concrete	1.22	0.91
964	0 (Polyline)-748	MH-615	MH-614	3.15	3.19	2.44	2.43	27.56	0.87	0.011	0.41	0.22	0.03	14.8	18.6	1,623.80	Box	Concrete	0.61	0.61
4832	0 (Polyline)-747	MH-614	MH-2662	3.19	3	2.43	1.89	50	0.76	0.011	1.47	1	0.07	6.9	49.6	3,724.30	Box	Concrete	0.61	0.61
5378	0 (Polyline)-764(1)(1)	MH-2662	MH-2380	3	2.94	1.89	1.89	5.61	2.67	0.011	0.97	1.22	0.84	69.3	54.3	56,225.50	Box	Concrete	1.52	0.91
877	0 (Polyline)-752	MH-558	MH-557	3.15	3.14	2.44	2.43	25.37	0.8	0.011	0.38	0.23	0.02	9.8	14.3	1,138.50	Box	Concrete	0.61	0.61
4458	0 (Polyline)-751	MH-557	MH-2380	3.14	2.94	2.43	1.89	50.05	0.73	0.011	1.28	1	0.05	4.6	47.3	2,464.00	Box	Concrete	0.61	0.61
4238	0 (Polyline)-763	MH-2380	MH-2424	2.94	3.41	1.89	1.86	50	2.73	0.011	0.98	1.22	0.9	74.2	52.3	60,350.80	Box	Concrete	1.52	0.91
4215	0 (Polyline)-762	MH-2424	MH-2406	3.41	3.05	1.86	1.84	50	2.73	0.011	0.98	1.22	0.9	74.2	43.7	62,234.00	Box	Concrete	1.52	0.91
5375	0 (Polyline)-761(2)	MH-2406	MH-305	3.05	2.28	1.84	1.27	43.68	1.92	0.011	3.06	6.22	0.94	15	59.2	66,575.30	Box	Concrete	1.52	0.91
5374	0 (Polyline)-761(1)	MH-305	O-112	2.28	2	1.27	1.26	7.53	3.65	0.011	0.95	1.53	1.59	103.8	81.2	1,31,122.90	Box	Concrete	1.83	0.91
2606	0 (Polyline)-887	MH-1636	MH-295	2.49	2.64	1.78	1.22	47.21	0.85	0.011	1.91	1.05	0.14	13	77.1	6,942.00	Box	Concrete	0.61	0.61
2280	0 (Polyline)-886	MH-1447	MH-183	2.56	2.54	1.85	1.22	44.61	0.69	0.011	1.19	1.14	0.03	2.6	73.9	1,520.30	Box	Concrete	0.61	0.61
4944	0 (Polyline)-2015	MH-2696	MH-364	3.27	3.5	2.56	2.54	50	1.39	0.011	0.63	0.22	0.15	69.4	39.8	7,590.40	Box	Concrete	0.61	0.61
583	0 (Polyline)-2016	MH-364	MH-365	3.5	3.28	2.54	2.29	15.66	0.85	0.011	2.23	1.22	0.16	13.1	43.6	8,646.40	Box	Concrete	0.61	0.61
2655	0 (Polyline)-2187	MH-1664	MH-1582	3.43	3.16	2.72	2.45	50	1.08	0.011	1.72	0.71	0.24	34.7	48.1	12,379.80	Box	Concrete	0.61	0.61
2510	0 (Polyline)-2188	MH-1582	MH-1533	3.16	3.01	2.45	2.3	50	1.28	0.011	1.48	0.53	0.3	56.1	56.5	15,525.80	Box	Concrete	0.61	0.61
5388	0 (Polyline)-2189(1)	MH-1533	MH-365	3.01	3.28	2.3	2.29	20.94	1.81	0.011	0.76	0.36	0.31	85.6	57.1	16,579.90	Box	Concrete	0.91	0.61
5389	0 (Polyline)-2189(2)	MH-365	MH-1534	3.28	3.29	2.29	2.27	29.08	2.15	0.011	0.84	0.52	0.47	90.4	50.5	25,801.30	Box	Concrete	1.22	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
3901	0 (Polyline)-2190	MH-1534	MH-1407	3.29	3.16	2.27	2.15	50	1.77	0.011	1.47	1.14	0.49	43.2	44.9	27,786.60	Box	Concrete	1.22	0.61
5380	0 (Polyline)-2191(1)	MH-1407	MH-2669	3.16	3.19	2.15	1.61	37.29	1.54	0.011	2.78	4.98	0.54	10.9	45.2	31,479.70	Box	Concrete	1.22	0.91
3499	0 (Polyline)-771	MH-2096	MH-2097	3.85	3.67	3.14	2.96	50	1.17	0.011	1.53	0.58	0.26	44.7	55	13,213.30	Box	Concrete	0.61	0.61
3635	0 (Polyline)-772	MH-2097	MH-1022	3.67	3.54	2.96	2.83	50	1.4	0.011	1.43	0.49	0.34	70	61	17,860.20	Box	Concrete	0.61	0.61
1596	0 (Polyline)-773	MH-1022	MH-1023	3.54	3.32	2.83	2.61	50	1.32	0.011	1.82	0.64	0.39	60.8	57.8	20,962.40	Box	Concrete	0.61	0.61
3976	0 (Polyline)-774	MH-1023	MH-2319	3.32	3.4	2.61	2.58	50	2.11	0.011	0.82	0.52	0.45	85.8	51.9	24,598.70	Box	Concrete	1.22	0.61
4878	0 (Polyline)-775	MH-2319	MH-954	3.4	3.03	2.58	2.32	50	1.69	0.011	2.01	1.69	0.57	33.7	49.2	32,969.40	Box	Concrete	1.22	0.61
1487	0 (Polyline)-776	MH-954	MH-144	3.03	2.8	2.32	2.09	50	1.77	0.011	2.04	1.59	0.69	43.4	53.9	40,775.70	Box	Concrete	1.22	0.61
249	0 (Polyline)-777	MH-144	MH-145	2.8	2.74	2.09	1.73	17.09	1.57	0.011	3.48	3.37	0.75	22.3	75.3	45,467.80	Box	Concrete	1.22	0.61
2206	0 (Polyline)-788	MH-145	MH-1400	2.74	3.41	1.73	1.71	39.6	2.65	0.011	0.97	0.92	0.84	91.6	62.6	51,265.90	Box	Concrete	1.22	0.91
2287	0 (Polyline)-789	MH-1400	MH-951	3.41	3.4	1.71	1.69	44.67	2.72	0.011	0.98	1.22	0.9	73.6	61	56,647.50	Box	Concrete	1.52	0.91
1482	0 (Polyline)-790	MH-951	MH-952	3.4	3.28	1.69	1.67	37.81	2.73	0.011	0.99	1.22	0.91	74.8	60.2	60,288.90	Box	Concrete	1.52	0.91
5382	0 (Polyline)-2010(1)	MH-952	MH-2307	3.28	3.53	1.67	1.66	31.46	2.86	0.011	0.97	1.53	0.91	59.8	60	62,074.70	Box	Concrete	1.83	0.91
4007	0 (Polyline)-2009	MH-2307	MH-2331	3.53	3.56	1.66	1.63	50	2.89	0.011	0.98	1.53	0.95	62.2	60.3	65,897.70	Box	Concrete	1.83	0.91
4852	0 (Polyline)-2008	MH-2331	MH-2669	3.56	3.19	1.63	1.61	50	2.92	0.011	0.99	1.53	1	65.1	60.4	71,168.20	Box	Concrete	1.83	0.91
5381	0 (Polyline)-2191(2)	MH-2669	MH-1408	3.19	3.27	1.61	1.6	17.77	3.24	0.011	1.1	2.32	1.42	61.2	44.5	1,04,916.80	Box	Concrete	1.83	1.22
4088	0 (Polyline)-2192	MH-1408	MH-2367	3.27	2.96	1.6	1.57	45	3.25	0.011	1.1	2.32	1.44	61.9	40.3	1,07,098.30	Box	Concrete	1.83	1.22
4742	0 (Polyline)-2193	MH-2367	MH-182	2.96	2.84	1.57	1.52	30.81	2.74	0.011	1.72	4.34	1.44	33.2	34.8	1,10,385.20	Box	Concrete	1.83	1.22
306	0 (Polyline)-2194	MH-182	MH-183	2.84	2.54	1.52	1.22	27.06	2.33	0.011	3.2	10.86	1.45	13.4	47.8	1,12,629.80	Box	Concrete	1.83	1.22
670	0 (Polyline)-890	MH-183	MH-295	2.54	2.64	1.22	1.22	18.38	3.28	0.011	1.11	2.32	1.48	63.7	62.8	1,15,329.70	Box	Concrete	1.83	1.22
477	0 (Polyline)-889	MH-295	MH-294	2.64	2.65	1.22	1.2	28.28	3.34	0.011	1.13	2.32	1.56	67.4	62.9	1,23,451.70	Box	Concrete	1.83	1.22
4295	0 (Polyline)-888	MH-294	O-111	2.65	2	1.2	-1.65	33.59	2.1	0.011	6.36	30.24	1.57	5.2	181	1,26,473.40	Box	Concrete	1.83	1.22
4646	0 (Polyline)-845	MH-2600	MH-1069	3.08	3.13	2.37	2.34	50	1.69	0.011	0.72	0.36	0.25	70.1	58.6	12,896.80	Box	Concrete	0.91	0.61
1670	0 (Polyline)-846	MH-1069	MH-1070	3.13	3.29	2.34	2.32	39.7	1.78	0.011	0.74	0.36	0.29	80.8	55.9	15,737.30	Box	Concrete	0.91	0.61
3014	0 (Polyline)-2100	MH-1856	MH-1857	3.53	3.22	2.82	2.51	49.03	0.8	0.011	1.23	0.76	0.07	9.3	19.5	3,558.20	Box	Concrete	0.61	0.61
5390	0 (Polyline)-891(1)	MH-2163	MH-1857	3.34	3.22	2.63	2.51	19.26	0.66	0.011	0.58	0.74	0.01	1.3	12.9	479	Box	Concrete	0.61	0.61
5392	0 (Polyline)-891(2)(1)	MH-1857	MH-1070	3.22	3.29	2.51	2.32	4.57	0.73	0.011	2.47	1.97	0.09	4.4	37.4	4,565.40	Box	Concrete	0.61	0.61
5393	0 (Polyline)-891(2)(2)	MH-1070	MH-2164	3.29	3.1	2.32	2.31	26.18	2	0.011	0.78	0.52	0.37	71.6	52.7	21,008.20	Box	Concrete	1.22	0.61
4412	0 (Polyline)-892	MH-2164	MH-1963	3.1	2.98	2.31	2.27	50	1.92	0.011	0.97	0.68	0.41	60.3	47	23,845.60	Box	Concrete	1.22	0.61
3213	0 (Polyline)-893	MH-1963	MH-824	2.98	2.76	2.27	2.05	50	1.67	0.011	1.82	1.55	0.5	32.5	43.7	30,620.30	Box	Concrete	1.22	0.61
1284	0 (Polyline)-894	MH-824	MH-825	2.76	2.91	2.05	1.59	35.35	1.55	0.011	2.67	2.66	0.55	20.5	60.3	33,975.80	Box	Concrete	1.22	0.61
9122	CO-230	MH-2962	MH-2963	3.84	4	3.13	3.1	65.6	1.31	0.011	0.61	0.22	0.13	60	47.7	6,566.70	Box	Concrete	0.61	0.61
9124	EX	MH-2963	MH-2964	4	3.85	3.1	3.05	97.07	1.26	0.011	0.59	0.22	0.12	54.9	38.9	6,566.70	Box	Concrete	0.61	0.61
9128	EX	MH-2964	MH-2965	3.85	3.48	3.05	2.24	71.56	0.88	0.011	2	1.03	0.17	16.2	63.2	10,717.00	Box	Concrete	0.61	0.61
604	0 (Polyline)-827	MH-379	MH-378	4.09	3.87	3.38	3.16	15.88	0.67	0.011	1.01	1.13	0.02	1.7	45.7	994.6	Box	Concrete	0.61	0.61
2182	0 (Polyline)-826	MH-378	MH-1385	3.87	4.34	3.16	3.14	50	1.34	0.011	0.61	0.22	0.14	63.6	64.1	7,046.40	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
4777	0 (Polyline)-825	MH-1385	MH-1936	4.34	4.54	3.14	3.11	50	1.75	0.011	0.74	0.36	0.28	78	63.8	15,536.90	Box	Concrete	0.91	0.61
3166	0 (Polyline)-824	MH-1936	MH-1134	4.54	4.2	3.11	3.09	50	2.08	0.011	0.81	0.52	0.43	81.8	62.1	24,929.40	Box	Concrete	1.22	0.61
1775	0 (Polyline)-823	MH-1134	MH-810	4.2	3.99	3.09	3.04	50	2.05	0.011	1.08	0.7	0.55	77.6	55	33,713.70	Box	Concrete	1.22	0.61
1261	0 (Polyline)-822	MH-810	MH-809	3.99	3.65	3.06	2.64	50	1.61	0.011	2.34	2.14	0.56	26.3	46	36,487.00	Box	Concrete	1.22	0.61
4902	0 (Polyline)-821	MH-809	MH-2503	3.65	3.65	2.64	2.34	50	1.66	0.011	2.12	3.22	0.57	17.8	47.7	37,848.20	Box	Concrete	1.22	0.91
4413	0 (Polyline)-820	MH-2503	MH-2502	3.65	3.72	2.34	2.31	49.97	2.37	0.011	0.9	0.92	0.63	68.6	64.4	42,419.70	Box	Concrete	1.22	0.91
4747	0 (Polyline)-819	MH-2502	MH-2530	3.72	3.58	2.31	2.29	32.44	2.4	0.011	0.91	0.92	0.66	71.2	64.4	45,557.80	Box	Concrete	1.22	0.91
5395	0 (Polyline)-818(2)	MH-2530	MH-125	3.58	3.64	2.29	2.28	21.06	2.41	0.011	0.91	0.92	0.66	71.7	64.4	46,864.60	Box	Concrete	1.22	0.91
4732	0 (Polyline)-828	MH-2629	MH-2116	3.25	3.65	2.54	2.52	50	0.85	0.011	0.39	0.22	0.03	13.3	73.3	1,454.00	Box	Concrete	0.61	0.61
3537	0 (Polyline)-829	MH-2116	MH-2036	3.65	3.37	2.52	2.49	50	1.27	0.011	0.6	0.22	0.12	55.9	76.5	6,798.20	Box	Concrete	0.61	0.61
3369	0 (Polyline)-830	MH-2036	MH-1306	3.37	3.49	2.49	2.47	50	1.58	0.011	0.68	0.36	0.2	56.4	79.2	12,456.30	Box	Concrete	0.91	0.61
2050	0 (Polyline)-831	MH-1306	MH-1307	3.49	3.37	2.47	2.44	50	1.69	0.011	0.72	0.36	0.25	69.9	81.6	16,594.50	Box	Concrete	0.91	0.61
2925	0 (Polyline)-832	MH-1307	MH-1811	3.37	3.69	2.44	2.42	50	2.04	0.011	0.8	0.52	0.4	75.7	83.7	27,190.00	Box	Concrete	1.22	0.61
3971	0 (Polyline)-833	MH-1811	MH-2317	3.69	3.89	2.42	2.39	50	2.17	0.011	0.84	0.52	0.49	93.2	85.2	34,784.20	Box	Concrete	1.22	0.61
4217	0 (Polyline)-834	MH-2317	MH-2351	3.89	3.91	2.39	2.37	50	2.27	0.011	0.87	0.92	0.56	61	57.4	41,618.10	Box	Concrete	1.22	0.91
4048	0 (Polyline)-835	MH-2351	MH-125	3.91	3.64	2.37	2.28	56.13	1.97	0.011	1.31	1.58	0.6	38.1	60.9	46,252.50	Box	Concrete	1.22	0.91
5394	0 (Polyline)-818(1)	MH-125	MH-2482	3.64	3.53	2.28	2.26	46.56	3.07	0.011	1.05	1.53	1.19	77.4	64.1	93,997.40	Box	Concrete	1.83	0.91
5397	0 (Polyline)-817(2)	MH-2482	MH-92	3.53	3.49	2.26	2.24	31.6	3.06	0.011	1.04	1.53	1.17	76.5	63.6	95,382.20	Box	Concrete	1.83	0.91
4696	0 (Polyline)-837	MH-2618	MH-2603	3.67	3.7	2.96	2.93	50	1.29	0.011	0.6	0.22	0.13	58	61.9	6,345.50	Box	Concrete	0.61	0.61
4655	0 (Polyline)-838	MH-2603	MH-2129	3.7	3.67	2.93	2.91	50	1.65	0.011	0.7	0.36	0.24	65.1	62.7	12,826.30	Box	Concrete	0.91	0.61
3567	0 (Polyline)-839	MH-2129	MH-2034	3.67	3.65	2.91	2.88	50	1.62	0.011	0.69	0.36	0.22	61.2	63.4	12,826.30	Box	Concrete	0.91	0.61
3365	0 (Polyline)-840	MH-2034	MH-2035	3.65	3.84	2.88	2.86	50	1.82	0.011	0.76	0.36	0.31	86.4	62.2	19,382.40	Box	Concrete	0.91	0.61
3493	0 (Polyline)-841	MH-2035	MH-2093	3.84	3.59	2.86	2.83	50	2.04	0.011	0.8	0.52	0.4	76.4	59.4	26,357.80	Box	Concrete	1.22	0.61
4086	0 (Polyline)-842	MH-2093	MH-2366	3.59	3.97	2.83	2.81	50	2.13	0.011	0.83	0.52	0.46	88.7	49.2	31,854.40	Box	Concrete	1.22	0.61
4250	0 (Polyline)-843	MH-2366	MH-92	3.97	3.49	2.81	2.24	54.52	1.54	0.011	2.32	2.38	0.45	18.8	66.9	31,854.40	Box	Concrete	1.22	0.61
9126	0 (Polyline)-817(1)(1)	MH-92	MH-2965	3.49	3.48	2.24	2.24	6.16	3.44	0.011	1.11	1.84	1.56	84.6	63.3	1,28,562.80	Box	Concrete	2.13	0.91
9127	0 (Polyline)-817(1)(2)	MH-2965	MH-2481	3.48	3.48	2.24	2.23	22.87	3.52	0.011	1.14	1.84	1.68	91.5	62.4	1,39,279.80	Box	Concrete	2.13	0.91
4622	0 (Polyline)-816	MH-2481	MH-2591	3.48	3.31	2.23	2.21	39.39	3.51	0.011	1.14	1.84	1.68	91.4	60	1,40,501.90	Box	Concrete	2.13	0.91
4774	0 (Polyline)-815	MH-2591	MH-2639	3.31	3.28	2.21	2.19	47.2	3.52	0.011	1.14	1.84	1.69	91.8	51.3	1,43,495.50	Box	Concrete	2.13	0.91
4930	0 (Polyline)-814	MH-2639	MH-2692	3.28	3.03	2.19	2.02	44.83	2.84	0.011	2.26	4.94	1.71	34.6	53.3	1,48,360.60	Box	Concrete	2.13	0.91
5009	0 (Polyline)-813	MH-2692	MH-2556	3.03	3.15	2.02	2	43.09	3.55	0.011	1.15	1.84	1.74	94.9	60.1	1,52,884.60	Box	Concrete	2.13	0.91

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4536	0 (Polyline)-812	MH-2556	MH-2555	3.15	2.95	2	1.94	64.88	3.28	0.011	1.43	2.49	1.75	70.4	51.4	1,56,413.30	Box	Concrete	2.13	0.91
4866	0 (Polyline)-811	MH-2555	MH-825	2.95	2.91	1.94	1.59	49.65	2.7	0.011	2.84	6.94	1.73	25	47.8	1,58,490.80	Box	Concrete	2.13	0.91
4860	0 (Polyline)-810	MH-825	MH-2593	2.91	3.01	1.59	1.38	50.35	2.91	0.011	2.54	8.11	2.1	25.9	47	1,93,676.10	Box	Concrete	2.13	1.22
4626	0 (Polyline)-809	MH-2593	MH-2592	3.01	4.02	1.38	1.35	50	3.76	0.011	1.21	2.81	2.1	74.9	55	1,96,259.20	Box	Concrete	2.13	1.22
5033	0 (Polyline)-808	MH-2592	O-110	4.02	4.21	1.35	-0.86	34.15	2.45	0.011	6.21	31.99	2.12	6.6	147.6	2,00,823.30	Box	Concrete	2.13	1.22
4270	0 (Polyline)-2244	MH-2444	MH-312	2.85	2.49	2.14	1.78	50	0.69	0.011	0.81	0.82	0.02	2.3	24.8	954.8	Box	Concrete	0.61	0.61
504	0 (Polyline)-2245	MH-312	MH-313	2.49	2.77	1.78	1.76	13.15	0.79	0.011	0.51	0.32	0.03	8.5	43.2	1,460.60	Box	Concrete	0.61	0.61
5026	0 (Polyline)-2240	MH-2723	MH-2452	3.93	3.7	3	2.8	50	1.46	0.011	1.23	2.6	0.18	6.9	19.2	9,078.80	Box	Concrete	1.22	0.91
4289	0 (Polyline)-2241	MH-2452	MH-2453	3.7	4.04	2.8	2.6	50	1.56	0.011	1.5	2.6	0.31	11.9	36	16,189.30	Box	Concrete	1.22	0.91
4794	0 (Polyline)-2242	MH-2453	MH-1164	4.04	3.51	2.6	2.3	50	1.58	0.011	1.88	3.19	0.41	12.8	64.8	21,999.80	Box	Concrete	1.22	0.91
5402	0 (Polyline)-2243(1)	MH-1164	MH-313	3.51	2.77	2.8	1.76	18.57	1.41	0.011	4.02	9.73	0.46	4.7	28.2	25,223.40	Box	Concrete	1.22	0.91
5403	0 (Polyline)-2243(2)	MH-313	O-113	2.77	2	1.76	1.25	20.49	1.49	0.011	3.3	6.53	0.54	8.2	56.2	29,721.90	Box	Concrete	1.22	0.91
9872	0 (Polyline)-1076(1)	MH-3098	MH-1748	3.35	3.39	2.33	2.3	39.23	1.18	0.011	0.3	0.24	0.11	45.3	119.2	5,592.50	Box	Concrete	0.61	0.61
2807	0 (Polyline)-1075	MH-1748	MH-1747	3.39	3.06	2.35	2.33	50	1.18	0.011	0.27	0.22	0.1	45.8	114.2	5,592.50	Box	Concrete	0.61	0.61
3539	0 (Polyline)-1074	MH-1747	MH-2117	3.06	3.25	2.54	2.35	50	0.95	0.011	1.23	0.59	0.12	20.2	96	8,006.20	Box	Concrete	0.61	0.61
3271	0 (Polyline)-1056	MH-1990	MH-1931	3.36	3.28	2.37	2.35	50	0.92	0.011	0.11	0.22	0.04	19.3	114.3	2,112.50	Box	Concrete	0.61	0.61
3155	0 (Polyline)-1055	MH-1931	MH-585	3.28	3.15	2.4	2.37	50	1.23	0.011	0.23	0.22	0.08	39.1	109.6	6,133.80	Box	Concrete	0.61	0.61
918	0 (Polyline)-1054	MH-585	MH-584	3.15	3.13	2.42	2.4	42.8	1.44	0.011	0.31	0.22	0.12	53.9	104.2	9,689.60	Box	Concrete	0.61	0.61
9877	CO-397	MH-584	MH-2117	3.13	3.25	2.42	2.54	6.52	1.04	0.011	0.39	1.25	0.14	11.4	92.4	12,648.90	Box	Concrete	0.6	0.6
9878	CO-398	MH-2117	MH-2594	3.25	3.24	2.54	2.51	21.6	1.62	0.011	1.01	0.33	0.24	72.1	81.2	21,643.40	Box	Concrete	0.6	0.6
4632	0 (Polyline)-2109	MH-2594	MH-2595	3.24	3.59	2.53	2.45	50	1.62	0.011	1.1	0.38	0.26	70	72.9	24,011.00	Box	Concrete	0.61	0.61
5001	0 (Polyline)-2110	MH-2595	MH-2312	3.59	2.85	2.5	2.14	50	1.24	0.011	2.06	0.82	0.32	38.6	69.7	29,324.40	Box	Concrete	0.61	0.61
3958	0 (Polyline)-2111	MH-2312	MH-353	2.85	3.37	2.16	2.12	50	2.13	0.011	0.98	0.47	0.39	83.6	67.6	37,109.40	Box	Concrete	0.91	0.61
566	0 (Polyline)-2112	MH-353	O-115	3.37	2.05	2.12	2.11	11.44	2.44	0.011	0.82	0.52	0.45	86.1	53.7	43,186.30	Box	Concrete	1.22	0.61
1170	0 (Polyline)-1049	MH-749	MH-750	3.05	3.07	2.34	2.21	33.28	0.9	0.011	1.21	0.61	0.11	17.4	47.2	5,355.40	Box	Concrete	0.61	0.61
4022	0 (Polyline)-1050	MH-2339	MH-2016	2.97	3.51	2.26	2.23	50	1.44	0.011	0.64	0.22	0.16	75.2	59	8,224.50	Box	Concrete	0.61	0.61
3323	0 (Polyline)-1051	MH-2016	MH-750	3.51	3.07	2.23	2.21	48.87	1.62	0.011	0.69	0.36	0.22	61.6	57.9	12,086.30	Box	Concrete	0.91	0.61
2594	0 (Polyline)-1052	MH-750	MH-282	3.07	2.94	2.21	2.18	51.13	1.97	0.011	0.77	0.52	0.35	67.8	57.2	20,363.30	Box	Concrete	1.22	0.61
459	0 (Polyline)-1053	MH-282	MH-283	2.94	3.07	2.18	2.06	12.69	1.5	0.011	2.11	2.31	0.36	15.6	67.7	21,985.70	Box	Concrete	1.22	0.61
1604	0 (Polyline)-1027	MH-1027	MH-1028	3.69	3.29	2.98	2.58	50	0.77	0.011	1.31	0.87	0.07	7.5	26.9	3,312.30	Box	Concrete	0.61	0.61
3476	0 (Polyline)-1028	MH-1028	MH-1241	3.29	3.12	2.58	2.41	50	1.05	0.011	1.33	0.56	0.18	32.5	43.1	9,452.20	Box	Concrete	0.61	0.61
5474	0 (Polyline)-1029(1)	MH-1241	MH-2498	3.12	3.03	2.41	2.32	29.4	1.17	0.011	1.4	0.54	0.24	44.5	54.4	12,886.70	Box	Concrete	0.61	0.61
3873	0 (Polyline)-1047	MH-62	MH-2273	3.2	3.15	2.49	2.44	53.48	1.02	0.011	0.69	0.29	0.09	29.5	43.6	4,397.50	Box	Concrete	0.61	0.61
4402	0 (Polyline)-1046	MH-2273	MH-2498	3.15	3.03	2.44	2.32	50	1.08	0.011	1.14	0.46	0.16	35.5	52.4	8,889.70	Box	Concrete	0.61	0.61
5475	0 (Polyline)-1029(2)	MH-2498	MH-1242	3.03	2.87	2.32	2.16	20.6	1.2	0.011	2.28	0.86	0.41	48.1	63.8	23,122.10	Box	Concrete	0.61	0.61
2495	0 (Polyline)-1030	MH-1242	MH-1460	2.87	2.92	2.16	2.13	50	2.11	0.011	0.82	0.52	0.45	85.7	68	25,342.60	Box	Concrete	1.22	0.61

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5476	0 (Polyline)-1031(1)	MH-1460	MH-283	2.92	3.07	2.13	2.06	28.5	1.75	0.011	1.5	1.19	0.48	40.2	73.1	28,632.10	Box	Concrete	1.22	0.61
5477	0 (Polyline)-1031(2)	MH-283	MH-1461	3.07	3.05	2.06	1.98	21.52	1.9	0.011	2.03	2.54	0.83	32.9	57.6	51,257.00	Box	Concrete	1.22	0.91
3961	0 (Polyline)-1032	MH-1461	MH-2313	3.05	3.26	1.98	1.95	50	2.68	0.011	0.97	0.92	0.87	94.1	60	53,787.70	Box	Concrete	1.22	0.91
4051	0 (Polyline)-1033	MH-2313	MH-327	3.26	3.33	1.95	1.93	50	2.71	0.011	0.98	1.22	0.88	72.6	56.8	57,725.10	Box	Concrete	1.52	0.91
527	0 (Polyline)-1034	MH-327	MH-328	3.33	3.55	1.93	1.92	13.54	2.7	0.011	0.97	1.22	0.87	71.7	55.7	59,160.40	Box	Concrete	1.52	0.91
4786	0 (Polyline)-1035	MH-2645	MH-2246	3.46	3.58	2.75	2.73	50	1.2	0.011	0.57	0.22	0.1	47.5	57.8	5,190.90	Box	Concrete	0.61	0.61
3812	0 (Polyline)-1036	MH-2246	MH-1352	3.58	3.66	2.73	2.7	50	1.47	0.011	0.64	0.22	0.17	78.2	56.7	9,182.60	Box	Concrete	0.61	0.61
2129	0 (Polyline)-1037	MH-1352	MH-1353	3.66	3.35	2.7	2.64	39.18	1.27	0.011	1.07	0.39	0.22	55.4	55.2	12,582.40	Box	Concrete	0.61	0.61
3345	EX	MH-1353	MH-1977	3.35	3.5	2.64	2.6	67.88	2.06	0.019	0.46	0.3	0.24	78.1	52	14,259.90	Box	Concrete	1.22	0.61
9101	0 (Polyline)-1039(1)	MH-1977	MH-2958	3.5	3.5	2.6	2.6	13.69	2.07	0.019	0.47	0.3	0.24	79.7	46.8	16,509.80	Box	Concrete	1.22	0.61
9102	0 (Polyline)-1039(2)	MH-2958	MH-161	3.5	3.53	2.6	2.37	36.78	1.47	0.011	1.57	1.84	0.24	12.9	64.8	16,509.80	Box	Concrete	1.22	0.61
2681	0 (Polyline)-1739	MH-1679	MH-228	3.52	3.73	2.81	2.78	50	1.07	0.011	0.53	0.22	0.07	34.4	42.9	3,764.10	Box	Concrete	0.61	0.61
377	0 (Polyline)-1740	MH-228	MH-441	3.73	3.68	2.78	2.32	10.54	0.71	0.011	2.4	2.03	0.08	3.8	82.2	4,191.10	Box	Concrete	0.61	0.61
3620	0 (Polyline)-2257	MH-2154	MH-213	3.48	3.58	2.77	2.75	41.14	0.83	0.011	0.38	0.22	0.03	12.2	49.3	1,332.90	Box	Concrete	0.61	0.61
354	0 (Polyline)-2258	MH-213	MH-214	3.58	3.65	2.75	2.74	18.04	0.87	0.011	0.41	0.22	0.03	15.4	51.5	1,836.00	Box	Concrete	0.61	0.61
3409	0 (Polyline)-2115	MH-2054	MH-440	3.76	3.67	3.05	2.96	50	0.87	0.011	0.8	0.42	0.06	15.4	21.3	3,240.80	Box	Concrete	0.61	0.61
5508	0 (Polyline)-2116(1)	MH-440	MH-214	3.67	3.65	2.96	2.74	15.96	0.78	0.011	1.73	1.13	0.09	7.8	36.6	4,682.30	Box	Concrete	0.61	0.61
5509	0 (Polyline)-2116(2)	MH-214	MH-441	3.65	3.68	2.74	2.74	3.86	1.26	0.011	0.59	0.22	0.12	53.9	52.2	6,695.60	Box	Concrete	0.61	0.61
5035	0 (Polyline)-2254	MH-2727	MH-1222	3.38	3.48	2.67	2.65	50	1.33	0.011	0.61	0.22	0.13	61.8	67.6	6,761.70	Box	Concrete	0.61	0.61
1914	0 (Polyline)-2255	MH-1222	MH-42	3.48	3.58	2.65	2.33	52.59	0.98	0.011	1.67	0.75	0.19	25.2	93.6	10,222.50	Box	Concrete	0.61	0.61
5504	0 (Polyline)-899(1)	MH-42	MH-1002	3.58	3.57	2.33	2.32	17.39	1.53	0.011	0.33	0.36	0.18	50.6	119.4	10,222.50	Box	Concrete	0.91	0.61
5507	0 (Polyline)-898(2)	MH-1002	MH-441	3.57	3.68	2.32	2.32	14.09	1.52	0.011	0.33	0.36	0.18	50	120.4	10,583.60	Box	Concrete	0.91	0.61
5506	0 (Polyline)-898(1)	MH-441	MH-1116	3.68	3.56	2.65	2.64	35.84	2.15	0.011	0.63	0.39	0.36	91.3	65.8	21,669.20	Box	Concrete	1.22	0.61
4330	0 (Polyline)-897	MH-1116	MH-270	3.56	3.5	2.64	2.63	39.39	2.2	0.011	0.61	0.37	0.36	97.4	64.5	23,318.40	Box	Concrete	1.22	0.61
10029	CO-443	MH-270	MH-3118	3.5	3.32	2.63	2.61	32.27	1.97	0.011	0.86	0.56	0.39	70.8	64.9	26,705.30	Box	Concrete	1.2	0.6
10030	CO-444	MH-3118	MH-3119	3.32	3	2.61	2.59	41.58	2.02	0.011	0.78	0.49	0.39	78.5	64.6	26,705.30	Box	Concrete	1.2	0.6
10031	CO-445	MH-3119	MH-3120	3	3	2.59	2.58	56.88	2.72	0.011	0.55	0.48	0.45	93.8	63.5	32,349.60	Box	Concrete	1.8	0.6
10032	CO-446	MH-3120	MH-2681	3	3.1	2.58	2.57	64.08	3.01	0.011	0.45	0.68	0.49	72.7	40.2	37,718.80	Box	Concrete	1.83	0.91
4898	0 (Polyline)-1041	MH-2681	MH-2627	3.1	3.17	2.57	2.46	60.68	2.27	0.011	1.22	2.92	0.49	16.7	44.7	40,662.30	Box	Concrete	1.83	0.91
4725	0 (Polyline)-1042	MH-2627	MH-1701	3.17	3.52	2.46	2.44	41.82	2.53	0.011	0.81	1.53	0.52	33.9	51.1	44,246.20	Box	Concrete	1.83	0.91
2720	0 (Polyline)-1043	MH-1701	MH-1702	3.52	3.38	2.44	2.42	50	2.55	0.011	0.83	1.53	0.54	35.6	52.6	47,665.70	Box	Concrete	1.83	0.91

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
3055	0 (Polyline)-1044	MH-1702	MH-998	3.38	3.49	2.42	2.39	50	2.56	0.011	0.83	1.53	0.56	36.5	54.3	50,396.30	Box	Concrete	1.83	0.91
1558	0 (Polyline)-1045	MH-998	MH-999	3.49	3.58	2.39	2.37	38.62	2.57	0.011	0.84	1.53	0.57	37.3	55.9	53,096.60	Box	Concrete	1.83	0.91
4846	EX (Polyline)-999	MH-2665	MH-2666	4	3.74	3.29	3.03	61.42	0.84	0.019	0.65	0.36	0.05	12.9	26.4	2,363.00	Box	Concrete	0.61	0.61
4864	EX (Polyline)-1000	MH-2666	MH-2672	3.74	3.62	3.03	2.91	38.8	1.02	0.019	0.74	0.32	0.09	29.3	31.5	5,071.20	Box	Concrete	0.61	0.61
5416	EX (Polyline)-1001(1)	MH-2672	MH-2691	3.62	3.6	2.91	2.59	33.49	0.94	0.019	1.15	0.54	0.12	21.2	52.7	6,603.60	Box	Concrete	0.61	0.61
868	0 (Polyline)-1738	MH-552	MH-551	3.72	3.72	3.01	3	25.19	0.94	0.011	0.46	0.22	0.05	21.2	29.3	2,314.00	Box	Concrete	0.61	0.61
4548	0 (Polyline)-1737	MH-551	MH-894	3.72	3.52	3	2.81	50	0.96	0.011	1.28	0.59	0.14	22.9	43.7	7,156.10	Box	Concrete	0.61	0.61
1393	0 (Polyline)-1736	MH-894	MH-893	3.52	3.8	2.81	2.78	50	1.58	0.011	0.68	0.36	0.21	57.2	58.2	11,366.30	Box	Concrete	0.91	0.61
1883	0 (Polyline)-1735	MH-893	MH-1202	3.8	3.69	2.78	2.76	50	1.84	0.011	0.76	0.36	0.32	88.7	53.3	18,820.40	Box	Concrete	0.91	0.61
4927	0 (Polyline)-1734	MH-1202	MH-2691	3.69	3.6	2.76	2.59	50	1.68	0.011	1.59	1.35	0.45	33.1	62.1	27,744.60	Box	Concrete	1.22	0.61
5417	EX (Polyline)-1001(2)	MH-2691	MH-2673	3.6	3.78	2.59	2.58	27.72	2.78	0.019	0.58	0.7	0.56	79	49.6	35,695.90	Box	Concrete	1.52	0.91
4920	EX (Polyline)-1002	MH-2673	MH-2685	3.78	3.8	2.58	2.55	50	2.8	0.019	0.58	0.7	0.56	80.1	42.9	37,761.50	Box	Concrete	1.52	0.91
5412	EX (Polyline)-1003(1)	MH-2685	MH-999	3.8	3.58	2.55	2.37	24.24	2.02	0.019	1.49	2.71	0.57	21	47.1	40,244.40	Box	Concrete	1.52	0.91
5414	EX (Polyline)-1003(2)(1	MH-999	MH-161	3.58	3.53	2.37	2.37	6.13	2.92	0.011	0.99	1.53	0.99	64.7	56.5	94,042.00	Box	Concrete	1.83	0.91
5415	EX (Polyline)-1003(2)(2	MH-161	MH-2641	3.53	3.43	2.37	2.36	19.63	3.2	0.011	1.02	1.84	1.17	63.5	56.4	1,11,101.00	Box	Concrete	2.13	0.91
4780	EX (Polyline)-1004	MH-2641	MH-2642	3.43	3.39	2.36	2.34	50	3.21	0.011	1.02	1.84	1.18	64	56	1,12,739.60	Box	Concrete	2.13	0.91
4913	EX (Polyline)-1005	MH-2642	MH-2687	3.39	3.48	2.34	2.31	50	3.21	0.011	1.03	1.84	1.19	64.5	55.2	1,15,950.50	Box	Concrete	2.13	0.91
4922	EX (Polyline)-1006	MH-2687	MH-2682	3.48	3.76	2.31	2.29	50	3.22	0.011	1.03	1.84	1.2	65.1	54.1	1,19,373.60	Box	Concrete	2.13	0.91
4900	EX (Polyline)-1007	MH-2682	MH-2567	3.76	3.81	2.29	2.26	50	3.23	0.011	1.03	1.84	1.21	65.6	52.4	1,22,767.10	Box	Concrete	2.13	0.91
4565	EX (Polyline)-1008	MH-2567	MH-2538	3.81	4.18	2.26	2.24	50	3.23	0.011	1.04	1.84	1.22	66.1	49.8	1,26,280.90	Box	Concrete	2.13	0.91
4497	EX (Polyline)-1009	MH-2538	MH-2539	4.18	3.72	2.24	2.21	50	3.24	0.011	1.04	1.84	1.23	66.7	41.8	1,29,896.60	Box	Concrete	2.13	0.91
5410	EX (Polyline)-1010(1)	MH-2539	MH-328	3.72	3.55	2.21	1.92	26.85	2.53	0.011	2.87	8.53	1.22	14.3	45.4	1,31,419.50	Box	Concrete	2.13	0.91
5411	EX (Polyline)-1010(2)	MH-328	MH-120	3.55	3.01	1.92	1.91	19.37	3.57	0.011	1.16	1.84	1.77	96.2	50.4	1,91,057.40	Box	Concrete	2.13	0.91
213	EX (Polyline)-1011	MH-120	MH-121	3.01	2.8	1.91	1.48	20.02	2.53	0.011	4.11	12.11	1.77	14.6	60.3	1,91,909.50	Box	Concrete	2.13	0.91
4612	EXI-1012	MH-121	MH-1029	2.8	3.3	1.48	1.45	56.59	3.72	0.011	1.14	3.32	1.79	53.7	56.4	1,94,243.40	Box	Concrete	2.44	1.22
1607	EXI-1013	MH-1029	MH-1030	3.3	3.72	1.45	1.44	22.23	3.72	0.011	1.14	3.32	1.78	53.7	56.8	1,97,474.70	Box	Concrete	2.44	1.22
5032	0 (Polyline)-1014	MH-1030	MH-3100	3.72	3.84	1.44	1.41	51.89	3.74	0.011	1.13	3.26	1.8	55.1	57.1	2,00,063.50	Box	Concrete	2.44	1.22
9881	0 (Polyline)-1015(2)	MH-3100	MH-43	3.84	3.44	1.41	1.39	54.37	3.74	0.011	1.13	3.27	1.8	55.1	57.6	2,03,574.00	Box	Concrete	2.44	1.22
2549	0 (Polyline)-1017	MH-1605	MH-1606	2.7	2.94	1.99	1.97	50	1.11	0.011	0.54	0.22	0.08	38	56.5	4,160.10	Box	Concrete	0.61	0.61
3649	0 (Polyline)-1018	MH-1606	MH-820	2.94	2.79	1.97	1.94	50	1.5	0.011	0.65	0.22	0.18	81.5	54.9	9,619.10	Box	Concrete	0.61	0.61
1278	0 (Polyline)-1019	MH-820	MH-821	2.79	3.12	1.94	1.92	50	1.62	0.011	0.69	0.36	0.22	61.2	50.9	13,004.20	Box	Concrete	0.91	0.61
4323	0 (Polyline)-1020	MH-821	MH-856	3.12	3.34	1.92	1.89	50	1.69	0.011	0.72	0.36	0.26	70.3	42.8	15,994.40	Box	Concrete	0.91	0.61
5408	0 (Polyline)-1021(1)	MH-856	MH-43	3.34	3.44	1.89	1.39	30.59	1.17	0.011	2.51	2.09	0.29	14	75.7	19,488.10	Box	Concrete	0.91	0.61
5409	0 (Polyline)-1021(2)	MH-43	MH-857	3.44	3.41	1.39	1.38	19.41	3.8	0.011	1.17	3.32	1.95	58.8	57.9	2,24,761.40	Box	Concrete	2.44	1.22
2572	0 (Polyline)-1022	MH-857	MH-1618	3.41	3.42	1.38	1.35	50	3.81	0.011	1.17	3.32	1.96	58.9	58	2,26,726.90	Box	Concrete	2.44	1.22
2755	0 (Polyline)-1023	MH-1618	MH-707	3.42	3.33	1.35	1.33	51.15	3.8	0.011	1.17	3.32	1.95	58.7	58.3	2,29,212.10	Box	Concrete	2.44	1.22

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1105	0 (Polyline)-1026	MH-706	MH-707	3.25	3.33	2.54	1.33	39.23	0.73	0.011	2.15	1.7	0.08	4.6	68.1	3,916.40	Box	Concrete	0.61	0.61
5407	0 (Polyline)-1024(2)	MH-707	MH-1224	3.33	3.43	1.33	1.3	48.86	3.82	0.011	1.18	3.32	1.99	59.9	58.5	2,36,841.00	Box	Concrete	2.44	1.22
5404	0 (Polyline)-1025(1)	MH-1224	MH-2461	3.43	3.2	1.3	1.29	28.78	3.82	0.011	1.18	3.32	1.98	59.6	58.7	2,38,558.50	Box	Concrete	2.44	1.22
1046	0 (Polyline)-2249	MH-668	MH-667	3.26	3.03	2.55	2.32	29.68	0.69	0.011	0.88	0.84	0.02	2.7	17.9	1,149.80	Box	Concrete	0.61	0.61
4929	0 (Polyline)-2248	MH-667	MH-2515	3.03	2.91	2.32	2.2	50	0.86	0.011	0.9	0.48	0.07	14	36.6	3,506.70	Box	Concrete	0.61	0.61
4443	0 (Polyline)-2247	MH-2515	MH-2462	2.91	3.17	2.2	2.17	50	1.34	0.011	0.61	0.22	0.14	63.5	39.9	7,469.90	Box	Concrete	0.61	0.61
4311	0 (Polyline)-2246	MH-2462	MH-2461	3.17	3.2	2.17	1.29	50	0.86	0.011	2.39	1.29	0.18	14	75.8	10,575.30	Box	Concrete	0.61	0.61
5405	0 (Polyline)-1025(2)	MH-2461	O-114	3.2	2	1.29	1.28	10.92	3.86	0.011	1.19	3.32	2.06	62.1	58.8	2,50,354.10	Box	Concrete	2.44	1.22
4520	0 (Polyline)-1077	MH-2041	MH-2549	3.34	3.11	2.3	2.28	50	1.39	0.011	0.59	0.36	0.13	36	43.5	6,614.80	Box	Concrete	0.91	0.61
4739	0 (Polyline)-1078	MH-2549	MH-172	3.11	3.24	2.28	2.26	41.33	1.6	0.011	0.69	0.36	0.22	59.6	37.9	11,746.00	Box	Concrete	0.91	0.61
291	0 (Polyline)-1079	MH-172	MH-173	3.24	3.22	2.26	1.69	19.31	1.1	0.011	2.84	2.79	0.24	8.7	46.4	13,834.90	Box	Concrete	0.91	0.61
9876	0 (Polyline)-1057(2)	MH-3099	MH-944	3.5	3.11	2.35	2.32	40.1	1.05	0.011	0.35	0.41	0.02	5.4	11.5	1,103.30	Box	Concrete	0.91	0.61
1471	0 (Polyline)-1058	MH-944	MH-945	3.11	3.11	2.32	1.7	37.74	1	0.011	1.36	2.09	0.05	2.6	41.7	2,992.40	Box	Concrete	0.91	0.61
3448	0 (Polyline)-2250	MH-2072	MH-73	2.64	2.78	1.93	1.91	35.77	1.14	0.011	0.55	0.22	0.09	41.9	49.5	4,577.80	Box	Concrete	0.61	0.61
142	0 (Polyline)-2251	MH-73	MH-74	2.78	3	1.91	1.73	18.37	0.83	0.011	1.67	0.96	0.11	11.5	65.3	5,893.20	Box	Concrete	0.61	0.61
3774	0 (Polyline)-1093	MH-2227	MH-2228	2.76	3.18	2.05	2.03	50	1.37	0.011	0.62	0.22	0.15	67.2	52.9	7,344.80	Box	Concrete	0.61	0.61
4096	0 (Polyline)-1094	MH-2228	MH-329	3.18	3.54	2.03	2	50	1.63	0.011	0.7	0.36	0.23	62.7	50	12,325.00	Box	Concrete	0.91	0.61
530	0 (Polyline)-1095	MH-329	MH-330	3.54	3.41	2	1.77	13.64	1.14	0.011	2.39	2.11	0.25	11.7	69.4	14,273.40	Box	Concrete	0.91	0.61
3151	0 (Polyline)-2252	MH-1929	MH-818	3.55	3.26	2.84	2.55	50	0.88	0.011	1.44	0.74	0.12	16.2	29.6	6,038.60	Box	Concrete	0.61	0.61
1275	0 (Polyline)-2253	MH-818	MH-819	3.26	2.81	2.55	1.8	37.27	0.84	0.011	2.48	1.37	0.18	12.8	61.5	9,135.40	Box	Concrete	0.61	0.61
2488	0 (Polyline)-1059	MH-1570	MH-1571	3.37	3.38	2.66	2.64	50	0.89	0.011	0.43	0.22	0.04	17	46.2	1,857.40	Box	Concrete	0.61	0.61
2589	0 (Polyline)-1060	MH-1571	MH-1628	3.38	3.35	2.64	2.61	50	1.33	0.011	0.61	0.22	0.13	61.7	45.5	7,440.30	Box	Concrete	0.61	0.61
3836	0 (Polyline)-1061	MH-1628	MH-983	3.35	3.18	2.61	2.47	50	1.13	0.011	1.3	0.51	0.21	40.8	42.4	12,513.40	Box	Concrete	0.61	0.61
1535	0 (Polyline)-1062	MH-983	MH-984	3.18	2.79	2.47	2.08	50	1.02	0.011	1.99	0.86	0.25	28.6	49.7	15,353.10	Box	Concrete	0.61	0.61
2566	0 (Polyline)-1063	MH-984	MH-1615	2.79	2.98	2.08	2.05	50	1.78	0.011	0.75	0.36	0.29	81	54.6	18,810.00	Box	Concrete	0.91	0.61
3681	0 (Polyline)-1064	MH-1615	MH-2180	2.98	3.21	2.05	2.03	44.87	1.97	0.011	0.77	0.52	0.35	67.3	49.2	23,796.10	Box	Concrete	1.22	0.61
5484	0 (Polyline)-1065(1)	MH-2180	MH-819	3.21	2.81	2.03	1.8	19.4	1.49	0.011	2.27	2.54	0.38	14.8	68.2	26,336.70	Box	Concrete	1.22	0.61
5485	0 (Polyline)-1065(2)	MH-819	MH-1994	2.81	3.24	1.8	1.78	35.73	2.25	0.011	0.87	0.92	0.54	59.1	60.3	38,318.40	Box	Concrete	1.22	0.91
5486	0 (Polyline)-1066(1)	MH-1994	MH-330	3.24	3.41	1.78	1.77	28.65	2.29	0.011	0.88	0.92	0.58	62.6	60.5	41,667.60	Box	Concrete	1.22	0.91
5487	0 (Polyline)-1066(2)	MH-330	MH-1995	3.41	3.23	1.77	1.76	21.36	2.57	0.011	0.95	0.92	0.78	84.8	60	57,635.40	Box	Concrete	1.22	0.91
4294	0 (Polyline)-1067	MH-1995	MH-2358	3.23	2.95	1.76	1.74	30.42	2.58	0.011	0.95	0.92	0.79	85.9	58.3	59,300.50	Box	Concrete	1.22	0.91

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5482	0 (Polyline)-1068(1)	MH-2358	MH-74	2.95	3	1.74	1.73	27.84	2.61	0.011	0.96	0.92	0.81	88.1	55.6	62,106.40	Box	Concrete	1.22	0.91
5483	0 (Polyline)-1068(2)	MH-74	MH-781	3	3.2	1.73	1.71	41.76	2.73	0.011	0.98	1.22	0.91	74.4	52.4	70,707.20	Box	Concrete	1.52	0.91
5480	0 (Polyline)-1069(1)(1)	MH-781	MH-945	3.2	3.11	1.71	1.7	22.48	2.73	0.011	0.98	1.22	0.9	74	49.5	72,382.00	Box	Concrete	1.52	0.91
5481	0 (Polyline)-1069(1)(2)	MH-945	MH-173	3.11	3.22	1.7	1.69	24.24	2.76	0.011	0.99	1.22	0.93	76.8	44.6	76,053.30	Box	Concrete	1.52	0.91
5488	0 (Polyline)-1070(1)	MH-173	MH-2089	3.22	2.86	1.69	1.58	49.92	2.56	0.011	1.69	3.12	1.12	35.9	44.4	92,268.80	Box	Concrete	1.83	0.91
1591	0 (Polyline)-1115	MH-1019	MH-803	3.14	2.36	2.43	1.65	50	0.89	0.011	2.39	1.2	0.21	17.1	59.6	10,438.50	Box	Concrete	0.61	0.61
1252	0 (Polyline)-1116	MH-803	MH-804	2.36	2.98	1.65	1.63	37.65	1.7	0.011	0.72	0.36	0.26	71.4	82.8	13,362.00	Box	Concrete	0.91	0.61
3926	0 (Polyline)-1084	MH-2297	MH-525	3.01	3.42	2.3	2.27	50	1.53	0.011	0.66	0.22	0.18	85.5	48.6	9,347.10	Box	Concrete	0.61	0.61
829	0 (Polyline)-1085	MH-525	MH-526	3.42	3.27	2.27	2.26	23.05	1.59	0.011	0.68	0.36	0.21	58.7	39	11,498.80	Box	Concrete	0.91	0.61
1006	0 (Polyline)-1083	MH-642	MH-641	3.43	3.34	2.72	2.63	28.8	1.01	0.011	1.21	0.52	0.15	28.1	33.7	7,450.90	Box	Concrete	0.61	0.61
5491	0 (Polyline)-1082(2)	MH-641	MH-526	3.34	3.27	2.63	2.26	23.07	0.87	0.011	2.34	1.23	0.19	15.2	35.4	9,584.60	Box	Concrete	0.61	0.61
5490	0 (Polyline)-1082(1)	MH-526	MH-804	3.27	2.98	2.26	1.63	26.3	1.44	0.011	2.91	3.62	0.39	10.9	59.8	21,901.50	Box	Concrete	1.22	0.61
3970	0 (Polyline)-1081	MH-804	MH-2090	2.98	3.02	1.63	1.61	50.64	2.42	0.011	0.92	0.92	0.67	72.7	54.8	37,424.10	Box	Concrete	1.22	0.91
3484	0 (Polyline)-1080	MH-2090	MH-2089	3.02	2.86	1.61	1.58	50	2.49	0.011	0.93	0.92	0.72	78.4	50.7	42,426.30	Box	Concrete	1.22	0.91
5489	0 (Polyline)-1070(2)	MH-2089	MH-1694	2.86	2.8	1.58	1.48	20.08	2.52	0.011	2.58	4.88	1.64	33.7	57.5	1,37,055.50	Box	Concrete	1.83	0.91
3256	0 (Polyline)-1071	MH-1694	MH-1985	2.8	3.72	1.48	1.46	33.17	3.41	0.011	1.15	2.32	1.66	71.4	48.9	1,39,003.20	Box	Concrete	1.83	1.22
4926	0 (Polyline)-1072	MH-1985	MH-288	3.72	3.92	1.46	1.44	40.3	3.43	0.011	1.15	2.32	1.69	72.8	42.3	1,43,615.80	Box	Concrete	1.83	1.22
468	0 (Polyline)-1073	MH-288	O-116	3.92	2.66	1.44	-0.05	25.41	2.16	0.011	5.88	25.15	1.75	7	102.5	1,51,106.60	Box	Concrete	1.83	1.22
4321	0 (Polyline)-1171	MH-2465	MH-1959	3.23	3.64	2.52	2.49	50	0.94	0.011	0.46	0.22	0.05	21.2	35.4	2,314.30	Box	Concrete	0.61	0.61
3207	0 (Polyline)-1172	MH-1959	MH-1960	3.64	3.39	2.49	2.47	50	1.12	0.011	0.54	0.22	0.08	39	35.1	4,668.80	Box	Concrete	0.61	0.61
4280	0 (Polyline)-1173	MH-1960	MH-1873	3.39	3.33	2.47	2.44	50	1.39	0.011	0.59	0.36	0.13	35.8	30.2	7,829.30	Box	Concrete	0.91	0.61
3044	0 (Polyline)-1174	MH-1873	MH-1874	3.33	2.51	2.44	1.8	50	1.12	0.011	1.99	1.84	0.19	10.2	35.9	12,326.00	Box	Concrete	0.91	0.61
4260	0 (Polyline)-1175	MH-1874	MH-2276	2.51	2.46	1.8	1.75	50	1.51	0.011	0.9	0.51	0.25	48.5	40.4	16,405.20	Box	Concrete	0.91	0.61
3880	0 (Polyline)-1176	MH-2276	MH-2277	2.46	2.2	1.75	1.5	50	1.29	0.011	1.69	1.15	0.29	25.2	42.2	20,086.70	Box	Concrete	0.91	0.61
4486	0 (Polyline)-1177	MH-2277	MH-2534	2.2	2.56	1.5	1.45	50	1.8	0.011	0.97	1.3	0.34	26.5	32.9	24,289.20	Box	Concrete	1.22	0.91
4653	0 (Polyline)-1178	MH-2534	MH-911	2.56	3.17	1.45	1.4	50	1.87	0.011	1.02	1.3	0.4	31	28.9	29,400.60	Box	Concrete	1.22	0.91
1421	0 (Polyline)-1179	MH-911	O-79	3.17	3.17	1.14	0.05	41.94	1.48	0.011	3.27	6.64	0.51	7.7	96.6	38,310.30	Box	Concrete	1.22	0.91
10159	CO-478	MH-3152	MH-3153	3.5	3.31	2.8	2.7	55.71	1.31	0.011	1.15	0.41	0.25	60.4	84.2	12,508.70	Box	Concrete	0.61	0.61
10160	CO-479	MH-3153	MH-3154	3.31	3.13	2.7	2.5	94.66	1.52	0.011	1.35	0.44	0.37	84.4	96.7	19,737.10	Box	Concrete	0.61	0.61
10161	CO-480	MH-3154	MH-3141	3.13	3.16	2.5	2.45	28.83	1.67	0.011	0.83	0.68	0.46	68.1	114.1	25,750.70	Box	Concrete	0.91	0.61
10142	CO-462	MH-3135	MH-3136	3.5	3.5	2.85	2.83	56.39	1.84	0.011	0.64	0.31	0.27	89.4	77.9	13,843.70	Box	Concrete	0.91	0.61
10143	CO-463	MH-3136	MH-3137	3.5	3.27	2.83	2.8	45.49	1.89	0.011	0.89	0.42	0.4	95.3	77.7	21,639.10	Box	Concrete	0.91	0.61
10144	CO-464	MH-3137	MH-3138	3.27	3.5	2.8	2.75	45.37	1.82	0.011	1.12	0.54	0.46	85.9	83.1	26,344.40	Box	Concrete	0.91	0.61
10145	CO-465	MH-3138	MH-3139	3.5	3.5	2.75	2.7	48.33	1.81	0.011	1.09	0.52	0.45	85.4	86.1	26,344.40	Box	Concrete	0.91	0.61
10146	CO-466	MH-3139	MH-3140	3.5	3.23	2.7	2.65	56.75	1.89	0.011	1.03	0.48	0.46	95.7	88.8	28,413.90	Box	Concrete	0.91	0.61
10147	CO-467	MH-3140	MH-3141	3.23	3.16	2.65	2.45	57.02	1.52	0.011	1.73	0.96	0.48	49.8	103.1	31,125.40	Box	Concrete	0.91	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
10148	CO-468	MH-3141	MH-3142	3.16	3.13	2.45	2.4	51.06	2.13	0.011	1.56	0.51	0.87	170.4	112.2	57,943.70	Box	Concrete	0.91	0.61
10149	CO-469	MH-3142	MH-3143	3.13	2.88	2.4	2.25	54.23	2.13	0.011	1.58	0.85	0.88	102.8	103.7	59,934.30	Box	Concrete	0.91	0.61
10150	CO-470	MH-3143	MH-3144	2.88	2.8	2.25	2.2	45.42	2.13	0.011	1.65	0.54	0.92	170.4	91.8	63,991.10	Box	Concrete	0.91	0.61
10151	CO-471	MH-3144	MH-3151	2.8	2.29	2.2	1.6	35.66	1.47	0.011	3.66	2.11	0.93	44.1	95.7	65,828.20	Box	Concrete	0.91	0.61
10156	CO-475	MH-3148	MH-3149	3.5	3.22	2.85	2.5	55.63	1.02	0.011	1.78	0.77	0.22	29.3	59.4	11,360.50	Box	Concrete	0.61	0.61
10157	CO-476	MH-3149	MH-3150	3.22	3.5	2.5	2.4	60.87	1.65	0.011	1.23	0.39	0.39	99.9	72.9	20,295.30	Box	Concrete	0.61	0.61
10158	CO-477	MH-3150	MH-3151	3.5	2.29	2.4	1.6	32.97	1.06	0.011	3.61	1.5	0.49	32.6	90	26,546.80	Box	Concrete	0.61	0.61
10153	CO-473	MH-3151	MH-3145	2.29	2.16	1.6	1.5	21.56	2.13	0.011	2.36	1.11	1.31	118.6	111.6	93,541.80	Box	Concrete	0.91	0.61
10154	CO-474	MH-3145	O-212	2.16	3.26	1.5	1.38	68.99	2.13	0.011	2.48	0.68	1.37	203	130.7	98,615.40	Box	Concrete	0.91	0.61
49	0 (Polyline)-1235	MH-12	MH-11	3.51	3.51	2.8	2.8	0.78	0.85	0.011	0.39	0.22	0.03	13.1	20.5	1,432.30	Box	Concrete	0.61	0.61
4083	0 (Polyline)-1234	MH-11	MH-1969	3.51	3.23	2.8	2.52	50	0.83	0.011	1.27	0.72	0.08	11.7	27.8	4,299.10	Box	Concrete	0.61	0.61
3226	0 (Polyline)-1233	MH-1969	MH-1855	3.23	2.97	2.52	2.26	50	1	0.011	1.58	0.69	0.19	27.3	41.1	9,900.20	Box	Concrete	0.61	0.61
3012	0 (Polyline)-1232	MH-1855	MH-1828	2.97	2.18	2.26	1.47	50	0.97	0.011	2.68	1.22	0.3	24.3	61.9	15,880.20	Box	Concrete	0.61	0.61
2956	0 (Polyline)-1231	MH-1828	MH-1595	2.18	2.95	1.47	1.44	50	2.06	0.011	0.81	0.52	0.41	79.3	77.1	22,652.20	Box	Concrete	1.22	0.61
2533	0 (Polyline)-1230	MH-1595	MH-1542	2.95	3.07	1.44	1.42	50	2.22	0.011	0.86	0.92	0.53	57.1	51.8	30,329.80	Box	Concrete	1.22	0.91
2440	0 (Polyline)-1229	MH-1542	MH-910	3.07	2.74	1.42	1.39	50	2.33	0.011	0.89	0.92	0.61	66	50.1	36,985.90	Box	Concrete	1.22	0.91
1418	0 (Polyline)-1228	MH-910	MH-909	2.74	2.36	1.39	1.35	50	2.25	0.011	1.13	1.2	0.71	59.3	44.4	45,868.70	Box	Concrete	1.22	0.91
4378	0 (Polyline)-1227	MH-909	O-78	2.36	2.29	1.35	0.15	48.14	1.58	0.011	3.84	6.49	0.84	12.9	102.7	56,132.00	Box	Concrete	1.22	0.91
664	0 (Polyline)-1221	MH-417	MH-418	3.31	3.38	2.6	2.01	17.97	0.66	0.011	1.35	1.75	0.02	1.2	33	1,059.30	Box	Concrete	0.61	0.61
4964	0 (Polyline)-1222	MH-2704	MH-1267	2.77	3.32	2.06	2.03	50	1.27	0.011	0.6	0.22	0.12	55.6	59.9	6,080.10	Box	Concrete	0.61	0.61
5585	0 (Polyline)-1223(1)	MH-1267	MH-418	3.32	3.38	2.03	2.01	40.95	1.48	0.011	0.65	0.22	0.17	79.2	59.2	9,278.20	Box	Concrete	0.61	0.61
5586	0 (Polyline)-1223(2)	MH-418	MH-1268	3.38	2.92	2.01	1.99	29.43	1.6	0.011	0.69	0.36	0.21	59	58	12,290.20	Box	Concrete	0.91	0.61
3894	0 (Polyline)-1224	MH-1268	MH-2284	2.92	3.03	1.99	1.98	29.65	1.68	0.011	0.71	0.36	0.25	68.8	57.7	14,898.00	Box	Concrete	0.91	0.61
4180	0 (Polyline)-1225	MH-2284	MH-631	3.03	3.2	1.98	1.96	50	1.84	0.011	0.76	0.36	0.32	88.4	47.8	19,929.40	Box	Concrete	0.91	0.61
991	0 (Polyline)-1226	MH-631	O-75	3.2	1.84	1.96	0.35	26.36	1.38	0.011	3.89	5.77	0.39	6.8	131.9	25,808.40	Box	Concrete	1.22	0.61
3222	0 (Polyline)-1207	MH-1967	MH-1792	3.36	2.63	2.65	1.92	50	0.93	0.011	2.45	1.17	0.24	20.3	45	12,077.40	Box	Concrete	0.61	0.61
2890	0 (Polyline)-1208	MH-1792	MH-347	2.63	2.65	1.92	1.9	38.47	1.99	0.011	0.78	0.52	0.36	69.6	43.4	18,747.00	Box	Concrete	1.22	0.61
557	0 (Polyline)-1209	MH-347	MH-348	2.65	2.2	1.9	0.91	23.15	1.4	0.011	3.47	4.84	0.39	8	125.2	20,739.40	Box	Concrete	1.22	0.61
4124	0 (Polyline)-1254	MH-2383	MH-1575	3.12	3.61	2.41	2.38	50	1.17	0.011	0.56	0.22	0.1	44.4	48.9	4,854.80	Box	Concrete	0.61	0.61
2498	0 (Polyline)-1255	MH-1575	MH-409	3.61	3.08	2.38	2.36	50	1.4	0.011	0.63	0.22	0.15	69.8	44.3	8,210.20	Box	Concrete	0.61	0.61
651	0 (Polyline)-1256	MH-409	MH-342	3.08	2.87	2.36	2.16	17.59	0.94	0.011	2.19	1.03	0.22	21.8	42.3	13,108.60	Box	Concrete	0.61	0.61

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581	0 (Polyline)-1202	MH-363	MH-342	2.92	2.87	2.21	2.16	15.01	0.76	0.011	0.84	0.57	0.04	6.9	41	2,009.70	Box	Concrete	0.61	0.61
548	0 (Polyline)-1201	MH-342	MH-341	2.87	2.69	2.16	1.98	14.58	0.99	0.011	2.4	1.06	0.28	26.1	47.8	16,373.30	Box	Concrete	0.61	0.61
5025	0 (Polyline)-1200	MH-341	MH-2492	2.69	2.32	1.98	1.61	50	1.11	0.011	2.11	0.84	0.32	38.6	81	19,149.60	Box	Concrete	0.61	0.61
5598	0 (Polyline)-1199(2)	MH-2492	MH-348	2.32	2.2	1.61	0.91	49.94	1.08	0.011	1.07	1.14	0.4	34.9	162.2	24,156.30	Box	Concrete	0.61	0.61
10099	CO-461	MH-348	O-208	2.2	2.5	1.6	1.58	11.62	3.05	0.011	1	0.97	0.74	76.7	77.5	47,139.40	Box	Concrete	0.61	1.22
844	0 (Polyline)-1140	MH-536	MH-535	3.37	3.16	2.66	2.45	24.06	0.66	0.011	0.67	0.92	0.01	1	12.8	473.9	Box	Concrete	0.61	0.61
3983	0 (Polyline)-1139	MH-535	MH-1589	3.16	3.42	2.45	2.42	50	0.89	0.011	0.43	0.22	0.04	17	18.9	1,916.40	Box	Concrete	0.61	0.61
2521	0 (Polyline)-1138	MH-1589	MH-1588	3.42	2.84	2.42	2.13	50	0.79	0.011	1.17	0.74	0.06	8.6	39.6	3,671.50	Box	Concrete	0.61	0.61
3579	0 (Polyline)-1137	MH-1588	MH-1395	2.84	3.27	2.13	2.1	50	1.24	0.011	0.59	0.22	0.11	52.3	63.1	6,772.50	Box	Concrete	0.61	0.61
2197	0 (Polyline)-1136	MH-1395	MH-1394	3.27	3.76	2.1	2.08	50	1.44	0.011	0.64	0.22	0.16	75.2	63.4	10,587.50	Box	Concrete	0.61	0.61
3199	0 (Polyline)-1135	MH-1394	MH-1955	3.76	3.56	2.08	1.95	50	1.3	0.011	1.22	0.82	0.21	26.1	73	14,744.20	Box	Concrete	0.91	0.61
2574	0 (Polyline)-1160	MH-1619	MH-1620	3.3	3.46	2.59	2.57	50	0.99	0.011	0.49	0.22	0.06	26.1	24.5	2,852.50	Box	Concrete	0.61	0.61
3161	0 (Polyline)-1161	MH-1620	MH-1955	3.46	3.56	2.57	1.95	51.6	0.79	0.011	1.69	1.06	0.09	8.8	52.5	5,150.70	Box	Concrete	0.61	0.61
3343	0 (Polyline)-1158	MH-2024	MH-298	3.35	3.35	2.64	2.62	40.4	1	0.011	0.49	0.22	0.06	26.7	23.9	2,918.50	Box	Concrete	0.61	0.61
483	0 (Polyline)-1159	MH-298	MH-299	3.35	3.38	2.62	2.02	22.58	0.75	0.011	2.14	1.56	0.09	5.7	60.8	4,809.50	Box	Concrete	0.61	0.61
3646	0 (Polyline)-1148	MH-2167	MH-1398	3.58	3.56	2.95	2.9	50	1.52	0.011	0.92	0.51	0.26	49.7	71.5	12,939.40	Box	Concrete	0.91	0.61
2203	0 (Polyline)-1149	MH-1398	MH-1399	3.56	3.5	2.9	2.85	50	1.85	0.011	1.08	0.51	0.47	90.6	73.6	24,620.30	Box	Concrete	0.91	0.61
3903	0 (Polyline)-1150	MH-1399	MH-148	3.5	3.67	2.85	2.8	28.91	1.78	0.011	1.39	0.68	0.55	81.4	73.2	30,255.70	Box	Concrete	0.91	0.61
255	0 (Polyline)-1151	MH-148	MH-149	3.67	3.59	2.8	2.76	28	1.9	0.011	1.27	0.59	0.57	96.3	71.4	31,868.00	Box	Concrete	0.91	0.61
4380	0 (Polyline)-1117	MH-2490	MH-2491	3.7	3.75	2.99	2.97	37.9	1.97	0.011	0.77	0.52	0.35	67.1	43.8	17,789.50	Box	Concrete	1.22	0.61
5728	0 (Polyline)-1118(1)	MH-2491	MH-149	3.75	3.59	2.97	2.76	28.76	1.58	0.011	2.05	1.97	0.45	22.7	54.2	23,634.60	Box	Concrete	1.22	0.61
5729	0 (Polyline)-1118(2)	MH-149	MH-1269	3.59	3.38	2.76	2.37	33.35	1.76	0.011	3.2	2.53	1.05	41.4	57.5	59,719.80	Box	Concrete	1.22	0.61
1991	0 (Polyline)-1119	MH-1269	MH-948	3.38	3.39	2.37	2.08	50	2.1	0.011	2.46	4.16	1.09	26.3	55.9	63,131.80	Box	Concrete	1.52	0.91
1477	0 (Polyline)-1120	MH-948	MH-949	3.39	3.56	2.08	2.06	50	3.01	0.011	1.06	1.22	1.2	98.4	69.6	70,340.30	Box	Concrete	1.52	0.91
3841	0 (Polyline)-1121	MH-949	MH-2259	3.56	3.53	2.06	2.03	46.61	3.18	0.011	1.08	1.53	1.34	87.5	68.1	82,193.40	Box	Concrete	1.83	0.91
5633	0 (Polyline)-1122(1)(1)	MH-2259	MH-299	3.53	3.38	2.03	2.02	18.79	3.17	0.011	1.08	1.53	1.33	86.8	67.5	85,115.30	Box	Concrete	1.83	0.91
5634	0 (Polyline)-1122(1)(2)	MH-299	MH-78	3.38	3.23	2.02	2.02	6.49	3.22	0.011	1.09	1.53	1.39	90.6	67.2	90,456.90	Box	Concrete	1.83	0.91
2878	0 (Polyline)-1127	MH-1786	MH-1787	3.44	3.52	2.73	2.7	48.87	1.36	0.011	0.62	0.22	0.14	66.1	58.1	7,224.10	Box	Concrete	0.61	0.61
3120	0 (Polyline)-1128	MH-1913	MH-1801	3.52	3.66	2.81	2.79	50	0.99	0.011	0.49	0.22	0.06	26	55.9	2,842.00	Box	Concrete	0.61	0.61
2906	0 (Polyline)-1129	MH-1801	MH-1264	3.66	3.68	2.79	2.76	50	1.24	0.011	0.59	0.22	0.11	52.4	58.1	6,234.80	Box	Concrete	0.61	0.61
1983	0 (Polyline)-1130	MH-1264	MH-988	3.68	3.64	2.76	2.74	50	1.5	0.011	0.65	0.22	0.18	81.9	56.2	10,528.60	Box	Concrete	0.61	0.61
5635	0 (Polyline)-1131(1)	MH-988	MH-1787	3.64	3.52	2.74	2.7	28.53	1.4	0.011	0.94	0.57	0.21	36.9	55.7	13,575.20	Box	Concrete	0.91	0.61
5636	0 (Polyline)-1131(2)	MH-1787	MH-989	3.52	3.82	2.7	2.69	21.47	1.89	0.011	0.78	0.36	0.35	95.2	55.1	22,865.60	Box	Concrete	0.91	0.61
3489	0 (Polyline)-1132	MH-989	MH-2092	3.82	3.48	2.69	2.67	49.78	2.03	0.011	0.79	0.52	0.39	74.6	45.8	26,291.00	Box	Concrete	1.22	0.61
4143	0 (Polyline)-1133	MH-2092	MH-78	3.48	3.23	2.67	2.02	54	1.52	0.011	2.43	2.56	0.44	17.4	69.6	31,136.90	Box	Concrete	1.22	0.61
5632	0 (Polyline)-1122(2)	MH-78	MH-2263	3.23	3.5	2.02	2.01	19.17	3.54	0.011	1.15	1.84	1.72	93.7	66.7	1,22,241.70	Box	Concrete	2.13	0.91

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
3849	0 (Polyline)-1123	MH-2263	MH-1401	3.5	3.49	2.01	1.98	58.97	3.55	0.011	1.15	1.84	1.74	94.4	64.6	1,24,529.80	Box	Concrete	2.13	0.91
2208	0 (Polyline)-1124	MH-1401	MH-1402	3.49	3.62	1.98	1.96	50	3.55	0.011	1.15	1.84	1.74	94.5	60.4	1,28,763.80	Box	Concrete	2.13	0.91
5629	0 (Polyline)-1125(1)	MH-1402	MH-1955	3.62	3.56	1.96	1.95	14.99	3.53	0.011	1.15	1.84	1.71	93	56.8	1,30,447.20	Box	Concrete	2.13	0.91
5630	0 (Polyline)-1125(2)	MH-1955	MH-1295	3.56	2.81	1.95	1.8	35.01	2.87	0.011	2.52	5.4	1.97	36.5	66.5	1,51,599.90	Box	Concrete	2.13	0.91
2033	0 (Polyline)-1126	MH-1295	FO-131	2.81	2.7	1.8	0.65	12.01	2.4	0.011	6.87	25.43	1.99	7.8	142	1,54,597.50	Box	Concrete	2.13	0.91
1494	0 (Polyline)-1152	MH-958	MH-889	3.45	3.6	2.74	2.7	38	1.17	0.011	0.76	0.29	0.13	45.1	53.8	6,676.90	Box	Concrete	0.61	0.61
1387	0 (Polyline)-1157	MH-890	MH-889	3.43	3.6	2.72	2.7	37.15	0.97	0.011	0.48	0.22	0.05	24.2	53.6	2,648.40	Box	Concrete	0.61	0.61
3336	0 (Polyline)-1153	MH-889	MH-1616	3.6	3.57	2.7	2.68	50	1.71	0.011	0.72	0.36	0.26	72.2	52.7	14,167.40	Box	Concrete	0.91	0.61
2568	0 (Polyline)-1154	MH-1616	MH-785	3.57	3.3	2.68	2.59	50	1.47	0.011	1.15	0.66	0.29	44.7	53.7	16,890.70	Box	Concrete	0.91	0.61
1224	0 (Polyline)-1155	MH-785	MH-490	3.3	3.32	2.59	2.57	50	1.83	0.011	0.76	0.36	0.32	87.3	47.6	18,917.70	Box	Concrete	0.91	0.61
776	0 (Polyline)-1156	MH-490	FO-130	3.32	3.22	2.57	0.65	7.96	1.02	0.011	6.14	7.98	0.32	4	173.4	20,439.20	Box	Concrete	0.91	0.61
1430	0 (Polyline)-1203	MH-917	MH-918	3.13	2.56	2.42	1.5	68.28	0.7	0.011	1.22	1.12	0.03	3	85.9	1,701.70	Box	Concrete	0.61	0.61
4559	0 (Polyline)-1204	MH-918	MH-2417	2.56	2.99	1.5	1.48	37.06	1.26	0.011	0.36	0.25	0.14	54	162.2	7,181.70	Box	Concrete	0.61	0.61
4200	0 (Polyline)-1205	MH-2417	MH-523	2.99	2.5	1.48	1.45	52.01	1.59	0.011	0.37	0.36	0.21	57.6	165.1	11,873.00	Box	Concrete	0.91	0.61
826	0 (Polyline)-1206	MH-523	MH-524	2.5	2.47	1.45	0.8	15.42	1.07	0.011	0.4	3.33	0.22	6.7	219.5	14,774.50	Box	Concrete	0.91	0.61
10097	0(Polyline)-1199(1)(2)	MH-3132	MH-1852	2.33	2.41	0.91	0.89	13.4	0.69	0.011	0.02	0.27	0.01	2.6	244.1	352.2	Box	Concrete	0.61	0.61
3004	0 (Polyline)-1198	MH-1852	MH-1658	2.41	2.39	0.89	0.88	30.01	1.06	0.011	0.04	0.37	0.02	6.4	246.3	2,035.90	Box	Concrete	0.91	0.61
5600	0 (Polyline)-1197(2)	MH-1658	MH-206	2.39	2.75	0.88	0.86	48.67	1.44	0.011	0.07	0.51	0.06	10.7	262.3	6,269.20	Box	Concrete	1.22	0.61
5599	0 (Polyline)-1197(1)	MH-206	MH-1657	2.75	2.48	0.86	0.84	24.92	2	0.011	0.03	1.53	0.06	3.7	177.8	7,711.80	Box	Concrete	1.83	0.91
4892	0 (Polyline)-1196	MH-1657	MH-2391	2.48	2.51	0.84	0.83	28.18	2	0.011	0.03	1.53	0.06	3.7	179.2	9,096.00	Box	Concrete	1.83	0.91
5596	0 (Polyline)-1195(2)	MH-2391	MH-524	2.51	2.47	0.83	0.8	48.4	2	0.011	0.04	1.53	0.06	3.8	181.3	11,067.90	Box	Concrete	1.83	0.91
1936	0 (Polyline)-1194	MH-524	FO-129	2.47	2.13	0.8	0.65	51.6	2.27	0.011	0.06	4.5	0.12	2.7	198.3	27,351.40	Box	Concrete	2.13	0.91
1888	0 (Polyline)-1185	MH-1205	MH-1206	3.43	3.31	2.72	2.3	41.53	0.73	0.011	1.27	0.98	0.05	4.9	36.8	2,434.40	Box	Concrete	0.61	0.61
5056	0 (Polyline)-1180	MH-2735	MH-2021	3.78	3.52	3.07	2.81	50	0.73	0.011	0.92	0.71	0.03	4.9	18.3	1,753.90	Box	Concrete	0.61	0.61
3337	0 (Polyline)-1181	MH-2021	MH-1089	3.52	3.25	2.81	2.54	50	0.89	0.011	1.37	0.7	0.12	16.5	42.7	6,115.90	Box	Concrete	0.61	0.61
1701	0 (Polyline)-1182	MH-1089	MH-871	3.25	3.24	2.54	2.52	50	1.47	0.011	0.64	0.22	0.17	78.6	58.7	9,259.40	Box	Concrete	0.61	0.61
1359	0 (Polyline)-1183	MH-871	MH-872	3.24	3.14	2.52	2.43	50	1.22	0.011	1.09	0.4	0.2	50.4	60.7	11,910.00	Box	Concrete	0.61	0.61
2529	0 (Polyline)-1184	MH-872	MH-1593	3.14	3.37	2.43	2.41	46.79	1.67	0.011	0.71	0.36	0.24	67.3	64.4	14,922.60	Box	Concrete	0.91	0.61
507	0 (Polyline)-1170	MH-315	MH-314	3.59	3.57	2.88	2.86	14.89	0.7	0.011	0.4	0.37	0.01	3	38.5	553.1	Box	Concrete	0.61	0.61
3749	0 (Polyline)-1169	MH-314	MH-2214	3.57	3.49	2.86	2.78	50	0.91	0.011	0.79	0.39	0.07	18.6	46	3,742.60	Box	Concrete	0.61	0.61
3803	0 (Polyline)-1168	MH-2214	MH-2229	3.49	3.45	2.78	2.74	50	1.34	0.011	0.8	0.28	0.18	63.7	47.1	9,903.40	Box	Concrete	0.61	0.61

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5581	0 (Polyline)-1167(2)	MH-2229	MH-1593	3.45	3.37	2.74	2.41	30.19	0.98	0.011	2.24	1.01	0.25	24.8	53.5	14,576.80	Box	Concrete	0.61	0.61
5580	0 (Polyline)-1167(1)	MH-1593	MH-1655	3.37	3.49	2.41	2.4	19.81	2.17	0.011	0.84	0.52	0.49	92.8	63.8	31,617.00	Box	Concrete	1.22	0.61
2638	0 (Polyline)-1166	MH-1655	MH-1654	3.49	3.37	2.4	2.36	50	2.1	0.011	0.97	1.09	0.52	47.6	40.3	34,503.20	Box	Concrete	1.22	0.91
5584	0 (Polyline)-1165(2)	MH-1654	MH-1206	3.37	3.31	2.36	2.3	39.81	1.9	0.011	1.31	1.64	0.54	32.9	39.1	37,095.00	Box	Concrete	1.22	0.91
1837	0 (Polyline)-1186	MH-1173	MH-264	3.26	3.05	2.55	2.34	38.44	0.73	0.011	0.95	0.73	0.04	4.9	35.5	1,812.90	Box	Concrete	0.61	0.61
5582	CO-8	MH-264	MH-1206	3.05	3.31	2.34	2.3	22.92	0.86	0.011	0.71	0.38	0.05	14.2	56.7	2,826.60	Box	Concrete	0.61	0.61
5583	0 (Polyline)-1165(1)	MH-1206	MH-1904	3.31	3.4	2.3	2.29	10.19	2.35	0.011	0.9	0.92	0.62	67	36.5	43,195.60	Box	Concrete	1.22	0.91
3331	0 (Polyline)-1164	MH-1904	MH-1325	3.4	2.9	2.29	1.89	50	1.65	0.011	2.4	3.69	0.63	17.1	50.4	44,431.50	Box	Concrete	1.22	0.91
2082	0 (Polyline)-1163	MH-1325	FO-77	2.9	2.79	1.89	0.65	10.76	1.42	0.011	6	13.99	0.73	5.2	137.3	52,260.50	Box	Concrete	1.22	0.91
912	0 (Polyline)-1210	MH-580	MH-581	3.2	2.99	2.49	2.28	50	0.84	0.011	1.11	0.62	0.08	12.5	30.2	3,932.80	Box	Concrete	0.61	0.61
2887	0 (Polyline)-1211	MH-581	MH-261	2.99	3.22	2.28	1.86	53.57	0.83	0.011	1.51	0.86	0.1	11.9	76.1	5,341.30	Box	Concrete	0.61	0.61
615	0 (Polyline)-1215	MH-386	MH-385	3.06	2.6	2.35	1.89	16.34	0.85	0.011	2.98	1.62	0.22	13.5	73.8	11,070.10	Box	Concrete	0.61	0.61
2738	0 (Polyline)-1214	MH-385	MH-1711	2.6	2.92	1.89	1.86	50	1.71	0.011	0.47	0.36	0.26	72.5	110	13,395.30	Box	Concrete	0.91	0.61
2757	0 (Polyline)-1216	MH-1722	MH-1711	2.97	2.92	2.26	1.86	60.08	1.22	0.011	1.75	1.32	0.25	18.6	76.8	12,433.40	Box	Concrete	0.91	0.61
5604	0 (Polyline)-1217(2)	MH-1711	MH-261	2.92	3.22	1.86	1.86	6.37	2.19	0.011	0.85	0.92	0.5	54.2	74.5	27,723.00	Box	Concrete	1.22	0.91
5602	0 (Polyline)-1212(2)	MH-261	MH-205	3.22	3	1.86	1.84	30.34	2.34	0.011	0.9	0.92	0.61	66.8	74.9	34,368.90	Box	Concrete	1.22	0.91
342	0 (Polyline)-1213	MH-205	O-207	3	2.92	1.84	0.86	35.92	1.51	0.011	3.62	6.82	0.64	9.4	129.8	37,071.00	Box	Concrete	1.22	0.91
947	0 (Polyline)-1147	MH-604	MH-603	3.7	3.47	2.99	2.76	27.07	0.69	0.019	0.51	0.51	0.01	2.3	51.5	610.2	Box	Concrete	0.61	0.61
4050	0 (Polyline)-1146	MH-603	MH-252	3.47	3.19	2.76	2.47	50	0.86	0.019	0.8	0.43	0.06	14	93.9	3,163.80	Box	Concrete	0.61	0.61
1348	0 (Polyline)-1145	MH-252	MH-201	3.19	3.32	2.49	2.47	38.37	1.51	0.011	0.12	0.52	0.09	16.8	125	4,897.70	Box	Concrete	1.22	0.61
510	0 (Polyline)-1189	MH-317	MH-316	3.39	3.34	2.68	2.63	13.93	0.83	0.011	0.98	0.56	0.06	11.5	100.8	3,285.90	Box	Concrete	0.61	0.61
1653	0 (Polyline)-1190	MH-1058	MH-1059	3.87	3.5	3.16	2.79	50	1.04	0.011	1.98	0.83	0.26	31.5	62	13,283.20	Box	Concrete	0.61	0.61
5625	0 (Polyline)-1191(1)	MH-1059	MH-316	3.5	3.34	2.79	2.63	25.86	1.18	0.011	1.97	0.75	0.34	45.6	92.5	17,701.00	Box	Concrete	0.61	0.61
5626	0 (Polyline)-1191(2)	MH-316	MH-1376	3.34	3.23	2.63	2.52	24.17	1.33	0.011	1.13	0.67	0.42	62.4	110.5	21,905.60	Box	Concrete	0.61	0.61
2167	0 (Polyline)-1192	MH-1376	MH-200	3.23	3.33	2.52	2.5	42.43	2.11	0.011	0.6	0.52	0.44	84.9	122.6	23,616.50	Box	Concrete	1.22	0.61
334	0 (Polyline)-1193	MH-200	MH-201	3.33	3.32	2.5	2.49	16	2.12	0.011	0.61	0.52	0.46	87.3	123.2	25,810.20	Box	Concrete	1.22	0.61
3902	0 (Polyline)-1144	MH-201	MH-841	3.32	3.5	2.58	2.49	54.97	1.81	0.011	0.6	0.94	0.45	47.3	114.5	32,252.80	Box	Concrete	1.22	0.61
1308	0 (Polyline)-1143	MH-841	MH-840	3.5	3.4	2.6	2.58	44.22	2.09	0.011	0.61	0.56	0.46	82.2	102.1	35,188.30	Box	Concrete	1.22	0.61
4638	0 (Polyline)-1142	MH-840	MH-2287	3.4	3.34	2.43	2.4	50	2.1	0.011	0.64	0.57	0.48	83.6	127.6	38,738.50	Box	Concrete	1.22	0.61
10088	0 (Polyline)-1141(1)	MH-2287	MH-3131	3.34	3.39	2.72	2.63	27.28	1.53	0.011	1.76	0.58	0.49	85.6	70.9	41,493.60	Box	Concrete	0.61	0.61
10089	0 (Polyline)-1141(2)	MH-3131	O-189	3.39	2.5	2.3	1.8	66.44	1.3	0.011	2.35	0.84	0.5	59.3	93.4	41,967.10	Box	Concrete	0.61	0.61
498	0 (Polyline)-1241	MH-309	MH-308	3.4	3.13	2.69	2.42	22.79	0.64	0.011	0.55	1.06	0	0.4	7.7	224.7	Box	Concrete	0.61	0.61
2087	0 (Polyline)-1240	MH-308	MH-928	3.13	3.34	2.42	2.4	40.99	0.77	0.011	0.33	0.22	0.02	7.6	11.5	856.7	Box	Concrete	0.61	0.61
1445	0 (Polyline)-1239	MH-928	MH-927	3.34	2.87	2.4	2.16	50	0.73	0.011	0.85	0.67	0.03	4.5	26.8	1,759.10	Box	Concrete	0.61	0.61
5591	0(Polyline)-2155(1)(1)	MH-927	MH-874	2.87	2.74	2.16	2.03	33.91	0.77	0.011	0.9	0.6	0.04	7.4	53.9	2,717.70	Box	Concrete	0.61	0.61
3339	0 (Polyline)-2154	MH-874	O-76	2.74	2.65	2.03	0.55	45.42	0.69	0.011	1.76	1.74	0.04	2.4	185.4	2,717.70	Box	Concrete	0.61	0.61

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3049	0 (Polyline)-1218	MH-1876	MH-720	2.77	2.94	2.06	2.03	50	0.91	0.011	0.44	0.22	0.04	18.3	64.3	2,000.40	Box	Concrete	0.61	0.61
1126	0 (Polyline)-1219	MH-720	MH-721	2.94	2.53	2.03	1.52	31.64	0.76	0.011	1.76	1.24	0.08	6.3	108.7	4,358.20	Box	Concrete	0.61	0.61
1373	0 (Polyline)-1220	MH-881	MH-880	3.3	3.3	2.59	1.65	36.86	0.69	0.011	1.57	1.55	0.04	2.5	72.4	1,954.30	Box	Concrete	0.61	0.61
3187	0 (Polyline)-1236	MH-1948	MH-1511	3.23	3.03	2.52	2.32	50	0.76	0.011	0.88	0.62	0.04	6.4	18.9	2,000.30	Box	Concrete	0.61	0.61
2387	0 (Polyline)-1237	MH-1511	MH-729	3.03	2.45	2.32	1.74	50	0.82	0.011	1.8	1.04	0.12	11.2	70.9	6,183.90	Box	Concrete	0.61	0.61
1140	0 (Polyline)-1238	MH-729	MH-730	2.45	2.62	1.74	1.71	42.97	1.53	0.011	0.5	0.22	0.19	85.8	126	10,060.60	Box	Concrete	0.61	0.61
814	0 (Polyline)-2159	MH-730	MH-515	2.62	2.8	1.71	1.7	30.71	1.61	0.011	0.4	0.36	0.22	60.7	127.3	12,915.20	Box	Concrete	0.91	0.61
2072	0 (Polyline)-2158	MH-515	MH-1318	2.8	3.28	1.7	1.67	50	1.64	0.011	0.42	0.36	0.23	63.8	129.3	14,606.60	Box	Concrete	0.91	0.61
2476	0 (Polyline)-2157	MH-1318	MH-880	3.28	3.3	1.67	1.65	51.81	1.7	0.011	0.47	0.36	0.26	71.9	131.5	18,081.50	Box	Concrete	0.91	0.61
5587	0 (Polyline)-2156(1)	MH-880	MH-875	3.3	2.89	1.65	1.63	36.09	1.8	0.011	0.55	0.36	0.31	84.1	133	22,674.50	Box	Concrete	0.91	0.61
5590	0 (Polyline)-2155(2)	MH-875	MH-721	2.89	2.53	1.63	1.52	23.68	1.55	0.011	0.43	1.61	0.32	19.9	142.3	24,863.80	Box	Concrete	1.22	0.61
9116	EX	MH-721	MH-2960	2.53	2.62	1.52	1.5	40.88	2.38	0.019	0.33	0.53	0.37	69.7	101.9	29,936.40	Box	Concrete	1.22	0.91
9118	EX	MH-2960	O-173	2.62	2.18	1.5	0.55	38.4	1.51	0.019	0.32	3.74	0.35	9.4	153.9	29,936.40	Box	Concrete	1.22	0.91
885	0 (Polyline)-1253	MH-562	MH-563	2.87	2.89	2.16	2.15	26.57	0.84	0.011	0.39	0.22	0.03	12.9	22.7	1,406.20	Box	Concrete	0.61	0.61
5594	0 (Polyline)-1249(2)	MH-563	MH-754	2.89	2.96	2.15	2.14	16.82	0.96	0.011	0.47	0.22	0.05	23.5	22	2,718.30	Box	Concrete	0.61	0.61
2794	0 (Polyline)-1250	MH-754	MH-1723	2.96	2.63	2.14	1.92	39.14	0.83	0.011	1.28	0.72	0.09	12	34.6	4,783.40	Box	Concrete	0.61	0.61
9008	0 (Polyline)-1251(1)	MH-1723	MH-2955	2.63	3.3	1.92	1.9	40.44	1.43	0.011	0.63	0.22	0.16	73.1	39.7	8,945.50	Box	Concrete	0.61	0.61
9009	0 (Polyline)-1251(2)	MH-2955	O-158	3.3	3.01	1.9	0.4	15.02	1.03	0.011	4.02	5.13	0.22	4.2	104.6	13,033.50	Box	Concrete	0.91	0.61
2242	0 (Polyline)-1242	MH-1423	MH-1424	3.34	2.76	2.63	2.05	50	0.75	0.011	1.45	1.04	0.06	6	27	3,175.30	Box	Concrete	0.61	0.61
3642	0 (Polyline)-1243	MH-1424	MH-1613	2.76	2.61	2.05	1.9	50	0.93	0.011	1.11	0.53	0.11	20.3	48.6	5,601.90	Box	Concrete	0.61	0.61
2562	0 (Polyline)-1244	MH-1613	MH-1501	2.61	3.14	1.9	1.87	50	1.56	0.011	0.67	0.36	0.2	54.8	60.7	10,769.30	Box	Concrete	0.91	0.61
2369	0 (Polyline)-1245	MH-1501	MH-1502	3.14	3.24	1.87	1.85	50	1.67	0.011	0.71	0.36	0.25	67.8	61.2	14,210.10	Box	Concrete	0.91	0.61
3286	0 (Polyline)-1246	MH-1502	MH-1384	3.24	2.97	1.85	1.82	50	1.82	0.011	0.76	0.36	0.31	86.1	58.6	19,274.50	Box	Concrete	0.91	0.61
2180	0 (Polyline)-1247	MH-1384	MH-95	2.97	3	1.82	1.81	34.7	1.86	0.011	0.77	0.36	0.33	91	47.5	21,819.30	Box	Concrete	0.91	0.61
175	0 (Polyline)-1248	MH-95	O-73	3	1.59	1.81	1.35	20.59	1.45	0.011	2.85	3.47	0.4	11.5	43.6	27,197.80	Box	Concrete	1.22	0.61
4816	0 (Polyline)-1265	MH-2658	MH-2601	3.2	3.16	2.49	2.45	30.95	1.34	0.011	0.49	0.86	0.04	4.3	18.5	1,862.80	Box	Concrete	1.22	0.61
4648	0 (Polyline)-1266	MH-2601	MH-574	3.16	3	2.45	2.29	44.31	1.47	0.011	1.2	1.41	0.18	13	24.7	9,754.40	Box	Concrete	1.22	0.61
903	0 (Polyline)-1267	MH-574	MH-575	3	2.7	2.29	1.69	43.27	1.43	0.011	2.11	2.74	0.27	9.7	47	14,598.40	Box	Concrete	1.22	0.61
2214	0 (Polyline)-1268	MH-1406	MH-1405	2.45	2.63	1.74	1.72	47.82	1.48	0.011	0.65	0.22	0.17	79.3	65.3	8,673.20	Box	Concrete	0.61	0.61
4755	0 (Polyline)-1257	MH-2633	MH-2225	3.32	3.14	2.61	2.43	50	0.93	0.011	1.24	0.59	0.12	20.7	30.2	6,169.40	Box	Concrete	0.61	0.61
3770	0 (Polyline)-1258	MH-2225	MH-771	3.14	2.94	2.43	2.23	42.58	1	0.011	1.5	0.65	0.18	27.6	35.3	9,440.50	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
5607	0(Polyline)-1259(1)(1)	MH-771	MH-1405	2.94	2.63	2.23	1.72	26.66	0.87	0.011	2.55	1.34	0.2	15	50.7	10,793.20	Box	Concrete	0.61	0.61
5608	0(Polyline)-1259(1)(2)	MH-1405	MH-575	2.63	2.7	1.72	1.69	28.01	1.91	0.011	0.97	0.68	0.41	60.2	65.6	22,200.50	Box	Concrete	1.22	0.61
2933	0 (Polyline)-1260	MH-575	MH-1214	2.7	3.24	1.69	1.67	52.78	2.68	0.011	0.89	1.53	0.7	45.5	44.1	38,960.20	Box	Concrete	1.83	0.91
1902	0 (Polyline)-1261	MH-1214	MH-1215	3.24	3.23	1.67	1.64	50	2.68	0.011	0.89	1.53	0.69	45.2	43.3	40,820.10	Box	Concrete	1.83	0.91
3700	0 (Polyline)-1262	MH-1215	MH-2189	3.23	2.93	1.64	1.62	50	2.69	0.011	0.89	1.53	0.7	45.7	42.2	43,565.30	Box	Concrete	1.83	0.91
4982	0 (Polyline)-1263	MH-2189	MH-2067	2.93	2.87	1.62	1.59	50	2.76	0.011	0.93	1.53	0.79	51.9	38.2	52,291.30	Box	Concrete	1.83	0.91
3437	0 (Polyline)-1264	MH-2067	O-72	2.87	3	1.59	1.35	39.08	2.31	0.011	2.35	5.36	1.02	19	36.7	69,688.70	Box	Concrete	1.83	0.91
2775	0 (Polyline)-1280	MH-1731	MH-859	3.63	3.38	2.92	2.67	48.17	0.98	0.011	1.53	0.69	0.17	25	38.5	8,714.20	Box	Concrete	0.61	0.61
1336	0 (Polyline)-1279	MH-859	MH-858	3.38	3.32	2.67	2.09	35.48	0.94	0.011	2.63	1.23	0.27	21.5	70.8	13,809.50	Box	Concrete	0.61	0.61
2582	0 (Polyline)-1269	MH-1624	MH-1625	3.76	3.36	3.05	2.62	47.55	0.73	0.011	1.16	0.91	0.04	4.6	28.4	2,122.70	Box	Concrete	0.61	0.61
1161	0 (Polyline)-1276	MH-744	MH-743	3.55	3.47	2.84	2.76	33.02	0.78	0.011	0.72	0.46	0.04	8.3	54	1,929.50	Box	Concrete	0.61	0.61
4352	0 (Polyline)-1275	MH-743	MH-2477	3.47	3.41	2.76	2.7	50	1.24	0.011	0.93	0.34	0.18	51.8	62.5	9,309.00	Box	Concrete	0.61	0.61
4430	0 (Polyline)-1274	MH-2477	MH-1244	3.41	3.5	2.7	2.63	43.07	1.46	0.011	1.19	0.4	0.31	76.9	58.9	16,949.00	Box	Concrete	0.61	0.61
5612	0 (Polyline)-1273(2)	MH-1244	MH-1625	3.5	3.36	2.64	2.62	17.65	1.63	0.011	1.03	0.54	0.34	63.2	47.3	19,307.00	Box	Concrete	0.91	0.61
5611	0 (Polyline)-1273(1)	MH-1625	MH-1243	3.36	2.95	2.62	2.24	39.33	1.29	0.011	2.32	1.59	0.4	25	52.9	22,863.50	Box	Concrete	0.91	0.61
2493	0 (Polyline)-1272	MH-1243	MH-1573	2.95	2.83	2.24	2.12	50	1.56	0.011	1.51	0.82	0.44	54.2	69.6	25,923.50	Box	Concrete	0.91	0.61
3011	0 (Polyline)-1271	MH-1573	MH-1271	2.83	2.57	2.12	1.86	50	1.5	0.011	2.08	1.17	0.56	47.6	96.9	33,729.60	Box	Concrete	0.91	0.61
5610	0 (Polyline)-1270(2)	MH-1271	MH-1825	2.57	2.53	1.86	1.72	41.55	1.66	0.011	1.11	0.93	0.62	66.3	125.7	38,204.80	Box	Concrete	0.91	0.61
2951	0 (Polyline)-1277	MH-1825	MH-1826	2.53	2.5	1.72	1.64	47.72	1.92	0.011	1.23	0.69	0.68	99.2	141.7	43,596.10	Box	Concrete	0.91	0.61
4081	0 (Polyline)-1278	MH-1826	MH-858	2.5	3.32	2.09	1.64	67.42	1.61	0.011	2.03	0.8	0.76	95.1	169	50,372.90	Box	Concrete	0.61	0.61
9839	CO-383	MH-858	MH-3090	3.32	3.5	2.09	2	62.32	2.33	0.011	1.53	1.58	1.03	65.2	67.2	70,216.40	Box	Concrete	1.22	0.91
9843	CO-385	MH-3090	MH-3091	3.5	3.01	2	1.95	79.82	2.72	0.011	1.1	1.03	1.01	97.8	65.6	70,216.40	Box	Concrete	1.22	0.91
9847	CO-386(1)	MH-3091	MH-3093	3.01	3.17	1.95	1.9	82.6	2.73	0.011	1.08	1.34	0.99	74.3	61.3	72,448.00	Box	Concrete	1.52	0.91
9848	CO-386(2)	MH-3093	O-187	3.17	3.29	1.9	1.85	106.99	2.9	0.011	1	1.18	1.05	89	50.2	80,237.00	Box	Concrete	1.52	0.91
3946	0 (Polyline)-1800	MH-1978	MH-235	3.43	3.71	2.29	2.27	36.22	0.74	0.011	0.08	0.22	0.03	14	100.9	1,531.60	Box	Concrete	0.61	0.61
3244	0 (Polyline)-1799	MH-1686	MH-1978	3.02	3.43	2.31	2.29	50	0.83	0.011	0.19	0.22	0.07	32.5	97.1	5,092.70	Box	Concrete	0.61	0.61
2693	0 (Polyline)-1798	O-201	MH-1686	3.37	3.02	2.66	2.31	50	0.9	0.011	0.28	0.8	0.1	13	59.2	8,820.00	Box	Concrete	0.61	0.61
4246	EX (Polyline)-1333	MH-2435	MH-2436	4.75	4.52	4.04	3.81	50	0.98	0.019	0.85	0.38	0.1	25	46.4	4,819.60	Box	Concrete	0.61	0.61
4724	EX (Polyline)-1334	MH-2436	MH-2562	4.52	4.21	3.81	3.5	50	1.33	0.019	1.26	0.45	0.28	61.9	68.2	14,636.70	Box	Concrete	0.61	0.61
5438	EX (Polyline)-1335(1)	MH-2562	MH-88	4.21	4.13	3.5	3.42	37.32	1.88	0.019	0.92	0.43	0.41	94.3	75.8	22,312.20	Box	Concrete	0.91	0.61
5051	0 (Polyline)-1343	MH-2733	MH-88	4.25	4.13	3.54	3.42	54.45	0.79	0.011	0.72	0.46	0.04	8.4	64.8	1,943.40	Box	Concrete	0.61	0.61
5439	EX (Polyline)-1335(2)	MH-88	MH-2563	4.13	4.08	3.42	3.37	12.69	1.83	0.019	1.18	0.56	0.49	87.1	74.6	27,971.10	Box	Concrete	0.91	0.61
4921	EX (Polyline)-1336	MH-2563	MH-2608	4.08	4.15	3.37	3.14	50	1.82	0.019	1.35	0.65	0.56	86.8	70.4	32,284.30	Box	Concrete	0.91	0.61
4671	EX (Polyline)-1337	MH-2608	MH-2440	4.15	4.26	3.14	3.04	50	2.38	0.019	0.99	1.4	0.64	46	40.8	38,359.40	Box	Concrete	1.52	0.91
5436	EX (Polyline)-1338(1)	MH-2440	MH-338	4.26	4.11	3.04	2.74	38.6	2.06	0.019	1.58	2.76	0.65	23.6	52.8	40,665.30	Box	Concrete	1.52	0.91
1601	0 (Polyline)-1340	MH-1025	MH-1026	3.68	3.5	2.97	2.77	46.5	0.88	0.011	1.22	0.63	0.1	15.8	81.5	5,048.60	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
3477	0 (Polyline)-1341	MH-1026	MH-338	3.5	4.11	2.77	2.74	67.5	1.4	0.011	0.58	0.35	0.13	36.7	99.9	6,772.50	Box	Concrete	0.91	0.61
5437	EX (Polyline)-1338(2)	MH-338	MH-543	4.11	3.87	2.74	2.73	15.97	3.18	0.019	0.63	0.89	0.77	86.9	68.4	49,255.60	Box	Concrete	1.83	0.91
856	EX (Polyline)-1339	MH-543	O-135	3.87	3.91	2.73	2.72	19.76	3.15	0.019	0.62	0.89	0.75	84.7	68.2	49,255.60	Box	Concrete	1.83	0.91
3692	0 (Polyline)-2091	MH-2185	MH-2030	3	3.27	2.38	2.35	49.52	1.27	0.011	0.52	0.36	0.09	23.5	93.2	4,352.30	Box	Concrete	0.91	0.61
3358	0 (Polyline)-2092	MH-2030	MH-143	3.27	3.5	2.35	1.69	62.98	1.08	0.011	1.61	1.67	0.12	7.4	149.5	6,761.30	Box	Concrete	0.91	0.61
2007	0 (Polyline)-1357	MH-1279	MH-1280	4.54	4.45	3.83	3.59	44.22	0.68	0.011	0.64	0.71	0.01	1.8	37.6	652.1	Box	Concrete	0.61	0.61
708	0 (Polyline)-1836	MH-445	MH-446	4.9	5	4.19	3.93	20.41	0.66	0.011	0.81	1.08	0.01	1.1	23.3	609	Box	Concrete	0.61	0.61
988	EX (Polyline)-1332	MH-630	MH-629	4.7	4.92	3.99	3.98	28.25	0.89	0.019	0.25	0.12	0.02	17	42.6	1,076.80	Box	Concrete	0.61	0.61
4757	EX (Polyline)-1331	MH-629	MH-1419	4.92	5	3.98	3.95	50.78	1.21	0.019	0.33	0.12	0.06	48.5	42.6	3,373.90	Box	Concrete	0.61	0.61
5445	EX (Polyline)-1330(2)	MH-1419	MH-446	5	5	3.95	3.93	38.4	1.15	0.019	0.32	0.12	0.05	42	41.3	3,373.90	Box	Concrete	0.61	0.61
5444	EX (Polyline)-1330(1)	MH-446	MH-1418	5	4.63	3.93	3.92	9.53	1.04	0.019	0.47	0.2	0.06	31.4	41.4	4,321.50	Box	Concrete	0.61	0.61
4266	EX (Polyline)-1329	MH-1418	MH-2442	4.63	4.5	3.92	3.79	50.43	1	0.019	0.65	0.29	0.08	27.5	49.5	5,572.50	Box	Concrete	0.61	0.61
5443	EX (Polyline)-1328(2)	MH-2442	MH-2585	4.5	4.5	3.79	3.73	29.03	1.16	0.019	0.68	0.26	0.11	43.8	60.1	8,484.20	Box	Concrete	0.61	0.61
4940	EX (Polyline)-1315	MH-2695	MH-136	4.5	4.5	3.79	3.77	48.36	0.97	0.019	0.27	0.12	0.03	23.9	61.4	1,511.60	Box	Concrete	0.61	0.61
237	EX (Polyline)-1316	MH-136	MH-137	4.5	4.5	3.77	3.76	6.28	1.16	0.019	0.32	0.12	0.05	43.7	63.3	3,216.90	Box	Concrete	0.61	0.61
4950	EX (Polyline)-1327	MH-137	MH-2680	4.5	4.5	3.76	3.74	50.35	1.37	0.019	0.36	0.12	0.08	66.6	63.6	4,994.10	Box	Concrete	0.61	0.61
5442	EX (Polyline)-1328(1)	MH-2680	MH-2585	4.5	4.5	3.74	3.73	20.78	1.49	0.019	0.38	0.12	0.1	80.5	63.3	6,829.50	Box	Concrete	0.61	0.61
4607	0 (Polyline)-1347	MH-2585	MH-2414	4.5	4.81	3.73	3.7	49.01	1.61	0.011	0.69	0.36	0.22	60	63.6	16,715.80	Box	Concrete	0.91	0.61
4190	0 (Polyline)-1348	MH-2414	MH-2216	4.81	4.56	3.7	3.68	50	1.71	0.011	0.73	0.36	0.26	72.9	63.9	21,330.10	Box	Concrete	0.91	0.61
3753	0 (Polyline)-1349	MH-2216	MH-1313	4.56	4.54	3.68	3.65	50	1.83	0.011	0.76	0.36	0.32	87.9	61.8	26,556.50	Box	Concrete	0.91	0.61
2063	0 (Polyline)-1350	MH-1313	MH-1024	4.54	4.47	3.65	3.63	50	1.97	0.011	0.77	0.52	0.35	67.3	59.7	30,248.50	Box	Concrete	1.22	0.61
1599	0 (Polyline)-1351	MH-1024	MH-973	4.47	4.5	3.63	3.6	50	2	0.011	0.78	0.52	0.37	71	58.8	32,970.50	Box	Concrete	1.22	0.61
5440	0 (Polyline)-1352(1)	MH-973	MH-1280	4.5	4.45	3.6	3.59	22.33	2.02	0.011	0.79	0.52	0.38	73	57.6	35,049.80	Box	Concrete	1.22	0.61
5441	0 (Polyline)-1352(2)	MH-1280	MH-974	4.45	4.38	3.59	3.58	27.67	2.03	0.011	0.79	0.52	0.39	74.7	56.1	36,391.80	Box	Concrete	1.22	0.61
3221	0 (Polyline)-1353	MH-974	MH-1770	4.38	4.33	3.58	3.55	50	2.03	0.011	0.79	0.52	0.39	75.3	52.2	37,241.10	Box	Concrete	1.22	0.61
2849	0 (Polyline)-1354	MH-1770	MH-1771	4.33	4.17	3.55	3.46	50	1.76	0.011	1.26	0.99	0.42	42	53.6	40,236.70	Box	Concrete	1.22	0.61
4677	0 (Polyline)-1355	MH-1771	MH-1440	4.17	4.19	3.46	3.44	50	2.13	0.011	0.83	0.52	0.46	88.2	50	45,425.60	Box	Concrete	1.22	0.61
2269	0 (Polyline)-1356	MH-1440	MH-1441	4.19	3.87	3.44	2.21	45.12	1.47	0.011	3.28	3.86	0.49	12.8	79.5	49,712.20	Box	Concrete	1.22	0.61
2817	0 (Polyline)-1345	MH-1753	MH-7	4.42	4.23	3.71	2.24	50.81	0.74	0.011	2.19	1.64	0.09	5.3	68.3	4,390.00	Box	Concrete	0.61	0.61
563	0 (Polyline)-1314	MH-352	MH-351	4.49	4.35	3.78	3.64	15.41	0.67	0.011	0.76	0.91	0.01	1.5	40.6	684.9	Box	Concrete	0.61	0.61
3006	0 (Polyline)-1309	MH-1853	MH-1850	4.8	4.76	4.09	4.05	50	1.41	0.011	0.73	0.25	0.18	71.4	60.7	9,078.30	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
3001	0 (Polyline)-1310	MH-1850	MH-1851	4.76	4.69	4.05	3.98	50	1.29	0.011	1	0.36	0.21	57.4	61.8	11,086.10	Box	Concrete	0.61	0.61
4803	0 (Polyline)-1311	MH-1851	MH-1396	4.69	4.63	3.98	3.92	50	1.48	0.011	1	0.34	0.27	79.8	56.7	14,957.50	Box	Concrete	0.61	0.61
5462	0 (Polyline)-1312(1)	MH-1396	MH-351	4.63	4.35	3.92	3.64	34.95	1.1	0.011	2.15	0.87	0.32	37	50.8	18,716.50	Box	Concrete	0.61	0.61
5463	0 (Polyline)-1312(2)	MH-351	MH-1397	4.35	4.06	3.64	3.35	12.43	0.96	0.011	3.2	1.48	0.34	23	41.8	20,109.60	Box	Concrete	0.61	0.61
2416	0 (Polyline)-1313	MH-1397	MH-1528	4.06	4.16	3.35	2.34	48.33	1.44	0.011	2.71	3.39	0.37	10.8	74.9	21,803.50	Box	Concrete	1.22	0.61
3047	0 (Polyline)-1607	MH-1875	MH-1705	3.78	4.1	3.07	3.04	50	1.07	0.011	0.53	0.22	0.07	34.2	31.8	3,740.20	Box	Concrete	0.61	0.61
2727	0 (Polyline)-1608	MH-1705	MH-1706	4.1	4.34	3.04	2.4	48.55	0.85	0.011	2.05	1.11	0.15	13.6	72.3	8,274.80	Box	Concrete	0.61	0.61
3995	0 (Polyline)-1589	MH-196	MH-1439	3.92	3.85	3.21	3.14	58.27	1.03	0.011	0.77	0.33	0.1	29.8	31.3	4,936.10	Box	Concrete	0.61	0.61
5355	0 (Polyline)-1588(2)	MH-1439	MH-275	3.85	3.7	3.14	2.51	27.2	0.8	0.011	2.44	1.48	0.15	9.8	71.5	7,817.50	Box	Concrete	0.61	0.61
3023	0 (Polyline)-1603	MH-1861	MH-1862	3.57	3.82	2.86	2.83	50	1.29	0.011	0.6	0.22	0.12	57.2	70.3	6,257.20	Box	Concrete	0.61	0.61
4687	0 (Polyline)-1604	MH-1862	MH-2614	3.82	3.86	2.83	2.81	50	1.58	0.011	0.67	0.22	0.2	91.3	70.5	10,696.10	Box	Concrete	0.61	0.61
4889	0 (Polyline)-1605	MH-2614	MH-284	3.86	4	2.81	2.78	44.77	1.72	0.011	0.73	0.36	0.27	73.8	69.9	15,537.20	Box	Concrete	0.91	0.61
462	0 (Polyline)-1606	MH-284	MH-285	4	3.94	2.78	2.78	17.59	1.75	0.011	0.74	0.36	0.28	77.8	70.2	17,339.90	Box	Concrete	0.91	0.61
4391	0 (Polyline)-1582	MH-2494	MH-2423	4.78	4.55	4.07	3.84	50	0.79	0.011	1.06	0.66	0.06	8.9	20.6	2,970.30	Box	Concrete	0.61	0.61
4213	0 (Polyline)-1583	MH-2423	MH-1009	4.55	4.67	3.84	3.53	50	0.87	0.011	1.46	0.77	0.11	15	41.8	6,050.10	Box	Concrete	0.61	0.61
3434	0 (Polyline)-2042	MH-2065	MH-1009	4.26	4.67	3.55	3.53	49.61	1.47	0.011	0.65	0.22	0.17	78.7	59.7	8,610.90	Box	Concrete	0.61	0.61
1575	0 (Polyline)-1584	MH-1009	MH-1010	4.67	4.21	3.53	3.5	50	1.77	0.011	0.79	0.39	0.31	80.1	55.3	16,748.00	Box	Concrete	0.91	0.61
3558	0 (Polyline)-1585	MH-1010	MH-1892	4.21	4.07	3.5	3.36	50	1.48	0.011	1.48	0.85	0.38	45.4	60.9	22,002.80	Box	Concrete	0.91	0.61
3081	0 (Polyline)-1586	MH-1892	MH-1893	4.07	4.01	3.36	3.3	50	1.86	0.011	1.16	0.55	0.5	91.5	60.9	29,562.20	Box	Concrete	0.91	0.61
5356	0 (Polyline)-1587(1)	MH-1893	MH-285	4.01	3.94	3.3	3.23	4.94	1.29	0.011	2.93	1.99	0.51	25.8	45.8	31,476.30	Box	Concrete	0.91	0.61
5357	0 (Polyline)-1587(2)	MH-285	MH-1438	3.94	3.58	2.78	2.57	39.14	1.68	0.011	2.29	1.17	0.8	68.4	87.1	50,138.70	Box	Concrete	0.91	0.61
5354	0 (Polyline)-1588(1)	MH-1438	MH-275	3.58	3.7	2.57	2.51	28.72	2.02	0.011	1.7	1.98	0.82	41.6	72.9	52,689.10	Box	Concrete	1.22	0.91
447	0 (Polyline)-1581	MH-275	MH-274	3.7	3.85	2.51	2.5	12.83	2.77	0.011	0.99	1.22	0.94	77.4	76.3	61,139.20	Box	Concrete	1.52	0.91
2591	0 (Polyline)-1580	MH-274	MH-188	3.85	4.22	2.5	2.48	50	2.78	0.011	1	1.22	0.95	78.4	76.8	62,798.40	Box	Concrete	1.52	0.91
2496	0 (Polyline)-1609	MH-1574	MH-188	3.91	4.22	3.2	2.48	46.53	0.84	0.011	2.19	1.2	0.16	13	73	7,944.10	Box	Concrete	0.61	0.61
314	0 (Polyline)-1579	MH-188	MH-187	4.22	4.21	2.48	2.47	10.19	2.88	0.011	1.03	1.22	1.06	87.5	77.2	72,511.30	Box	Concrete	1.52	0.91
2155	0 (Polyline)-1578	MH-187	MH-1369	4.21	4.14	2.47	2.45	47.86	2.9	0.011	1.03	1.22	1.09	89.2	77.3	74,374.30	Box	Concrete	1.52	0.91
2367	0 (Polyline)-1577	MH-1369	MH-1500	4.14	4.33	2.45	2.42	50	2.94	0.011	1.04	1.22	1.13	92.7	77.3	79,479.10	Box	Concrete	1.52	0.91
4092	0 (Polyline)-1576	MH-1500	MH-1706	4.33	4.34	2.42	2.4	50.05	3	0.011	1.06	1.22	1.19	97.7	77	86,337.00	Box	Concrete	1.52	0.91
4066	0 (Polyline)-1575	MH-1706	MH-2359	4.34	4.41	2.4	2.37	49.95	3.18	0.011	1.08	1.53	1.33	87.1	76.9	99,916.50	Box	Concrete	1.83	0.91
4886	0 (Polyline)-1574	MH-2359	MH-796	4.41	4.44	2.37	2.35	50	3.19	0.011	1.09	1.53	1.36	88.7	77.2	1,04,901.50	Box	Concrete	1.83	0.91
5461	0 (Polyline)-1573(2)	MH-796	MH-1528	4.44	4.16	2.35	2.34	19.11	3.18	0.011	1.08	1.53	1.34	87.5	77.3	1,06,806.20	Box	Concrete	1.83	0.91
5460	0 (Polyline)-1573(1)	MH-1528	MH-795	4.16	4.09	2.34	2.32	26.53	3.48	0.011	1.13	1.84	1.62	88.1	77.5	1,30,790.80	Box	Concrete	2.13	0.91
3772	0 (Polyline)-1572	MH-795	MH-2226	4.09	4.09	2.32	2.3	42.21	3.5	0.011	1.13	1.84	1.65	89.8	77.7	1,34,807.70	Box	Concrete	2.13	0.91
4233	0 (Polyline)-1571	MH-2226	MH-2192	4.09	4.35	2.3	2.27	62.33	3.52	0.011	1.14	1.84	1.69	92.1	78	1,40,753.10	Box	Concrete	2.13	0.91
3705	0 (Polyline)-1570	MH-2192	MH-2002	4.35	4.16	2.27	2.25	50	3.54	0.011	1.15	1.84	1.72	93.3	78.1	1,46,359.50	Box	Concrete	2.13	0.91

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
5339	0 (Polyline)-1569(2)	MH-2002	MH-7	4.16	4.23	2.25	2.24	8.33	4.29	0.019	0.77	1.92	1.73	89.8	58.1	1,50,566.60	Box	Concrete	2.44	1.22
5338	0 (Polyline)-1569(1)	MH-7	MH-1700	4.23	4.07	2.24	2.23	30.06	3.73	0.011	1.14	3.32	1.8	54.2	58.1	1,57,631.20	Box	Concrete	2.44	1.22
5341	0 (Polyline)-1568(2)	MH-1700	MH-1441	4.07	3.87	2.23	2.21	28.16	3.73	0.011	1.14	3.32	1.8	54.2	58.4	1,59,977.20	Box	Concrete	2.44	1.22
5340	0 (Polyline)-1568(1)	MH-1441	MH-1699	3.87	3.51	2.21	2.19	32.44	3.8	0.011	1.25	3.56	2.08	58.4	58.7	2,11,050.00	Box	Concrete	2.44	1.22
4635	0 (Polyline)-1567	MH-1699	MH-2252	3.51	3.5	2.19	2.17	49.59	3.88	0.011	1.2	3.32	2.1	63.3	58.8	2,15,721.30	Box	Concrete	2.44	1.22
5337	0 (Polyline)-1566(2)	MH-2252	MH-143	3.5	3.5	2.17	1.69	24.14	2.86	0.011	4.1	21.02	2.11	10	80.4	2,20,013.60	Box	Concrete	2.44	1.22
5336	0 (Polyline)-1566(1)	MH-143	O-123	3.5	3.5	1.69	1.68	24.59	4.05	0.011	0.73	2.94	2.18	74.2	102.1	2,28,413.50	Box	Concrete	2.44	1.22
3450	0 (Polyline)-1965	MH-2073	MH-1550	3.84	3.59	3.13	2.88	50	0.81	0.011	1.15	0.68	0.07	10.5	39.9	3,620.30	Box	Concrete	0.61	0.61
2453	0 (Polyline)-1966	MH-1550	MH-1529	3.59	3.68	2.88	2.85	50	1.56	0.011	0.66	0.22	0.19	89	58.4	10,083.50	Box	Concrete	0.61	0.61
2418	0 (Polyline)-1967	MH-1529	MH-903	3.68	3.7	2.85	2.83	50	1.8	0.011	0.75	0.36	0.3	83.2	48.5	16,902.90	Box	Concrete	0.91	0.61
1409	0 (Polyline)-1968	MH-903	MH-904	3.7	3.27	2.83	2.56	50	1.34	0.011	1.84	1.18	0.36	30.8	47.3	21,562.60	Box	Concrete	0.91	0.61
2248	0 (Polyline)-1969	MH-904	MH-759	3.27	3.17	2.56	2.46	50	1.56	0.011	1.38	0.75	0.41	54.8	51	24,894.60	Box	Concrete	0.91	0.61
1185	0 (Polyline)-1970	MH-759	O-124	3.17	2.81	2.46	1.27	33.94	1.18	0.011	3.77	3.03	0.46	15.3	124.9	29,288.60	Box	Concrete	0.91	0.61
1035	0 (Polyline)-1596	MH-660	MH-661	3.33	3.2	2.62	2.49	29.61	0.8	0.011	1.03	0.62	0.06	9.8	40.6	3,096.00	Box	Concrete	0.61	0.61
1885	0 (Polyline)-1597	MH-1203	MH-1204	3.75	3.96	3.04	3.01	50	1.15	0.011	0.56	0.22	0.09	42.8	47.6	4,678.50	Box	Concrete	0.61	0.61
2491	0 (Polyline)-1598	MH-1204	MH-1572	3.96	3.84	3.01	2.99	46.4	1.38	0.011	0.63	0.22	0.15	68.4	42.7	8,058.40	Box	Concrete	0.61	0.61
5352	0 (Polyline)-1591(1)	MH-2142	MH-1572	3.95	3.84	3.24	2.99	37.18	0.75	0.011	1.11	0.8	0.05	5.9	25.7	2,400.50	Box	Concrete	0.61	0.61
5353	0 (Polyline)-1591(2)	MH-1572	MH-1230	3.84	3.82	2.99	2.98	12.82	1.57	0.011	0.68	0.36	0.2	56.3	34	11,896.90	Box	Concrete	0.91	0.61
1928	0 (Polyline)-1592	MH-1230	MH-1166	3.82	3.46	2.98	2.75	50	1.24	0.011	1.53	1.12	0.23	20.5	33.3	13,596.90	Box	Concrete	0.91	0.61
5350	0 (Polyline)-1593(1)	MH-1166	MH-661	3.46	3.2	2.75	2.49	48.87	1.29	0.011	1.7	1.16	0.29	25.1	43.3	17,860.70	Box	Concrete	0.91	0.61
3298	0 (Polyline)-1594	MH-661	MH-158	3.2	3.26	2.49	2.47	47.26	2	0.011	0.78	0.52	0.37	71.3	43	23,430.00	Box	Concrete	1.22	0.61
270	0 (Polyline)-1595	MH-158	O-125	3.26	2.97	2.47	2.29	11.24	1.47	0.011	2.53	2.96	0.38	12.8	51.5	25,342.80	Box	Concrete	1.22	0.61
1689	0 (Polyline)-1797	MH-1081	MH-1082	2.92	2.99	2.21	1.98	41.36	0.78	0.011	0.16	0.72	0.06	8.3	127.3	3,009.00	Box	Concrete	0.61	0.61
3922	0 (Polyline)-1818	MH-2296	MH-1415	3.67	3.48	2.96	2.77	50	1.01	0.011	1.38	0.6	0.17	28.5	54.3	8,625.90	Box	Concrete	0.61	0.61
2229	0 (Polyline)-1819	MH-1415	MH-1416	3.48	3.68	2.77	2.74	50	1.74	0.011	0.74	0.36	0.28	76.7	69.1	14,525.20	Box	Concrete	0.91	0.61
4624	0 (Polyline)-1820	MH-1416	MH-333	3.68	4.08	2.74	2.72	50	1.98	0.011	0.77	0.52	0.36	68.5	69.8	19,784.00	Box	Concrete	1.22	0.61
536	0 (Polyline)-1821	MH-333	MH-334	4.08	3.9	2.72	2.71	20.12	1.99	0.011	0.78	0.52	0.37	70.1	70.7	21,433.00	Box	Concrete	1.22	0.61
4249	0 (Polyline)-1600	MH-334	MH-2354	3.9	4.22	2.71	2.68	50	2	0.011	0.78	0.52	0.37	71.1	71.5	22,291.10	Box	Concrete	1.22	0.61
4056	0 (Polyline)-1601	MH-2354	MH-519	4.22	4.18	2.68	2.66	50	2.05	0.011	0.8	0.52	0.4	76.9	72.5	25,636.40	Box	Concrete	1.22	0.61
820	0 (Polyline)-1602	MH-519	MH-520	4.18	4.18	2.66	2.65	22.46	2.06	0.011	0.8	0.52	0.41	78.3	73.1	27,554.60	Box	Concrete	1.22	0.61
1451	0 (Polyline)-1796	MH-932	MH-931	4.75	4.52	4.04	3.81	37.53	0.73	0.011	0.94	0.75	0.03	4.5	16.6	1,691.20	Box	Concrete	0.61	0.61

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4932	0 (Polyline)-1795	MH-931	MH-2624	4.52	4.25	3.81	3.54	50	0.85	0.011	1.32	0.72	0.1	13.2	26.6	4,974.40	Box	Concrete	0.61	0.61
4717	0 (Polyline)-1794	MH-2624	MH-855	4.25	4.02	3.54	3.31	50	0.97	0.011	1.42	0.64	0.16	24.4	32.8	8,463.20	Box	Concrete	0.61	0.61
5373	0 (Polyline)-1793(2)	MH-855	MH-520	4.02	4.18	3.31	2.65	25.33	0.83	0.011	2.76	1.57	0.18	11.8	53.9	10,290.50	Box	Concrete	0.61	0.61
5372	0 (Polyline)-1793(1)	MH-520	MH-854	4.18	3.88	2.65	2.63	24.69	2.28	0.011	0.88	0.92	0.56	61.2	48.6	38,605.30	Box	Concrete	1.22	0.91
3497	0 (Polyline)-1792	MH-854	MH-2095	3.88	3.58	2.63	2.57	50	1.98	0.011	1.27	1.52	0.59	38.9	49.9	41,105.90	Box	Concrete	1.22	0.91
4388	0 (Polyline)-1791	MH-2095	MH-1391	3.58	3.81	2.57	2.54	50	2.39	0.011	0.91	0.92	0.65	70.1	50	46,050.80	Box	Concrete	1.22	0.91
2191	0 (Polyline)-1790	MH-1391	MH-1390	3.81	3.48	2.54	2.47	50	2.05	0.011	1.35	1.56	0.69	44.2	49.1	50,878.20	Box	Concrete	1.22	0.91
5345	0 (Polyline)-1789(2)	MH-1390	MH-332	3.48	3.48	2.47	2.45	29.54	2.52	0.011	0.94	0.92	0.74	80.9	46.7	56,419.30	Box	Concrete	1.22	0.91
3332	0 (Polyline)-1785	MH-2020	MH-376	3.86	3.86	3.15	3.13	50	1.22	0.011	0.58	0.22	0.11	50.2	33.5	5,490.00	Box	Concrete	0.61	0.61
601	0 (Polyline)-1786	MH-376	MH-377	3.86	3.62	3.13	2.81	15.65	0.8	0.011	2.24	1.37	0.13	9.6	36.2	7,098.60	Box	Concrete	0.61	0.61
2330	0 (Polyline)-1787	MH-1478	MH-1479	3.7	3.54	2.99	2.83	50	0.88	0.011	1.05	0.54	0.08	15.6	37.2	4,292.30	Box	Concrete	0.61	0.61
5348	0 (Polyline)-1788(1)	MH-1479	MH-377	3.54	3.62	2.83	2.81	40.88	1.34	0.011	0.62	0.22	0.14	63.8	47	7,252.10	Box	Concrete	0.61	0.61
5344	0 (Polyline)-1789(1)	MH-377	MH-332	3.62	3.48	2.81	2.45	29.58	0.99	0.011	2.39	1.06	0.27	25.8	54.6	15,291.00	Box	Concrete	0.61	0.61
533	0 (Polyline)-1784	MH-332	MH-331	3.48	3.08	2.45	2.07	13.97	1.59	0.011	4.13	6.85	0.94	13.7	65.6	72,642.20	Box	Concrete	1.22	0.91
5809	CO-10	MH-331	MH-1082	3.08	2.99	2.07	1.98	24.26	1.97	0.011	2.08	2.5	0.95	37.9	93	73,396.40	Box	Concrete	1.22	0.91
5346	0 (Polyline)-1782(1)	MH-1082	MH-2304	2.99	3.41	1.98	1.96	43.66	2.83	0.011	1.01	1.22	1.01	82.8	98.6	78,759.90	Box	Concrete	1.52	0.91
9992	0 (Polyline)-1781(1)	MH-2304	MH-3107	3.41	3.89	1.96	-1.63	43	1.77	0.011	5.89	15.7	1.11	7	295.2	89,151.80	Box	Concrete	1.52	0.91
9995	0(Polyline)-781(2)(1)	MH-3107	MH-3108	3.89	3.32	1.96	-1.63	56.39	1.79	0.011	5.39	13.71	1.1	8	293.1	89,151.80	Box	Concrete	1.52	0.91
9996	0(Polyline)-781(2)(2)	MH-3108	O-122	3.32	2.75	1.96	-1.63	55.31	1.79	0.011	5.42	13.85	1.1	7.9	290.8	89,151.80	Box	Concrete	1.52	0.91
4534	0 (Polyline)-442	MH-2554	MH-2320	3.81	4.13	3.1	3.08	50	1.03	0.011	0.51	0.22	0.06	30.1	38	3,290.50	Box	Concrete	0.61	0.61
3981	0 (Polyline)-443	MH-2320	MH-727	4.13	3.87	3.08	3.05	50	1.48	0.011	0.64	0.36	0.16	45.1	34.5	9,003.40	Box	Concrete	0.91	0.61
1137	0 (Polyline)-444	MH-727	MH-728	3.87	3.33	3.05	2.22	32.18	1.1	0.011	2.67	2.62	0.23	8.7	52.6	13,436.50	Box	Concrete	0.91	0.61
4903	0 (Polyline)-469	MH-2683	MH-725	3.01	3.46	2.3	2.28	50	0.87	0.011	0.41	0.22	0.03	14.8	67.2	1,615.30	Box	Concrete	0.61	0.61
1134	0 (Polyline)-470	MH-725	MH-726	3.46	3.35	2.28	2.26	32.14	1.25	0.011	0.51	0.36	0.08	21.8	70.4	4,450.90	Box	Concrete	0.91	0.61
2252	0 (Polyline)-476	MH-1430	MH-1429	3.26	3.25	2.55	2.53	44.47	0.97	0.011	0.47	0.22	0.05	23.7	29.4	2,596.60	Box	Concrete	0.61	0.61
4410	EXI-475	MH-1429	MH-726	3.25	3.35	2.53	2.26	56.2	0.95	0.011	1.42	0.66	0.15	21.9	50.6	7,962.70	Box	Concrete	0.61	0.61
5327	EXI-474(1)	MH-726	MH-1351	3.35	3.34	2.26	2.24	43.8	1.91	0.011	0.74	0.52	0.31	59.4	72.6	18,457.70	Box	Concrete	1.22	0.61
5330	EXI-473(2)	MH-1351	MH-728	3.34	3.33	2.24	2.22	42	2.01	0.011	0.79	0.92	0.38	41.3	49.7	23,918.10	Box	Concrete	1.22	0.91
5329	0 (Polyline)-473(1)	MH-728	MH-1350	3.33	3.27	2.22	2.21	8	2.34	0.011	0.9	0.92	0.61	66.6	49.9	40,668.10	Box	Concrete	1.22	0.91
4473	0 (Polyline)-472	MH-1350	MH-2528	3.27	3.28	2.21	2.19	50	2.36	0.011	0.9	0.92	0.63	68.2	47.2	41,905.30	Box	Concrete	1.22	0.91
4650	0 (Polyline)-471	MH-2528	O-134	3.28	3.58	2.19	-0.66	50	1.45	0.011	4.57	9.83	0.64	6.5	204.4	44,184.20	Box	Concrete	1.22	0.91
1831	0 (Polyline)-445	MH-1169	MH-1170	3.56	3.47	2.85	1.66	41.07	0.68	0.011	1.59	1.64	0.04	2.2	82.5	1,806.90	Box	Concrete	0.61	0.61
1390	0 (Polyline)-468	MH-892	MH-891	3.26	2.9	2.55	2.19	36.96	0.8	0.011	1.55	0.96	0.09	9.2	46.2	4,471.50	Box	Concrete	0.61	0.61
1728	0 (Polyline)-467	MH-891	MH-1105	2.9	3.11	2.19	2.17	40.44	1.47	0.011	0.64	0.22	0.17	78.5	71.2	8,755.20	Box	Concrete	0.61	0.61
5306	0 (Polyline)-466(2)	MH-1105	MH-2689	3.11	2.92	2.17	1.83	21.17	1.11	0.011	2.18	2.06	0.2	9.6	99.5	10,801.90	Box	Concrete	0.91	0.61
495	0 (Polyline)-448	MH-307	MH-306	2.73	2.59	2.02	1.88	13.06	0.66	0.011	0.81	1.01	0.01	1.3	104.6	682.2	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
3628	0 (Polyline)-447	MH-306	MH-2158	2.59	2.98	1.88	1.85	50	1.16	0.011	0.09	0.36	0.05	13.9	121.7	2,585.20	Box	Concrete	0.91	0.61
4917	0 (Polyline)-446	MH-2158	MH-2689	2.98	2.92	1.85	1.83	50	1.5	0.011	0.11	0.52	0.08	15.4	125.7	6,365.70	Box	Concrete	1.22	0.61
5305	0 (Polyline)-466(1)	MH-2689	MH-764	2.92	3.02	1.83	1.81	38.36	1.71	0.011	0.64	0.92	0.19	20.6	86.6	18,686.50	Box	Concrete	1.22	0.91
1191	0 (Polyline)-465	MH-764	MH-763	3.02	2.82	1.81	1.78	50	1.77	0.011	0.67	0.92	0.22	24.3	89	22,600.20	Box	Concrete	1.22	0.91
4314	EXI-464	MH-763	MH-1541	2.82	2.91	1.78	1.76	50	1.8	0.011	0.69	0.92	0.24	26.2	91.6	25,098.60	Box	Concrete	1.22	0.91
2437	EXI-463	MH-1541	MH-1540	2.91	3.15	1.76	1.73	50	1.84	0.011	0.71	0.92	0.26	28.8	94.2	28,359.10	Box	Concrete	1.22	0.91
4528	EXI-462	MH-1540	MH-2552	3.15	3.07	1.73	1.71	50	1.9	0.011	0.74	0.92	0.31	33.4	96.8	33,760.60	Box	Concrete	1.22	0.91
4661	EXI-461	MH-2552	MH-1815	3.07	3.01	1.71	1.68	50	1.97	0.011	0.77	0.92	0.35	37.9	99.3	39,233.20	Box	Concrete	1.22	0.91
5326	EXI-460(2)	MH-1815	MH-1170	3.01	3.47	1.68	1.66	48.83	2.18	0.011	0.28	1.22	0.38	31.3	101.7	43,820.70	Box	Concrete	1.52	0.91
4870	0 (Polyline)-459	MH-1170	MH-2674	3.47	3.31	1.66	1.63	51.17	2.21	0.011	0.29	1.22	0.4	32.8	104.1	48,465.70	Box	Concrete	1.52	0.91
4985	0 (Polyline)-458	MH-2674	O-121	3.31	2	1.63	-1.63	46.47	1.66	0.011	0.27	14.41	0.38	2.6	284.4	48,465.70	Box	Concrete	1.52	0.91
3444	0 (Polyline)-508	MH-2070	MH-1838	2.88	2.83	2.17	1.82	50	1.34	0.011	2.12	1.36	0.42	30.8	54.8	21,254.50	Box	Concrete	0.91	0.61
2978	0 (Polyline)-509	MH-1838	MH-698	2.83	3.25	1.82	1.8	50	2.24	0.011	0.87	0.92	0.54	58.5	36.9	27,809.40	Box	Concrete	1.22	0.91
1093	0 (Polyline)-510	MH-698	MH-699	3.25	3.38	1.8	1.54	31.22	1.62	0.011	2.32	3.7	0.57	15.4	40.5	30,934.20	Box	Concrete	1.22	0.91
1129	0 (Polyline)-500	MH-723	MH-722	2.97	3.08	2.26	2.25	31.85	0.88	0.011	0.42	0.22	0.03	16.2	50.9	1,769.00	Box	Concrete	0.61	0.61
1405	0 (Polyline)-499	MH-722	MH-901	3.08	2.86	2.25	2.15	50	1.09	0.011	1.03	0.42	0.15	36.5	57.7	8,207.10	Box	Concrete	0.61	0.61
4826	0 (Polyline)-498	MH-901	MH-2545	2.86	3.05	2.15	2.13	50	1.77	0.011	0.74	0.36	0.29	80.1	62.2	16,344.30	Box	Concrete	0.91	0.61
4510	0 (Polyline)-497	MH-2545	MH-2544	3.05	3	2.13	2.1	52.88	2.04	0.011	0.8	0.52	0.4	76	60.2	23,745.20	Box	Concrete	1.22	0.61
4953	0 (Polyline)-496	MH-2544	MH-1661	3	2.8	2.1	2.08	47.12	2.16	0.011	0.84	0.52	0.48	91.4	52.6	30,454.80	Box	Concrete	1.22	0.61
2648	0 (Polyline)-495	MH-1661	MH-1660	2.8	2.6	2.08	1.59	50	1.6	0.011	2.47	2.32	0.57	24.5	63.7	38,065.80	Box	Concrete	1.22	0.61
4492	0 (Polyline)-494	MH-1660	MH-1715	2.6	3.32	1.59	1.56	50	2.37	0.011	0.9	0.92	0.63	68.7	53.6	42,880.00	Box	Concrete	1.22	0.91
5302	0 (Polyline)-493(2)	MH-1715	MH-699	3.32	3.38	1.56	1.54	35.65	2.4	0.011	0.91	0.92	0.66	71.5	51.3	46,171.70	Box	Concrete	1.22	0.91
5301	0 (Polyline)-493(1)	MH-699	MH-1714	3.38	3.25	1.54	1.54	14.36	2.9	0.011	1.03	1.22	1.08	88.8	45.5	77,705.10	Box	Concrete	1.52	0.91
9984	0 (Polyline)-492(2)(1)	MH-1714	O-198	3.25	2.5	1.54	1.03	37.8	1.96	0.011	3.24	6.31	1.08	17.2	58	78,548.50	Box	Concrete	1.52	0.91
1319	0 (Polyline)-489	MH-847	MH-848	2.85	2.93	1.65	1.63	50	1.46	0.011	0.44	0.92	0.06	7	10.7	3,277.90	Box	Concrete	1.22	0.91
9981	0 (Polyline)-490(1)	MH-848	O-197	2.93	2.58	1.63	1.03	24.14	1.31	0.011	1.7	6.49	0.09	1.4	42.1	5,066.20	Box	Concrete	1.22	0.91
3799	0 (Polyline)-2002	MH-2239	MH-502	4.14	3.86	3.43	3.15	50	0.73	0.011	0.94	0.72	0.04	5	23.8	1,808.80	Box	Concrete	0.61	0.61
794	0 (Polyline)-2003	MH-502	MH-503	3.86	3.71	3.15	2.9	21.34	0.76	0.011	1.52	1.05	0.07	6.7	57.1	3,725.20	Box	Concrete	0.61	0.61
2188	0 (Polyline)-1805	MH-1388	MH-1389	3.85	3.81	3.14	3.1	50	1.09	0.011	0.69	0.28	0.1	36.3	49.9	5,134.50	Box	Concrete	0.61	0.61
5287	0 (Polyline)-1806(1)	MH-1389	MH-1604	3.81	3.69	3.1	3	24.79	0.96	0.011	1.34	0.62	0.14	23.4	59.8	7,731.30	Box	Concrete	0.61	0.61
5289	0(Polyline)-1806(2)(1)	MH-1604	MH-384	3.69	3.67	3	2.97	12.45	1.34	0.011	1.24	0.8	0.24	30.4	70.1	13,235.50	Box	Concrete	0.91	0.61

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612	0 (Polyline)-1817	MH-384	MH-383	3.67	3.52	2.97	2.95	16.13	1.46	0.011	0.99	0.57	0.25	43.1	73.8	13,587.40	Box	Concrete	0.91	0.61
5292	0 (Polyline)-1816(2)	MH-383	MH-503	3.52	3.71	2.95	2.9	35.58	1.42	0.011	1.06	0.36	0.26	72.5	76.6	14,650.80	Box	Concrete	0.61	0.61
5291	0 (Polyline)-1816(1)	MH-503	MH-2194	3.71	3.83	2.9	2.88	14.42	1.62	0.011	1.12	0.36	0.34	95.8	77.8	19,823.80	Box	Concrete	0.61	0.61
3707	0 (Polyline)-1815	MH-2194	O-211	3.83	3.8	2.88	2.8	50	1.65	0.011	1.21	0.39	0.38	99.6	66.8	22,385.30	Box	Concrete	0.61	0.61
9200	0(Polyline)-2040(1)(2)	MH-2990	MH-2991	3.82	3.75	3.11	3.04	33.23	0.7	0.011	0.47	0.43	0.01	3	14.1	645.7	Box	Concrete	0.61	0.61
9199	0(Polyline)-2040(1)(1)	MH-2991	FO-175	3.75	3.72	3.04	3.01	14.88	0.84	0.011	0.78	0.43	0.06	12.8	18.9	2,957.50	Box	Concrete	0.61	0.61
3248	0 (Polyline)-2223	MH-1980	MH-1900	4.13	3.93	3.42	3.22	50	0.92	0.011	1.27	0.62	0.12	19.3	46	6,062.50	Box	Concrete	0.61	0.61
3095	0 (Polyline)-2224	MH-1900	MH-262	3.93	3.97	3.22	3.19	50	1.77	0.011	0.74	0.36	0.29	79.8	61.5	15,145.90	Box	Concrete	0.91	0.61
429	0 (Polyline)-2225	MH-262	MH-263	3.97	3.88	3.19	3.17	11.24	1.42	0.011	1.34	0.8	0.31	38.3	62.4	17,003.40	Box	Concrete	0.91	0.61
2504	0 (Polyline)-718	MH-1579	MH-1578	4.16	4.02	3.45	3.31	46.64	0.87	0.011	1	0.52	0.08	15.2	60.5	4,004.20	Box	Concrete	0.61	0.61
2001	0 (Polyline)-710	MH-1275	MH-1276	4.15	4.28	3.44	3.41	50	1	0.011	0.49	0.22	0.06	26.7	58	2,924.10	Box	Concrete	0.61	0.61
2338	0 (Polyline)-711	MH-1276	MH-1062	4.28	4.53	3.41	3.39	36.5	1.31	0.011	0.61	0.22	0.13	59.7	59.9	7,099.60	Box	Concrete	0.61	0.61
5366	0 (Polyline)-712(1)	MH-1062	MH-1578	4.53	4.02	3.39	3.31	32.3	1.07	0.011	1.17	0.48	0.16	34.3	65.7	9,556.40	Box	Concrete	0.61	0.61
5367	0 (Polyline)-712(2)	MH-1578	MH-1063	4.02	3.99	3.31	3.28	31.23	1.53	0.011	1.02	0.34	0.29	85	70.6	17,022.40	Box	Concrete	0.61	0.61
3514	0 (Polyline)-713	MH-1063	MH-263	3.99	3.88	3.28	3.17	57.86	1.49	0.011	1.26	0.42	0.34	80.3	67.1	20,782.30	Box	Concrete	0.61	0.61
5370	0 (Polyline)-714(2)(1)	MH-263	MH-114	3.88	3.83	3.17	3.12	14.86	1.67	0.011	1.75	0.89	0.6	67.4	66	38,715.30	Box	Concrete	0.91	0.61
5371	0 (Polyline)-714(2)(2)	MH-114	MH-898	3.83	3.83	3.15	3.11	27.34	1.95	0.011	1.33	0.92	0.6	65.3	64.1	38,715.30	Box	Concrete	1.22	0.61
4596	0 (Polyline)-715	MH-898	MH-2270	3.83	3.76	3.11	3.05	50	2.08	0.011	1.2	0.77	0.63	81.8	59	41,886.30	Box	Concrete	1.22	0.61
3868	0 (Polyline)-716	MH-2270	MH-387	3.76	3.36	3.05	2.65	50	1.68	0.011	2.49	2.11	0.7	33.3	53.5	47,668.90	Box	Concrete	1.22	0.61
618	0 (Polyline)-717	MH-387	MH-388	3.36	3.24	2.65	2.53	16.93	1.72	0.011	2.38	1.95	0.72	37.1	67.5	49,747.20	Box	Concrete	1.22	0.61
5028	0 (Polyline)-1994	MH-2724	MH-971	4.19	3.92	3.48	3.21	50	0.81	0.011	1.18	0.71	0.07	9.9	23.6	3,592.20	Box	Concrete	0.61	0.61
5364	0 (Polyline)-1995(1)	MH-971	MH-2118	3.92	3.77	3.21	3.01	38.88	0.93	0.011	1.45	0.69	0.14	20.7	39.9	7,459.40	Box	Concrete	0.61	0.61
756	0 (Polyline)-2045	MH-478	MH-477	4.38	3.87	3.67	3.16	20.38	0.72	0.011	1.84	1.53	0.06	4	26.5	3,069.90	Box	Concrete	0.61	0.61
2117	0 (Polyline)-2044	MH-477	MH-1345	3.87	3.75	3.16	3.04	50	1	0.011	1.11	0.49	0.13	27.1	44.3	6,753.90	Box	Concrete	0.61	0.61
3541	0 (Polyline)-2043	MH-1345	MH-2118	3.75	3.77	3.04	3.01	50	1.59	0.011	0.68	0.36	0.21	58.5	51.4	11,257.10	Box	Concrete	0.91	0.61
3335	0 (Polyline)-1996	MH-2118	MH-1346	3.77	3.57	3.01	2.86	61.1	1.53	0.011	1.46	0.81	0.41	51.1	52.6	23,255.50	Box	Concrete	0.91	0.61
2119	0 (Polyline)-1997	MH-1346	MH-1347	3.57	3.32	2.86	2.61	50	1.5	0.011	2.04	1.15	0.54	47.3	67	31,923.80	Box	Concrete	0.91	0.61
5362	0 (Polyline)-1998(1)	MH-1347	MH-388	3.32	3.24	2.61	2.53	41.22	1.87	0.011	1.51	0.71	0.66	92.4	80.2	39,500.20	Box	Concrete	0.91	0.61
5363	0 (Polyline)-1998(2)	MH-388	MH-1650	3.24	3.05	2.53	2.04	8.78	1.59	0.011	5.86	5.54	1.32	23.9	123.2	91,465.10	Box	Concrete	1.22	0.61
3386	0 (Polyline)-1999	MH-1650	MH-2044	3.05	3.75	2.04	2.01	50	3.2	0.011	0.82	1.53	1.36	89.2	126	94,360.50	Box	Concrete	1.83	0.91
3536	0 (Polyline)-2000	MH-2044	MH-258	3.75	3.6	2.01	1.99	50	3.26	0.011	0.87	1.53	1.44	94.4	126.4	1,03,665.60	Box	Concrete	1.83	0.91
423	0 (Polyline)-2001	MH-258	O-21	3.6	3.51	1.99	1.98	11.19	3.38	0.011	0.75	1.84	1.45	78.8	126.7	1,07,929.00	Box	Concrete	2.13	0.91
4575	0 (Polyline)-1822	MH-2571	MH-2572	4.19	4.49	3.48	3.46	50	0.81	0.011	0.36	0.22	0.02	10	18.5	1,095.50	Box	Concrete	0.61	0.61
5808	CO-9	MH-2572	MH-210	4.49	4.59	3.46	3.09	59.13	0.81	0.011	1.26	0.76	0.08	10.2	28.8	4,377.10	Box	Concrete	0.61	0.61
4371	0 (Polyline)-2089	MH-694	MH-2486	4.27	4.37	3.18	3.15	35.37	1.16	0.011	0.51	0.43	0.06	13.2	37.8	2,876.20	Box	Concrete	0.91	0.61
5015	0 (Polyline)-2088	MH-2486	MH-2720	4.37	4.5	3.15	3.13	50	1.36	0.011	0.57	0.36	0.12	32	40.2	6,239.70	Box	Concrete	0.91	0.61

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5013	0 (Polyline)-2087	MH-2720	MH-806	4.5	4.5	3.13	3.1	50	1.45	0.011	0.62	0.36	0.15	41.9	39.9	8,806.90	Box	Concrete	0.91	0.61
5343	0 (Polyline)-2086(2)	MH-806	MH-210	4.5	4.59	3.1	3.09	20.52	1.43	0.011	0.61	0.36	0.15	40.3	38.6	9,134.30	Box	Concrete	0.91	0.61
5342	0 (Polyline)-2086(1)	MH-210	MH-805	4.59	4.13	3.09	3.08	29.48	1.77	0.011	0.67	0.52	0.23	43.3	36.8	14,592.60	Box	Concrete	1.22	0.61
4163	0 (Polyline)-2085	MH-805	MH-1639	4.13	3.97	3.08	2.8	50	1.57	0.011	1.79	1.75	0.38	21.7	57.8	25,513.80	Box	Concrete	1.22	0.61
2610	0 (Polyline)-2084	MH-1639	O-20	3.97	3.07	3.05	1.87	48.12	1.46	0.011	3.06	3.68	0.44	12	123.3	29,995.70	Box	Concrete	1.22	0.61
3866	0 (Polyline)-1825	MH-2269	MH-966	3.94	2.81	3.23	2.1	50	0.77	0.011	2.19	1.46	0.11	7.4	70.3	5,482.10	Box	Concrete	0.61	0.61
1508	0 (Polyline)-1826	MH-966	MH-967	2.81	3.05	2.1	2.03	38.19	1.3	0.011	0.32	0.66	0.18	26.7	161	9,041.30	Box	Concrete	0.91	0.61
2947	0 (Polyline)-2046	MH-1823	MH-407	3.62	3.06	2.91	2.35	50	0.68	0.011	0.98	1.02	0.02	2.1	67.5	1,105.10	Box	Concrete	0.61	0.61
648	0 (Polyline)-2047	MH-407	MH-408	3.06	3.36	2.35	2.05	17.32	0.71	0.011	0.12	1.28	0.04	3.5	138.1	2,334.00	Box	Concrete	0.61	0.61
3398	0 (Polyline)-1807	MH-2049	MH-2050	3.5	3.38	2.72	2.37	39.19	0.99	0.011	0.95	1.54	0.03	2.2	82.8	1,737.40	Box	Concrete	0.91	0.61
3925	0 (Polyline)-1808	MH-2050	MH-1759	3.38	3.37	2.37	2.06	50	1.4	0.011	1.29	3.23	0.14	4.3	91.7	7,299.30	Box	Concrete	1.22	0.91
5295	0 (Polyline)-1809(1)	MH-1759	MH-408	3.37	3.36	2.06	2.05	9.96	1.67	0.011	0.15	0.92	0.17	18.4	108.9	9,142.50	Box	Concrete	1.22	0.91
5297	0(Polyline)-809(2)(1)	MH-408	MH-967	3.36	3.05	2.05	2.03	37.07	1.74	0.011	0.19	0.92	0.21	22.7	110.1	12,548.10	Box	Concrete	1.22	0.91
5298	0(Polyline)-809(2)(2)	MH-967	MH-687	3.05	3.11	2.03	2.03	3.28	2.1	0.011	0.23	1.22	0.32	26	118.2	22,278.10	Box	Concrete	1.52	0.91
1076	0 (Polyline)-1810	MH-687	O-19	3.11	3.36	2.03	1.87	29.02	1.78	0.011	0.23	4.13	0.32	7.7	130.1	22,552.10	Box	Concrete	1.52	0.91
1491	0 (Polyline)-2004	MH-956	O-22	3.16	3	2.45	1.77	36.31	0.65	0.011	0.83	1.32	0.01	0.7	120.2	472.3	Box	Concrete	0.61	0.61
1800	0 (Polyline)-2054	MH-1151	MH-1150	4.06	3.7	3.35	2.99	40.73	0.69	0.011	0.95	0.91	0.02	2.7	16.8	1,237.80	Box	Concrete	0.61	0.61
3710	0 (Polyline)-2053	MH-1150	MH-2195	3.7	3.35	2.99	2.64	50	0.85	0.011	1.5	0.81	0.11	13.8	29.4	5,834.60	Box	Concrete	0.61	0.61
5304	0 (Polyline)-2052(2)	MH-2195	MH-789	3.35	3.13	2.64	2.11	34.85	0.87	0.011	2.27	1.18	0.18	15.4	80.8	9,819.30	Box	Concrete	0.61	0.61
2074	0 (Polyline)-2050	MH-1319	MH-1320	3.19	3.18	1.91	1.88	38.97	1.78	0.011	0.23	1.04	0.26	24.8	110.5	13,116.60	Box	Concrete	1.22	0.91
3686	0 (Polyline)-2051	MH-1320	MH-2183	3.18	2.93	1.92	1.91	32.21	1.91	0.011	0.28	0.92	0.31	34.1	108.1	18,307.00	Box	Concrete	1.22	0.91
5303	0 (Polyline)-2052(1)	MH-2183	MH-789	2.93	3.13	2.11	1.92	32.76	1.54	0.011	0.45	1.79	0.33	18.7	143.6	21,787.00	Box	Concrete	1.22	0.61
1229	0 (Polyline)-2057	MH-789	MH-788	3.13	3.06	2.13	2.11	34.9	2.18	0.011	0.67	0.52	0.5	95.3	124.6	34,206.00	Box	Concrete	1.22	0.61
3840	0 (Polyline)-2056	MH-788	MH-2139	3.06	2.87	2.16	2.13	50	2.23	0.011	0.86	0.92	0.53	57.9	79.9	37,802.10	Box	Concrete	1.22	0.91
3591	0 (Polyline)-2055	MH-2139	MH-2138	2.87	3.22	2.51	2.16	50	1.66	0.011	2.27	1.97	0.61	31	93.5	44,914.30	Box	Concrete	1.22	0.61
9998	CO-436	MH-2138	MH-3109	3.22	3.17	2.51	2.45	62.03	2.08	0.011	1.14	0.74	0.6	81.8	61.4	44,914.30	Box	Concrete	1.22	0.61
10000	CO-437	MH-3109	O-200	3.17	2.45	2.45	1.58	29.5	1.24	0.011	3.84	2.69	0.58	21.6	103.1	44,914.30	Box	Concrete	0.9	0.6
2939	0 (Polyline)-485	MH-1819	MH-895	2.83	2.77	2.12	2.06	50	0.86	0.011	0.63	0.34	0.05	14.2	28	2,437.60	Box	Concrete	0.61	0.61
1396	0 (Polyline)-486	MH-895	MH-896	2.77	2.41	2.06	1.7	50	0.92	0.011	1.69	0.82	0.16	19.5	53.6	8,646.30	Box	Concrete	0.61	0.61
3028	0 (Polyline)-487	MH-896	MH-1864	2.41	3.06	1.7	1.68	50	1.65	0.011	0.6	0.52	0.16	29.8	77.6	8,646.30	Box	Concrete	1.22	0.61
9962	0 (Polyline)-488(1)	MH-1864	O-199	3.06	2.99	1.68	1.65	17.09	1.64	0.011	1	0.89	0.25	28.4	81.4	15,202.90	Box	Concrete	1.22	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
2535	0 (Polyline)-1619	MH-1596	MH-1597	4.56	4.54	3.85	3.82	50	1.09	0.011	0.53	0.22	0.08	35.8	32	3,913.10	Box	Concrete	0.61	0.61
4172	0 (Polyline)-1620	MH-1597	MH-471	4.54	4.27	3.82	3.56	50	0.94	0.011	1.49	0.7	0.15	21.4	33.6	8,204.00	Box	Concrete	0.61	0.61
747	0 (Polyline)-1621	MH-471	MH-472	4.27	4.29	3.56	2.87	22.36	0.81	0.011	2.85	1.7	0.17	10.3	98.4	9,820.60	Box	Concrete	0.61	0.61
4636	0 (Polyline)-1563	MH-2596	MH-2146	5.24	4.57	4.53	3.86	50	0.9	0.011	2.25	1.12	0.2	17.7	41.8	10,099.70	Box	Concrete	0.61	0.61
3605	0 (Polyline)-1564	MH-2146	MH-1496	4.57	4.27	3.86	3.56	50	1.13	0.011	1.87	0.74	0.3	40.1	44.9	15,247.70	Box	Concrete	0.61	0.61
2361	0 (Polyline)-1565	MH-1496	MH-1497	4.27	4.31	3.56	2.88	47.69	1.46	0.011	2.36	2.81	0.35	12.4	99.6	18,308.80	Box	Concrete	1.22	0.61
3553	0 (Polyline)-1541	MH-2123	MH-1991	4.36	4.47	3.65	3.62	50	1.75	0.011	0.74	0.36	0.28	78.2	78.9	14,379.00	Box	Concrete	0.91	0.61
3273	0 (Polyline)-1542	MH-1991	MH-1992	4.47	4.41	3.62	3.6	50	2.13	0.011	0.83	0.52	0.46	88.6	80	24,808.60	Box	Concrete	1.22	0.61
3748	0 (Polyline)-1543	MH-1992	MH-1956	4.41	4.29	3.6	3.28	50	1.69	0.011	2.25	1.88	0.65	34.6	105.5	36,677.50	Box	Concrete	1.22	0.61
3201	0 (Polyline)-1544	MH-1956	MH-1673	4.29	4.45	3.28	3.14	50	1.95	0.011	1.75	2.13	0.78	36.5	94.4	44,636.90	Box	Concrete	1.22	0.91
2671	0 (Polyline)-1545	MH-1673	MH-1674	4.45	4.34	3.14	3.12	50	2.63	0.011	0.75	0.92	0.83	90.3	101.5	49,050.10	Box	Concrete	1.22	0.91
4723	0 (Polyline)-1546	MH-1674	MH-1245	4.34	4.29	3.12	3.09	50	2.66	0.011	0.76	0.92	0.84	91.7	101.9	53,084.70	Box	Concrete	1.22	0.91
1952	0 (Polyline)-1547	MH-1245	MH-1246	4.29	4.32	3.09	3.07	50	2.86	0.011	0.73	1.22	1.01	83.3	102.5	67,802.70	Box	Concrete	1.52	0.91
4872	0 (Polyline)-1548	MH-1246	MH-2038	4.32	4.23	3.07	3.04	50	2.97	0.011	0.81	1.22	1.12	91.9	103	77,953.10	Box	Concrete	1.52	0.91
3373	0 (Polyline)-1549	MH-2038	MH-2039	4.23	4.32	3.04	3.02	50	3.11	0.011	0.71	1.53	1.19	77.6	103.6	86,051.10	Box	Concrete	1.83	0.91
3460	0 (Polyline)-1550	MH-2039	MH-2046	4.32	4.19	3.02	2.99	52.63	3.15	0.011	0.74	1.53	1.23	80.4	104.5	93,307.70	Box	Concrete	1.83	0.91
3392	0 (Polyline)-1551	MH-2046	MH-1356	4.19	4.37	2.99	2.97	47.38	3.21	0.011	0.78	1.53	1.3	84.9	105.1	1,03,484.00	Box	Concrete	1.83	0.91
2135	0 (Polyline)-1552	MH-1356	MH-1357	4.37	4.29	2.97	2.94	50	3.24	0.011	0.8	1.53	1.34	87.5	105.6	1,10,194.00	Box	Concrete	1.83	0.91
2564	0 (Polyline)-1553	MH-1357	MH-1614	4.29	4.27	2.94	2.92	50	3.22	0.011	0.8	1.53	1.33	87	106	1,12,923.60	Box	Concrete	1.83	0.91
3010	0 (Polyline)-1554	MH-1614	MH-1480	4.27	4.26	2.92	2.89	50	3.23	0.011	0.81	1.53	1.34	87.7	106.4	1,17,342.70	Box	Concrete	1.83	0.91
5617	0 (Polyline)-1555(1)	MH-1480	MH-1497	4.26	4.31	2.89	2.88	36.33	3.23	0.011	0.8	1.53	1.34	87.5	106.8	1,20,811.70	Box	Concrete	1.83	0.91
5619	0(Polyline)-1555(2)(1)	MH-1497	MH-472	4.31	4.29	2.88	2.87	4.34	3.47	0.011	0.78	1.84	1.51	82.3	107	1,39,907.10	Box	Concrete	2.13	0.91
2629	0 (Polyline)-1556	MH-472	MH-1050	4.29	4.15	2.87	2.84	59.62	3.48	0.011	0.84	1.95	1.63	83.5	107.4	1,50,630.70	Box	Concrete	2.13	0.91
1640	0 (Polyline)-1557	MH-1050	MH-1005	4.15	4.29	2.84	2.82	49.87	3.73	0.011	1.07	2.52	1.75	69.6	80.8	1,67,289.70	Box	Concrete	2.13	1.22
1569	0 (Polyline)-1558	MH-1005	MH-1006	4.29	4.52	2.82	2.8	50	3.72	0.011	1.06	2.51	1.74	69.2	81.6	1,69,141.90	Box	Concrete	2.13	1.22
4377	0 (Polyline)-1559	MH-1006	MH-779	4.52	4.17	2.8	2.78	50	3.73	0.011	1.07	2.51	1.76	70.1	82.4	1,74,723.50	Box	Concrete	2.13	1.22
1215	0 (Polyline)-1560	MH-779	O-182	4.17	4.08	2.78	2.76	51.99	3.87	0.011	1.08	2.46	1.93	78.2	83.2	1,94,854.10	Box	Concrete	2.13	1.22
2025	0 (Polyline)-1622	MH-1290	MH-923	4.71	4.45	4	3.74	50	0.73	0.011	0.87	0.69	0.03	4.4	18.5	1,563.10	Box	Concrete	0.61	0.61
1439	0 (Polyline)-1623	MH-923	MH-924	4.45	4.54	3.74	3.71	50	0.95	0.011	0.47	0.22	0.05	22.7	25.9	2,598.30	Box	Concrete	0.61	0.61
1627	0 (Polyline)-1624	MH-924	MH-1042	4.54	4.37	3.71	3.66	50	0.93	0.011	0.66	0.32	0.06	20.2	23	3,717.50	Box	Concrete	0.61	0.61
4350	0 (Polyline)-1625	MH-1042	MH-2476	4.37	4.21	3.66	3.5	50	0.86	0.011	1.01	0.54	0.08	14.5	27.4	4,899.40	Box	Concrete	0.61	0.61
4604	0 (Polyline)-1626	MH-2476	MH-741	4.21	3.98	3.5	3.27	50	1.01	0.011	1.5	0.65	0.18	27.7	37.7	11,920.00	Box	Concrete	0.61	0.61
1158	0 (Polyline)-1627	MH-741	O-181	3.98	4	3.27	2.26	27.31	0.84	0.011	3.37	1.86	0.24	13	111.2	16,237.00	Box	Concrete	0.61	0.61
2679	0 (Polyline)-1113	MH-1678	MH-1113	3.88	3.68	3.17	2.97	50	0.99	0.011	1.38	0.61	0.16	26.2	46.6	8,108.60	Box	Concrete	0.61	0.61
1741	0 (Polyline)-1114	MH-1113	MH-1114	3.68	3.53	2.97	2.82	43.21	1.66	0.011	1.86	0.95	0.64	66.9	65.3	33,338.20	Box	Concrete	0.91	0.61
4071	0 (Polyline)-1772	MH-2361	MH-2292	4.15	4.54	3.44	3.41	50	1.34	0.011	0.57	0.36	0.11	30.7	29.7	5,654.60	Box	Concrete	0.91	0.61

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3914	0 (Polyline)-1773	MH-2292	MH-2091	4.54	3.57	3.41	2.86	50	1.14	0.011	1.93	1.7	0.2	11.7	46.1	10,838.70	Box	Concrete	0.91	0.61
3487	0 (Polyline)-1774	MH-2091	MH-899	3.57	3.6	2.86	2.84	50	1.91	0.011	0.74	0.52	0.31	59.8	65.1	17,432.80	Box	Concrete	1.22	0.61
5613	0 (Polyline)-1775(1)	MH-899	MH-1114	3.6	3.53	2.84	2.82	10.89	1.68	0.011	1.21	1.02	0.34	33.5	67.4	20,231.40	Box	Concrete	1.22	0.61
5614	0 (Polyline)-1775(2)	MH-1114	MH-900	3.53	3.6	2.82	2.59	39.11	1.9	0.011	2.49	1.77	1.04	59	84.8	62,151.10	Box	Concrete	1.22	0.61
2961	0 (Polyline)-1776	MH-900	MH-1779	3.6	3.51	2.59	2.3	50	1.91	0.011	2.53	3.14	1.07	33.9	84.5	64,508.20	Box	Concrete	1.22	0.91
2864	0 (Polyline)-1777	MH-1779	MH-1780	3.51	3.72	2.3	2.28	50	3.02	0.011	0.67	1.53	1.12	73.1	102.1	68,989.50	Box	Concrete	1.83	0.91
4625	0 (Polyline)-1778	MH-1780	MH-2314	3.72	3.44	2.28	2.25	50	3.04	0.011	0.69	1.53	1.15	75	103.4	76,258.60	Box	Concrete	1.83	0.91
3964	0 (Polyline)-1779	MH-2314	MH-423	3.44	3.42	2.25	2.23	50	3.08	0.011	0.72	1.53	1.2	78.7	104.5	83,660.60	Box	Concrete	1.83	0.91
674	0 (Polyline)-1780	MH-423	O-117	3.42	3.41	2.23	2.13	16.23	2.38	0.011	0.73	5.21	1.22	23.5	109.9	88,637.30	Box	Concrete	1.83	0.91
2669	0 (Polyline)-2150	MH-1672	MH-110	4.02	3.85	3.31	2.73	56.6	0.76	0.011	1.43	0.97	0.07	6.9	39.4	3,418.10	Box	Concrete	0.61	0.61
1647	0 (Polyline)-2146	MH-1054	MH-1055	3.82	3.75	2.81	2.74	47.13	1.26	0.011	0.24	1.61	0.01	0.3	36.2	263.9	Box	Concrete	1.22	0.91
5623	0 (Polyline)-2147(1)	MH-1055	MH-110	3.75	3.85	2.74	2.73	14.92	1.41	0.011	0.38	0.92	0.04	4.8	40.5	2,654.10	Box	Concrete	1.22	0.91
5624	0 (Polyline)-2147(2)	MH-110	MH-1707	3.85	3.83	2.73	2.72	37.96	1.81	0.011	0.5	1.22	0.11	9.3	41.9	7,022.20	Box	Concrete	1.52	0.91
3415	0 (Polyline)-2148	MH-1707	MH-553	3.83	3.74	2.72	2.69	50	1.87	0.011	0.55	1.22	0.15	11.9	44.2	9,721.90	Box	Concrete	1.52	0.91
871	0 (Polyline)-2149	MH-553	O-68	3.74	3.5	2.69	2.4	29.37	1.67	0.011	1.51	5.41	0.17	3.2	61.5	12,118.20	Box	Concrete	1.52	0.91
1090	0 (Polyline)-1112	MH-697	MH-696	3.86	3.77	3.15	3.06	31.37	0.78	0.011	0.79	0.51	0.04	8.2	52.7	2,108.20	Box	Concrete	0.61	0.61
3260	0 (Polyline)-1111	MH-696	MH-1361	3.77	3.85	3.06	3.04	50	1.7	0.011	0.72	0.36	0.26	71.5	59	13,585.40	Box	Concrete	0.91	0.61
2141	0 (Polyline)-1110	MH-1361	MH-1360	3.85	3.69	3.04	2.98	50	1.62	0.011	1.09	0.57	0.35	61.9	58.3	19,598.90	Box	Concrete	0.91	0.61
2163	0 (Polyline)-1109	MH-1360	MH-1374	3.69	3.86	2.98	2.85	50	1.56	0.011	1.52	0.82	0.45	54.7	65.4	26,008.60	Box	Concrete	0.91	0.61
2503	0 (Polyline)-1108	MH-1374	MH-1457	3.86	3.92	2.85	2.8	50	2.02	0.011	1.03	1.2	0.51	42.1	49.4	30,123.20	Box	Concrete	1.22	0.91
2296	0 (Polyline)-1107	MH-1457	MH-1456	3.92	4.13	2.8	2.78	50	2.31	0.011	0.89	0.92	0.59	63.9	48.7	36,658.10	Box	Concrete	1.22	0.91
4715	0 (Polyline)-1106	MH-1456	MH-1484	4.13	3.93	2.78	2.75	50	2.37	0.011	0.9	0.92	0.63	68.7	40.7	41,722.00	Box	Concrete	1.22	0.91
2339	0 (Polyline)-1105	MH-1484	O-186	3.93	3.23	2.75	2.28	46.8	1.63	0.011	2.63	4.15	0.66	15.9	62.5	45,257.50	Box	Concrete	1.22	0.91
5064	0 (Polyline)-2152	MH-2738	MH-886	3.73	3.52	3.02	2.81	50	0.89	0.011	1.24	0.62	0.11	17.2	23.7	5,433.90	Box	Concrete	0.61	0.61
1382	0 (Polyline)-2153	MH-886	MH-887	3.52	3.57	2.81	2.41	37.31	1.41	0.011	1.79	2.41	0.21	8.8	36.9	11,060.40	Box	Concrete	1.22	0.61
5621	0 (Polyline)-1097(1)	MH-1017	MH-887	3.13	3.57	2.42	2.41	24.05	0.75	0.011	0.3	0.22	0.01	5.9	49.1	647.6	Box	Concrete	0.61	0.61
5622	0 (Polyline)-1097(2)	MH-887	MH-1018	3.57	3.66	2.41	2.4	20.91	1.79	0.011	0.68	0.52	0.24	45.6	50.2	12,909.40	Box	Concrete	1.22	0.61
3168	0 (Polyline)-1098	MH-1018	MH-1888	3.66	3.51	2.4	2.38	50	1.89	0.011	0.73	0.52	0.3	57.4	49.5	16,659.90	Box	Concrete	1.22	0.61
3072	0 (Polyline)-1099	MH-1888	MH-1598	3.51	3.67	2.38	2.35	50	1.95	0.011	0.76	0.92	0.34	37	28.7	20,097.00	Box	Concrete	1.22	0.91
2538	0 (Polyline)-1100	MH-1598	O-69	3.67	2.5	2.35	1.78	44.15	1.5	0.011	2.42	4.67	0.41	8.9	57.5	25,987.30	Box	Concrete	1.22	0.91
1029	0 (Polyline)-216	MH-656	MH-657	4.02	3.83	3.31	3.12	29.06	0.71	0.011	0.9	0.79	0.03	3.4	36.1	1,374.60	Box	Concrete	0.61	0.61

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3389	0 (Polyline)-217	MH-2045	MH-873	4.14	4.03	3.43	3.32	50	1.22	0.011	1.26	0.47	0.23	49.7	46.8	11,828.40	Box	Concrete	0.61	0.61
5675	0 (Polyline)-218(1)	MH-873	MH-657	4.03	3.83	3.32	3.12	22.94	1.03	0.011	2.1	0.9	0.27	29.8	48.2	13,964.00	Box	Concrete	0.61	0.61
5676	0 (Polyline)-218(2)	MH-657	MH-419	3.83	3.91	3.12	3.1	27.06	1.81	0.011	0.76	0.36	0.31	85.3	45.9	16,337.40	Box	Concrete	0.91	0.61
667	0 (Polyline)-219	MH-419	O-44	3.91	3.71	3.1	2.1	14.82	1.09	0.011	4.18	4.22	0.34	8	57.3	18,428.70	Box	Concrete	0.91	0.61
659	0 (Polyline)-196	MH-415	MH-414	3.97	4.19	3.26	2.14	17.9	0.65	0.011	1.56	2.42	0.02	0.7	41.6	919.1	Box	Concrete	0.61	0.61
1043	0 (Polyline)-2229	MH-665	MH-666	3.65	3.94	2.94	2.16	29.55	0.72	0.011	1.88	1.57	0.06	3.9	46.2	3,100.90	Box	Concrete	0.61	0.61
1032	0 (Polyline)-209	MH-659	MH-658	2.9	3.46	2.19	2.18	29.17	1.82	0.011	0.76	0.36	0.31	86.1	74.7	15,829.80	Box	Concrete	0.91	0.61
5674	0 (Polyline)-208(2)	MH-658	MH-666	3.46	3.94	2.18	2.16	42.7	2.03	0.011	0.79	0.52	0.39	74.6	75.3	20,400.30	Box	Concrete	1.22	0.61
5673	0 (Polyline)-208(1)	MH-666	MH-1155	3.94	3.99	2.16	2.15	18.35	2.14	0.011	0.83	0.52	0.47	89	75.9	25,454.00	Box	Concrete	1.22	0.61
5672	0 (Polyline)-207(2)	MH-1155	MH-414	3.99	4.19	2.15	2.14	27.5	2.15	0.011	0.84	0.52	0.48	90.8	75.9	26,474.10	Box	Concrete	1.22	0.61
5671	0 (Polyline)-207(1)	MH-414	MH-1154	4.19	4.03	2.14	2.12	26.35	2.18	0.011	0.85	0.52	0.49	94.4	75.8	28,328.90	Box	Concrete	1.22	0.61
4328	0 (Polyline)-206	MH-1154	O-43	4.03	4.41	2.12	2.1	35.11	2.2	0.011	0.85	0.92	0.51	55.7	50.4	30,288.90	Box	Concrete	1.22	0.91
2106	0 (Polyline)-240	MH-1338	MH-757	3.85	3.49	3.14	2.78	50	0.84	0.011	1.47	0.82	0.1	12.7	52.2	5,255.70	Box	Concrete	0.61	0.61
1182	0 (Polyline)-241	MH-757	MH-758	3.49	3.5	2.78	2.75	50	1.45	0.011	0.64	0.22	0.16	75.5	81.7	8,486.40	Box	Concrete	0.61	0.61
2842	0 (Polyline)-242	MH-758	MH-1251	3.5	3.5	2.75	2.73	48.5	1.62	0.011	0.69	0.36	0.23	62.1	83.8	12,535.10	Box	Concrete	0.91	0.61
3381	0 (Polyline)-238	MH-1251	MH-1871	3.5	4.31	2.73	2.7	50	1.75	0.011	0.66	0.52	0.21	40.5	86.8	12,535.10	Box	Concrete	1.22	0.61
3041	0 (Polyline)-239	MH-1871	O-140	4.31	4.5	2.7	2.34	70.11	1.5	0.011	1.53	1.68	0.26	15.6	117.7	16,653.60	Box	Concrete	1.22	0.61
1783	0 (Polyline)-286	MH-1139	MH-425	3.63	4.19	2.92	2.9	50	1.42	0.011	0.63	0.22	0.16	71.9	91.3	7,865.50	Box	Concrete	0.61	0.61
677	0 (Polyline)-287	MH-425	MH-426	4.19	4.32	2.9	2.89	18.61	1.47	0.011	0.64	0.22	0.17	78.5	92.9	9,153.60	Box	Concrete	0.61	0.61
1925	0 (Polyline)-301	MH-1229	MH-1228	4.18	4.22	3.47	3.45	41.98	0.97	0.011	0.47	0.22	0.05	24	26.3	2,619.90	Box	Concrete	0.61	0.61
5656	0 (Polyline)-300(2)	MH-1228	MH-426	4.22	4.32	3.45	2.89	19.96	0.77	0.011	2.42	1.62	0.12	7.3	59.4	6,404.40	Box	Concrete	0.61	0.61
5655	0 (Polyline)-300(1)	MH-426	MH-2026	4.32	4.41	2.89	2.88	30.04	1.81	0.011	0.75	0.36	0.31	84.8	93.9	17,067.90	Box	Concrete	0.91	0.61
3348	0 (Polyline)-299	MH-2026	MH-1515	4.41	4.39	2.88	2.85	50	1.84	0.011	0.76	0.36	0.32	88.4	95.5	18,410.30	Box	Concrete	0.91	0.61
2392	0 (Polyline)-298	MH-1515	MH-1514	4.39	4.47	2.85	2.83	50	1.97	0.011	0.77	0.52	0.35	67.5	98.1	21,521.00	Box	Concrete	1.22	0.61
3832	0 (Polyline)-297	MH-1514	MH-2256	4.47	4.5	2.83	2.81	38.7	2.16	0.011	0.84	0.52	0.48	91.9	100	31,260.20	Box	Concrete	1.22	0.61
4933	0 (Polyline)-296	MH-2256	MH-2513	4.5	4.33	2.81	2.78	61.18	2.4	0.011	0.91	0.92	0.66	71.2	67.4	44,222.50	Box	Concrete	1.22	0.91
4437	0 (Polyline)-295	MH-2513	MH-2456	4.33	4.34	2.78	2.75	50	2.55	0.011	0.95	0.92	0.77	83.4	67.2	53,925.90	Box	Concrete	1.22	0.91
4298	0 (Polyline)-294	MH-2456	MH-1677	4.34	4.43	2.75	2.73	50	2.63	0.011	0.97	0.92	0.83	90.4	65.8	60,476.00	Box	Concrete	1.22	0.91
2676	0 (Polyline)-293	MH-1677	MH-1676	4.43	4.42	2.73	2.7	50	2.71	0.011	0.98	1.22	0.88	72.7	64.8	66,430.10	Box	Concrete	1.52	0.91
3401	0 (Polyline)-292	MH-1676	MH-1486	4.42	3.74	2.7	2.68	50	2.77	0.011	1	1.22	0.95	77.8	64.5	73,600.80	Box	Concrete	1.52	0.91
2342	0 (Polyline)-291	MH-1486	MH-1485	3.74	3.43	2.68	2.42	50	2.09	0.011	2.29	3.91	0.99	25.2	79.1	79,457.40	Box	Concrete	1.52	0.91
3877	0 (Polyline)-290	MH-1485	MH-2241	3.43	3.89	2.42	2.39	50	2.91	0.011	1.03	1.22	1.1	90	94.7	89,150.40	Box	Concrete	1.52	0.91
3804	0 (Polyline)-289	MH-2241	MH-1952	3.89	3.65	2.39	2.37	50	3.11	0.011	1.06	1.53	1.25	81.4	96.2	1,03,748.10	Box	Concrete	1.83	0.91
3193	0 (Polyline)-288	MH-1952	O-139	3.65	4.33	2.37	2.34	48.9	3.25	0.011	1.1	1.53	1.44	94.1	97.7	1,22,690.10	Box	Concrete	1.83	0.91
3264	0 (Polyline)-155	MH-960	MH-357	3.65	3.87	2.94	2.9	66.29	0.87	0.011	0.41	0.22	0.03	15.4	47.5	1,679.40	Box	Concrete	0.61	0.61
572	0 (Polyline)-156	MH-357	MH-358	3.87	3.98	2.9	2.89	14.86	0.99	0.011	0.48	0.22	0.06	25.8	50.4	3,231.80	Box	Concrete	0.61	0.61

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1803	0 (Polyline)-157	MH-1152	MH-902	4.42	4.26	3.71	3.55	50	0.91	0.011	1.11	0.54	0.1	18.6	49	5,132.70	Box	Concrete	0.61	0.61
1407	0 (Polyline)-158	MH-902	MH-863	4.26	4.39	3.55	3.52	50	1.54	0.011	0.66	0.22	0.19	86.1	59	9,763.10	Box	Concrete	0.61	0.61
1345	0 (Polyline)-159	MH-863	MH-864	4.39	4.45	3.52	3.5	50	1.66	0.011	0.71	0.36	0.24	66.5	55.9	13,523.70	Box	Concrete	0.91	0.61
3953	0 (Polyline)-160	MH-864	MH-1016	4.45	4.19	3.5	3.47	50	1.79	0.011	0.75	0.36	0.3	82.9	47.2	17,987.30	Box	Concrete	0.91	0.61
5690	0 (Polyline)-161(1)	MH-1016	MH-358	4.19	3.98	3.47	2.89	39.83	1.2	0.011	2.52	1.96	0.34	17.1	45.1	21,348.20	Box	Concrete	0.91	0.61
633	0 (Polyline)-162	MH-358	O-137	3.98	4	2.89	2.24	23.81	1.43	0.011	3.03	3.87	0.4	10.2	106.9	25,605.50	Box	Concrete	1.22	0.61
4508	0 (Polyline)-163	MH-2543	MH-2052	4.18	4.14	3.47	3.43	50	1.56	0.011	0.79	0.26	0.23	88.7	62.8	11,543.50	Box	Concrete	0.61	0.61
3406	0 (Polyline)-164	MH-2052	MH-2053	4.14	4.3	3.43	3.41	50	1.97	0.011	0.77	0.52	0.35	67.6	59.7	18,871.50	Box	Concrete	1.22	0.61
3495	0 (Polyline)-165	MH-2053	MH-2094	4.3	4.15	3.41	3.38	50	2.15	0.011	0.84	0.52	0.47	90.7	53.1	26,767.30	Box	Concrete	1.22	0.61
4652	0 (Polyline)-166	MH-2094	MH-1551	4.15	3.58	3.38	2.57	50	1.54	0.011	2.94	2.99	0.58	19.4	78.8	34,546.90	Box	Concrete	1.22	0.61
2455	0 (Polyline)-167	MH-1551	MH-280	3.58	3.96	2.57	2.54	50	2.37	0.011	0.9	0.92	0.63	68.8	75	38,333.80	Box	Concrete	1.22	0.91
456	0 (Polyline)-168	MH-280	O-136	3.96	4	2.54	2.24	10.08	1.51	0.011	3.7	7.05	0.65	9.2	92.4	41,229.30	Box	Concrete	1.22	0.91
3910	0 (Polyline)-152	MH-2290	MH-2221	3.85	3.7	3.14	2.99	50	0.89	0.011	1.03	0.53	0.09	16.5	25.2	4,386.40	Box	Concrete	0.61	0.61
3762	0 (Polyline)-153	MH-2221	O-138	3.7	3.5	2.99	2.15	48.96	0.81	0.011	2.15	1.27	0.13	10.5	67.1	7,024.10	Box	Concrete	0.61	0.61
2327	0 (Polyline)-4	MH-1477	MH-1476	3.41	3.62	2.7	2.68	45	0.93	0.011	0.45	0.22	0.04	20	89.8	2,188.40	Box	Concrete	0.61	0.61
4600	0 (Polyline)-3	MH-1476	MH-2582	3.62	3.68	2.68	2.66	50	1.27	0.011	0.6	0.22	0.12	55.6	93.2	6,599.50	Box	Concrete	0.61	0.61
4919	0 (Polyline)-2	MH-2582	MH-607	3.68	3.22	2.66	2.51	50	1.06	0.011	1.26	0.52	0.17	33.4	105.6	10,356.40	Box	Concrete	0.61	0.61
10066	0 (Polyline)-193(2)	MH-607	MH-3129	3.22	3.36	3.26	2.51	8.27	0.76	0.011	4.22	2.91	0.19	6.7	61.4	11,978.60	Box	Concrete	0.61	0.61
261	0 (Polyline)-195	MH-153	MH-152	4	4	3.29	3.29	7.07	0.67	0.011	0.27	0.33	0	1.5	11.2	240.3	Box	Concrete	0.61	0.61
4799	0 (Polyline)-194	MH-152	MH-1284	4	4.09	3.29	3.26	50	0.76	0.011	0.31	0.22	0.01	6.7	10.2	747.8	Box	Concrete	0.61	0.61
10065	0 (Polyline)-193(1)	MH-1284	MH-3129	4.09	3.36	3.26	2.51	41.73	0.67	0.011	1.16	1.3	0.02	1.8	47.8	1,359.50	Box	Concrete	0.61	0.61
10068	CO-457	MH-3129	O-204	3.36	3.71	2.63	2.3	11.44	0.85	0.011	3	1.65	0.22	13.1	95.2	13,338.10	Box	Concrete	0.61	0.61
4974	0 (Polyline)-126	MH-2708	MH-2560	4.09	4.39	3.38	3.35	50	1.42	0.011	0.61	0.36	0.14	38.7	48.8	7,127.50	Box	Concrete	0.91	0.61
4549	0 (Polyline)-127	MH-2560	MH-1741	4.39	4.05	3.35	3.33	50	1.55	0.011	0.67	0.36	0.19	53.1	49.1	10,440.80	Box	Concrete	0.91	0.61
2795	0 (Polyline)-128	MH-1741	MH-1742	4.05	4.29	3.33	3.3	48.26	1.81	0.011	0.71	0.54	0.26	47.4	48.8	14,819.70	Box	Concrete	1.22	0.61
788	0 (Polyline)-91	MH-499	MH-498	4.1	4.06	3.39	3.35	21.16	0.71	0.011	0.49	0.42	0.02	3.8	42.3	799.7	Box	Concrete	0.61	0.61
5061	0 (Polyline)-90	MH-498	MH-2599	4.06	4.21	3.35	3.32	50	1.05	0.011	0.51	0.22	0.07	31.6	46.6	3,581.40	Box	Concrete	0.61	0.61
5773	0 (Polyline)-89(2)	MH-2599	MH-1742	4.21	4.29	3.32	3.3	34.89	1.42	0.011	0.61	0.36	0.14	38.8	48.3	8,020.50	Box	Concrete	0.91	0.61
5772	0 (Polyline)-89(1)	MH-1742	O-52	4.29	4.24	3.3	3.3	15.11	2.08	0.011	0.81	0.52	0.43	81.3	43.4	26,229.10	Box	Concrete	1.22	0.61
3809	0 (Polyline)-51	MH-2245	MH-2244	4.3	4.5	3.88	3.59	34.79	0.73	0.011	1.14	0.89	0.04	4.8	44.7	2,147.10	Box	Concrete	0.61	0.61
10074	CO-458	MH-2244	O-205	4.5	4.18	3.88	0	15.39	0.68	0.011	4.41	4.85	0.09	1.8	296.4	4,642.00	Box	Concrete	0.61	0.61

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4897	0 (Polyline)-47	MH-1292	MH-2646	4.73	4.54	3.74	3.71	50	1.07	0.011	0.33	0.36	0.02	6.5	69.6	1,199.10	Box	Concrete	0.91	0.61
4788	0 (Polyline)-48	MH-2646	MH-1312	4.54	4.77	3.76	3.74	50	1.07	0.011	0.53	0.22	0.07	34.2	65	4,249.30	Box	Concrete	0.61	0.61
2060	0 (Polyline)-49	MH-1312	MH-1262	4.77	4.5	3.79	3.76	50	1.15	0.011	0.56	0.22	0.09	43	59.6	5,832.40	Box	Concrete	0.61	0.61
1980	0 (Polyline)-50	MH-1262	O-185	4.5	4.25	3.84	3.79	45.86	1.26	0.011	0.89	0.33	0.18	54.1	40.8	11,965.30	Box	Concrete	0.61	0.61
4469	0 (Polyline)-45	MH-1291	MH-2526	4.62	4.46	3.69	3.67	40.89	1.12	0.011	0.39	0.36	0.04	10.2	24.9	1,881.80	Box	Concrete	0.91	0.61
4885	0 (Polyline)-44	MH-2526	MH-2668	4.46	4.45	3.67	3.65	39.09	1.27	0.011	0.52	0.36	0.09	23.7	24.4	4,760.30	Box	Concrete	0.91	0.61
4849	0 (Polyline)-43	MH-2668	O-58	4.45	4.7	3.65	3.52	70.01	1.19	0.011	0.87	0.7	0.11	15.7	20.7	6,486.30	Box	Concrete	0.91	0.61
2400	0 (Polyline)-129	MH-1518	MH-1519	4.61	4.49	3.9	3.69	45.62	0.82	0.011	1.11	0.65	0.07	10.7	35.5	3,526.40	Box	Concrete	0.61	0.61
4905	0 (Polyline)-56	MH-2684	MH-2525	5.47	4.88	4.76	4.17	38.79	0.7	0.011	1.33	1.19	0.04	3.2	14.7	1,935.40	Box	Concrete	0.61	0.61
5784	0 (Polyline)-57(1)	MH-2525	MH-2360	4.88	4.77	4.17	3.72	32.47	0.75	0.011	1.57	1.14	0.07	5.8	37.7	3,399.90	Box	Concrete	0.61	0.61
1678	0 (Polyline)-65	MH-1075	MH-1074	4.47	4.72	3.76	3.74	39.95	1.06	0.011	0.52	0.22	0.07	33.3	56.8	3,643.20	Box	Concrete	0.61	0.61
4068	0 (Polyline)-64	MH-1074	MH-2360	4.72	4.77	3.74	3.72	50	1.31	0.011	0.61	0.22	0.13	60.4	58	7,029.40	Box	Concrete	0.61	0.61
5785	0 (Polyline)-57(2)	MH-2360	MH-2126	4.77	4.64	3.72	3.71	28.75	1.58	0.011	0.66	0.22	0.2	90.7	55.6	11,350.70	Box	Concrete	0.61	0.61
5782	0 (Polyline)-58(1)	MH-2126	MH-1519	4.64	4.49	3.71	3.69	25.31	1.57	0.011	0.68	0.36	0.2	56.2	53.1	12,309.70	Box	Concrete	0.91	0.61
5783	0 (Polyline)-58(2)	MH-1519	MH-2127	4.49	4.33	3.69	3.62	24.69	1.35	0.011	1.34	0.86	0.27	31.2	58.2	16,668.60	Box	Concrete	0.91	0.61
5780	0 (Polyline)-59(1)	MH-2127	MH-2561	4.33	4.31	3.62	3.6	47.05	1.71	0.011	0.77	0.39	0.28	73	63	17,986.10	Box	Concrete	0.91	0.61
900	0 (Polyline)-67	MH-573	MH-572	4.52	4.51	3.81	3.79	25.82	1.04	0.011	0.51	0.22	0.07	31.3	31.8	3,418.20	Box	Concrete	0.61	0.61
4551	0 (Polyline)-66	MH-572	MH-2561	4.51	4.31	3.79	3.6	50	0.93	0.011	1.28	0.61	0.13	20.7	47	6,632.60	Box	Concrete	0.61	0.61
4570	0 (Polyline)-60	MH-2561	MH-2570	4.31	4.51	3.6	3.57	52.95	2.03	0.011	0.79	0.52	0.39	74.8	62.2	26,306.50	Box	Concrete	1.22	0.61
4598	0 (Polyline)-61	MH-2570	MH-2581	4.51	4.5	3.57	3.55	50	2.07	0.011	0.81	0.52	0.42	80.3	60.2	29,403.50	Box	Concrete	1.22	0.61
5024	0 (Polyline)-62	MH-2581	O-57	4.5	4.7	3.55	3.52	58.11	2.13	0.011	0.83	0.52	0.46	87.4	49.3	33,281.40	Box	Concrete	1.22	0.61
1017	0 (Polyline)-83	MH-649	MH-648	4.2	4.57	3.49	3.48	28.71	1.12	0.011	0.55	0.22	0.09	39.6	57	4,334.90	Box	Concrete	0.61	0.61
5006	0 (Polyline)-82	MH-648	MH-2051	4.57	4.35	3.48	3.45	50	1.43	0.011	0.64	0.22	0.16	74	56.2	8,440.80	Box	Concrete	0.61	0.61
3403	0 (Polyline)-81	MH-2051	MH-2029	4.35	4.03	3.45	3.32	50	1.22	0.011	1.31	0.49	0.24	50.2	60.4	13,798.80	Box	Concrete	0.61	0.61
3356	0 (Polyline)-80	MH-2029	MH-817	4.03	4.32	3.32	3.3	50	1.83	0.011	0.76	0.36	0.32	87.9	64.8	18,685.20	Box	Concrete	0.91	0.61
1272	0 (Polyline)-79	MH-817	MH-816	4.32	4.36	3.3	3.27	50	1.85	0.011	0.77	0.36	0.33	90.6	60.9	20,476.30	Box	Concrete	0.91	0.61
4540	0 (Polyline)-68	MH-2557	MH-325	4.45	4.53	3.74	3.72	36.67	1.14	0.011	0.55	0.22	0.09	41.4	34	4,532.10	Box	Concrete	0.61	0.61
524	0 (Polyline)-69	MH-325	MH-326	4.53	4.38	3.72	3.45	26.81	0.89	0.011	1.92	0.97	0.17	17	46.2	8,826.00	Box	Concrete	0.61	0.61
735	0 (Polyline)-78	MH-464	MH-463	4.6	4.25	3.89	3.54	19.89	0.73	0.011	1.67	1.28	0.06	4.9	41	3,202.00	Box	Concrete	0.61	0.61
4052	0 (Polyline)-77	MH-463	MH-2352	4.25	4.56	3.54	3.51	50	1.33	0.011	0.61	0.22	0.13	61.9	65.6	6,831.50	Box	Concrete	0.61	0.61
4395	0 (Polyline)-76	MH-2352	MH-2496	4.56	4.39	3.51	3.49	50	1.58	0.011	0.67	0.22	0.2	91.2	64.3	10,774.50	Box	Concrete	0.61	0.61
4768	0 (Polyline)-75	MH-2496	MH-976	4.39	4.47	3.49	3.46	50	1.71	0.011	0.73	0.36	0.26	72.8	62.2	15,455.40	Box	Concrete	0.91	0.61
5779	0 (Polyline)-74(2)	MH-976	MH-326	4.47	4.38	3.46	3.45	29.5	1.77	0.011	0.74	0.36	0.29	80.3	61	18,203.70	Box	Concrete	0.91	0.61
5778	0 (Polyline)-74(1)	MH-326	MH-975	4.38	4.48	3.45	3.44	20.52	2.12	0.011	0.83	0.52	0.45	86.5	59.3	29,373.70	Box	Concrete	1.22	0.61
5049	0 (Polyline)-73	MH-975	MH-1131	4.48	4.22	3.44	3.42	40.59	2.16	0.011	0.84	0.52	0.48	92.1	50.3	32,071.90	Box	Concrete	1.22	0.61
5777	0 (Polyline)-72(2)	MH-1131	MH-816	4.22	4.36	3.42	3.27	20.8	1.61	0.011	2.11	1.94	0.5	25.9	50.4	34,374.90	Box	Concrete	1.22	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
5776	0 (Polyline)-72(1)	MH-816	MH-1130	4.36	3.59	3.27	2.58	38.61	1.61	0.011	3.4	3.13	0.81	26	106.1	56,081.60	Box	Concrete	1.22	0.61
4778	0 (Polyline)-71	MH-1130	MH-2640	3.59	4.01	2.58	2.56	50	2.67	0.011	0.77	0.92	0.86	93.4	103.2	59,685.20	Box	Concrete	1.22	0.91
4996	0 (Polyline)-70	MH-2640	O-55	4.01	4.18	2.56	2.35	48.65	1.89	0.011	0.79	2.68	0.88	32.7	113.5	63,413.30	Box	Concrete	1.22	0.91
10071	0 (Polyline)-52(2)	MH-3130	MH-2705	4.27	4.1	3.59	3.39	42.8	0.76	0.011	0.94	0.66	0.04	6.3	23.8	2,104.90	Box	Concrete	0.61	0.61
4967	0 (Polyline)-53	MH-2705	MH-2573	4.1	4	3.39	3.29	50	1.03	0.011	1.02	0.43	0.13	30.4	34.9	6,911.10	Box	Concrete	0.61	0.61
4578	0 (Polyline)-54	MH-2573	MH-391	4	4.08	3.29	3.27	33.89	1.38	0.011	0.59	0.36	0.13	34.7	34.4	6,911.10	Box	Concrete	0.91	0.61
624	0 (Polyline)-55	MH-391	MH-392	4.08	3.5	3.27	2.49	32.75	1.06	0.011	2.22	2.51	0.15	5.9	99.6	8,488.90	Box	Concrete	0.91	0.61
9192	CO-250(2)	MH-2988	MH-2989	4	3.93	3.29	3.1	53.46	0.95	0.019	0.71	0.33	0.07	22.4	49.1	3,736.90	Box	Concrete	0.61	0.61
9179	CO-245	MH-2982	MH-2983	4	3.92	3.29	3.21	48.75	0.88	0.019	0.43	0.23	0.04	15.6	49.3	1,782.10	Box	Concrete	0.61	0.61
9181	CO-246	MH-2983	MH-2984	3.92	4	3.21	3.18	48.41	0.99	0.019	0.28	0.12	0.03	25.6	56.9	1,782.10	Box	Concrete	0.61	0.61
9183	CO-247	MH-2984	MH-2985	4	4.19	3.18	3.15	65.69	0.94	0.019	0.27	0.12	0.03	21.8	60.9	1,782.10	Box	Concrete	0.61	0.61
9185	CO-248	MH-2985	MH-2986	4.19	4	3.15	3.13	42.33	1.44	0.011	0.64	0.22	0.16	74.5	62.8	12,365.00	Box	Concrete	0.61	0.61
9187	CO-249	MH-2986	MH-2987	4	3.91	3.13	3.11	33.98	1.41	0.011	0.63	0.22	0.15	71.1	62.2	12,365.00	Box	Concrete	0.61	0.61
9191	CO-250(1)	MH-2987	MH-2989	3.91	3.93	3.11	3.1	19.39	1.45	0.011	0.64	0.22	0.16	75.7	61.7	13,504.60	Box	Concrete	0.61	0.61
9193	CO-251	MH-2989	MH-392	3.93	3.5	3.1	2.49	8.63	0.78	0.011	3.97	2.58	0.21	8	113.5	17,241.50	Box	Concrete	0.61	0.61
5039	0 (Polyline)-5	MH-2729	MH-791	3.64	3.76	2.93	2.9	50	2.1	0.011	0.59	0.52	0.44	84.1	113	22,293.90	Box	Concrete	1.22	0.61
1234	0 (Polyline)-6	MH-791	MH-792	3.76	3.81	2.9	2.88	34.78	2.15	0.011	0.64	0.52	0.47	90.4	113.8	25,680.30	Box	Concrete	1.22	0.61
4890	0 (Polyline)-7	MH-2679	MH-2254	4	4.12	3.29	3.26	50	0.82	0.011	0.37	0.22	0.02	11.1	51.9	1,218.60	Box	Concrete	0.61	0.61
3827	0 (Polyline)-8	MH-2254	MH-2255	4.12	4.07	3.26	3.24	50	1.09	0.011	0.53	0.22	0.08	36.6	55.1	4,480.50	Box	Concrete	0.61	0.61
5768	0 (Polyline)-9(1)	MH-2255	MH-792	4.07	3.81	3.24	2.88	31.28	0.77	0.011	1.51	1.02	0.07	7.1	85.2	4,480.50	Box	Concrete	0.61	0.61
5769	0 (Polyline)-9(2)	MH-792	MH-2559	3.81	3.92	2.88	2.88	18.73	2.17	0.011	0.66	0.52	0.49	93.4	114.2	30,831.60	Box	Concrete	1.22	0.61
4854	0 (Polyline)-10	MH-2559	MH-2511	3.92	4.03	2.88	2.85	50	2.18	0.011	0.66	0.52	0.49	94.4	114.5	32,031.10	Box	Concrete	1.22	0.61
4432	0 (Polyline)-11	MH-2511	MH-2512	4.03	4.17	2.85	2.83	50	2.21	0.011	0.7	0.52	0.52	99.4	114.8	35,649.80	Box	Concrete	1.22	0.61
4588	0 (Polyline)-12	MH-2512	MH-2577	4.17	4.24	2.83	2.8	50	2.18	0.011	0.67	0.52	0.5	95.1	115	35,649.80	Box	Concrete	1.22	0.61
4692	0 (Polyline)-13	MH-2577	MH-1265	4.24	4.04	2.8	2.78	35.16	2.21	0.011	0.86	0.92	0.52	56	77.8	38,808.10	Box	Concrete	1.22	0.91
5770	0 (Polyline)-14(1)	MH-1265	MH-392	4.04	3.5	2.78	2.49	24.43	1.54	0.011	2.53	4.51	0.5	11.1	94.7	38,808.10	Box	Concrete	1.22	0.91
5771	0 (Polyline)-14(2)	MH-392	MH-1266	3.5	3.64	2.49	2.47	40.11	2.57	0.011	0.7	0.92	0.78	84.7	117.6	65,469.90	Box	Concrete	1.22	0.91
4237	0 (Polyline)-15	MH-1266	MH-2431	3.64	3.91	2.47	2.44	50	2.6	0.011	0.72	0.92	0.8	87.3	118.2	69,373.80	Box	Concrete	1.22	0.91
10114	0 (Polyline)-17(1)	MH-2431	MH-3134	3.91	3.79	2.44	2.3	50.35	2.01	0.011	0.82	2.2	0.91	41.3	125.1	80,938.10	Box	Concrete	1.22	0.91
10115	0 (Polyline)-17(2)	MH-3134	O-54	3.79	3.69	2.44	2.3	43.92	1.98	0.011	0.82	2.35	0.91	38.8	122.5	84,155.50	Box	Concrete	1.22	0.91
1322	0 (Polyline)-84	MH-849	MH-850	4.29	4.37	3.58	3.36	39.04	0.72	0.011	0.9	0.73	0.03	4.2	23.4	1,540.70	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
178	0 (Polyline)-88	MH-98	MH-97	4.08	4.5	3.37	3.37	7.04	0.89	0.011	0.43	0.22	0.04	17	35.8	1,860.80	Box	Concrete	0.61	0.61
5775	0 (Polyline)-87(2)	MH-97	MH-850	4.5	4.37	3.37	3.36	12.44	0.98	0.011	0.48	0.22	0.05	25.1	36.3	2,782.30	Box	Concrete	0.61	0.61
5774	0 (Polyline)-87(1)	MH-850	MH-1532	4.37	4.42	3.36	3.34	35.21	1.19	0.011	0.57	0.22	0.1	47.1	32	5,336.70	Box	Concrete	0.61	0.61
2908	0 (Polyline)-86	MH-1532	MH-1802	4.42	3.61	3.34	2.9	50	0.86	0.011	1.7	0.91	0.13	14.4	62.2	7,220.50	Box	Concrete	0.61	0.61
3346	0 (Polyline)-85	MH-1802	O-53	3.61	4.5	2.9	2.3	50	0.88	0.011	2.04	1.06	0.17	15.6	144.8	9,367.20	Box	Concrete	0.61	0.61
1527	0 (Polyline)-125	MH-979	MH-978	3.72	3.56	3.01	2.85	38.34	1.08	0.011	1.53	0.63	0.22	34.9	100.1	11,065.50	Box	Concrete	0.61	0.61
4562	0 (Polyline)-124	MH-978	MH-2566	3.56	4.16	2.85	2.83	50	1.76	0.011	0.52	0.36	0.29	79.1	112.9	14,846.20	Box	Concrete	0.91	0.61
4660	0 (Polyline)-92	MH-2566	MH-486	4.16	4.13	2.83	2.8	50	1.78	0.011	0.53	0.36	0.29	80.7	114.4	16,439.60	Box	Concrete	0.91	0.61
770	0 (Polyline)-93	MH-486	MH-487	4.13	4.26	2.8	2.76	20.81	1.44	0.011	0.54	0.74	0.3	40.8	118.1	18,481.80	Box	Concrete	0.91	0.61
4771	0 (Polyline)-116	MH-2638	MH-2580	3.58	4.23	2.87	2.84	50	1.51	0.011	0.48	0.22	0.18	83	113.7	9,078.60	Box	Concrete	0.61	0.61
4594	0 (Polyline)-117	MH-2580	MH-1887	4.23	4.07	2.84	2.82	50	1.76	0.011	0.52	0.36	0.29	79.2	115.1	15,880.50	Box	Concrete	0.91	0.61
3070	0 (Polyline)-118	MH-1887	MH-1115	4.07	3.86	2.82	2.79	50	1.97	0.011	0.47	0.52	0.35	67.5	117	21,255.90	Box	Concrete	1.22	0.61
1744	0 (Polyline)-119	MH-1115	MH-878	3.86	3.95	2.79	2.77	49.27	1.99	0.011	0.49	0.52	0.36	69.5	119.1	24,244.70	Box	Concrete	1.22	0.61
5706	0 (Polyline)-120(1)(1)	MH-878	MH-487	3.95	4.26	2.77	2.76	20.86	2	0.011	0.5	0.52	0.37	70.7	120.6	26,221.50	Box	Concrete	1.22	0.61
5707	0 (Polyline)-120(1)(2)	MH-487	MH-2568	4.26	4.22	2.76	2.75	14.83	2.35	0.011	0.9	0.92	0.62	67.4	81.3	45,189.20	Box	Concrete	1.22	0.91
1325	0 (Polyline)-95	MH-852	MH-851	4.01	4.16	3.3	3.28	38.99	0.86	0.011	0.4	0.22	0.03	14.1	29.6	1,544.60	Box	Concrete	0.61	0.61
4567	0 (Polyline)-94	MH-851	MH-2568	4.16	4.22	3.28	2.75	50	0.82	0.011	1.73	0.99	0.11	11.4	76.2	6,203.70	Box	Concrete	0.61	0.61
5705	0 (Polyline)-120(2)	MH-2568	MH-879	4.22	3.66	2.75	2.65	28.94	1.85	0.011	1.85	2.39	0.71	29.9	86.8	52,461.80	Box	Concrete	1.22	0.91
5023	0 (Polyline)-121	MH-879	MH-1844	3.66	3.84	2.65	2.64	36.13	2.5	0.011	0.94	0.92	0.73	79.3	92.6	54,317.00	Box	Concrete	1.22	0.91
5815	CO-16	MH-1844	O-51	3.84	4.5	2.64	2.18	56.55	1.7	0.011	2.52	3.7	0.73	19.8	117.5	55,926.60	Box	Concrete	1.22	0.91
2657	0 (Polyline)-101	MH-1666	MH-1665	4.04	4.15	3.33	2.94	47.48	0.77	0.011	1.28	0.87	0.06	7	56.3	3,091.40	Box	Concrete	0.61	0.61
3464	0 (Polyline)-96	MH-2079	MH-946	4.03	4.05	3.32	3.3	37.91	0.94	0.011	0.46	0.22	0.05	21.4	28.2	2,335.00	Box	Concrete	0.61	0.61
5702	0 (Polyline)-97(1)(1)	MH-946	MH-46	4.05	4.08	3.3	2.95	28.23	0.79	0.011	1.69	1.06	0.09	8.7	58.4	4,995.00	Box	Concrete	0.61	0.61
3889	0 (Polyline)-113	MH-2281	MH-2282	3.95	3.69	3.24	2.98	50	1.26	0.011	1.91	0.69	0.38	54.2	71.1	19,074.90	Box	Concrete	0.61	0.61
4827	0 (Polyline)-114	MH-2282	MH-46	3.69	4.08	2.98	2.95	52.67	2.14	0.011	0.83	0.52	0.47	89.1	87.6	24,102.20	Box	Concrete	1.22	0.61
5703	0 (Polyline)-97(1)(2)	MH-46	MH-1665	4.08	4.15	2.95	2.94	20.8	2.26	0.011	0.87	0.92	0.55	59.9	59.3	30,305.90	Box	Concrete	1.22	0.91
5701	0 (Polyline)-97(2)	MH-1665	MH-947	4.15	3.81	2.94	2.8	37.32	1.77	0.011	1.87	2.57	0.63	24.4	67.5	35,220.30	Box	Concrete	1.22	0.91
4513	0 (Polyline)-98	MH-947	MH-2546	3.81	3.58	2.8	2.57	45.34	1.74	0.011	2.07	2.92	0.66	22.5	88.2	37,593.70	Box	Concrete	1.22	0.91
5816	CO-17	MH-2546	O-50	3.58	3.5	2.57	2.09	65.69	1.69	0.011	0.62	3.52	0.69	19.5	126.1	40,022.30	Box	Concrete	1.22	0.91
4518	0 (Polyline)-102	MH-2548	MH-89	3.88	3.8	3.17	3.09	24.87	0.78	0.011	0.85	0.56	0.04	7.9	59	2,216.90	Box	Concrete	0.61	0.61
166	0 (Polyline)-103	MH-89	MH-90	3.8	3.93	3.09	2.87	29.64	0.81	0.011	1.38	0.83	0.08	9.9	83.8	4,255.00	Box	Concrete	0.61	0.61
9833	0 (Polyline)-109(2)	MH-3089	MH-1340	4.35	4.04	2.93	2.91	44.33	1.47	0.011	0.46	0.54	0.07	12.7	93.5	3,463.80	Box	Concrete	1.22	0.61
2108	0 (Polyline)-108	MH-1340	MH-1339	4.04	3.77	2.91	2.88	50	1.62	0.011	0.58	0.52	0.14	27.3	97.3	7,841.50	Box	Concrete	1.22	0.61
5697	0 (Polyline)-107(2)	MH-1339	MH-90	3.77	3.93	2.88	2.87	35.96	1.71	0.011	0.63	0.52	0.19	36	100.6	11,167.20	Box	Concrete	1.22	0.61
5699	0 (Polyline)-107(1)(2)	MH-90	MH-2398	3.93	3.93	2.87	2.86	5.92	1.82	0.011	0.35	0.52	0.26	49.4	102.1	16,153.60	Box	Concrete	1.22	0.61
317	0 (Polyline)-145	MH-190	MH-189	4.1	3.97	3.39	3.26	8.06	0.67	0.011	1	1.2	0.02	1.5	26.2	886	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
4151	0 (Polyline)-144	MH-189	MH-2398	3.97	3.93	3.26	2.86	50	0.76	0.011	1.25	0.86	0.06	6.6	69.5	2,912.20	Box	Concrete	0.61	0.61
4475	0 (Polyline)-106	MH-2398	MH-2389	3.93	3.49	2.86	2.48	58.13	1.51	0.011	0.43	1.91	0.32	16.9	133	20,466.60	Box	Concrete	1.22	0.61
4133	0 (Polyline)-105	MH-2389	MH-2388	3.49	3.77	2.48	2.45	50	1.98	0.011	0.32	0.92	0.36	38.8	111	25,077.60	Box	Concrete	1.22	0.91
5007	0 (Polyline)-104	MH-2388	O-49	3.77	3.91	2.45	2.02	47.09	1.5	0.011	0.31	3.96	0.34	8.7	135.9	26,775.90	Box	Concrete	1.22	0.91
3987	0 (Polyline)-28	MH-2323	MH-2174	3	3.25	2.29	2.27	50	1.48	0.011	0.46	0.22	0.17	79.6	139.9	8,702.90	Box	Concrete	0.61	0.61
3668	0 (Polyline)-29	MH-2174	MH-130	3.25	3.12	2.27	2.25	28.57	1.65	0.011	0.43	0.36	0.24	65.7	141.3	13,214.40	Box	Concrete	0.91	0.61
228	0 (Polyline)-30	MH-130	MH-131	3.12	3.28	2.25	2.06	27.73	1.22	0.011	0.46	1.34	0.26	19.2	184	15,092.50	Box	Concrete	0.91	0.61
942	0 (Polyline)-32	MH-601	MH-600	4.03	4.16	3.32	3.3	26.94	1.09	0.011	0.53	0.22	0.08	35.9	27.8	3,928.80	Box	Concrete	0.61	0.61
4527	0 (Polyline)-31	MH-600	MH-2299	4.16	4.47	3.3	2.79	50	0.83	0.011	1.71	0.98	0.11	11.8	39.6	6,054.70	Box	Concrete	0.61	0.61
4506	0 (Polyline)-18	MH-2542	MH-1052	3.6	3.71	2.89	2.87	50	1.62	0.011	0.69	0.36	0.23	62	54.3	11,401.80	Box	Concrete	0.91	0.61
1644	0 (Polyline)-19	MH-1052	MH-1053	3.71	4.33	2.87	2.84	50	1.86	0.011	0.72	0.52	0.28	53.6	54	15,060.10	Box	Concrete	1.22	0.61
4629	0 (Polyline)-20	MH-1053	MH-2298	4.33	4.34	2.84	2.82	50	1.87	0.011	0.72	0.52	0.28	54.2	54.4	16,181.50	Box	Concrete	1.22	0.61
3928	0 (Polyline)-21	MH-2298	MH-2299	4.34	4.47	2.82	2.79	50	1.9	0.011	0.74	0.52	0.31	59	54.3	18,764.50	Box	Concrete	1.22	0.61
4397	0 (Polyline)-22	MH-2299	MH-2008	4.47	4.15	2.79	2.77	50	2.06	0.011	0.8	0.92	0.41	44.4	31.5	26,612.50	Box	Concrete	1.22	0.91
3309	0 (Polyline)-23	MH-2008	MH-1411	4.15	3.1	2.77	2.09	50	1.51	0.011	2.56	4.81	0.46	9.6	68.9	31,277.10	Box	Concrete	1.22	0.91
5694	0 (Polyline)-24(1)	MH-1411	MH-131	3.1	3.28	2.09	2.06	44.38	2.22	0.011	0.47	0.92	0.53	57.2	132.5	36,325.40	Box	Concrete	1.22	0.91
3789	0 (Polyline)-25	MH-131	MH-2141	3.28	3.69	2.06	2.04	55.57	2.58	0.011	0.54	1.22	0.75	61.6	158	54,724.80	Box	Concrete	1.52	0.91
5817	CO-18	MH-2141	O-48	3.69	3.53	2.04	1.9	76.62	2.19	0.011	0.54	2.32	0.74	32	165.8	58,183.40	Box	Concrete	1.52	0.91
1341	0 (Polyline)-146	MH-861	MH-186	3.95	3.82	3.24	2.28	36.46	0.68	0.011	1.49	1.57	0.03	2.1	60.5	1,638.60	Box	Concrete	0.61	0.61
3518	0 (Polyline)-130	MH-2105	MH-2106	4.29	3.77	3.58	3.06	50	0.88	0.011	1.92	0.99	0.16	16.2	45.6	8,067.80	Box	Concrete	0.61	0.61
4284	0 (Polyline)-131	MH-2106	MH-2291	3.77	3.91	3.06	3.04	50	1.64	0.011	0.7	0.36	0.23	64.2	60	12,055.80	Box	Concrete	0.91	0.61
3912	0 (Polyline)-132	MH-2291	MH-1064	3.91	4.11	3.04	3.01	50	1.78	0.011	0.75	0.36	0.3	81.6	57.9	16,271.00	Box	Concrete	0.91	0.61
1281	0 (Polyline)-112	MH-823	MH-822	3.88	3.69	3.17	2.98	35.35	0.83	0.019	0.72	0.41	0.05	12	55.7	2,489.20	Box	Concrete	0.61	0.61
3730	EX	MH-822	MH-2206	3.69	3.73	2.98	2.96	50	1.81	0.019	0.44	0.21	0.18	84.8	70.4	9,398.00	Box	Concrete	0.91	0.61
3996	EX (Polyline)-110	MH-2206	MH-1557	3.73	4.37	2.96	2.93	53.42	2.08	0.019	0.47	0.3	0.25	81.8	70.1	14,422.00	Box	Concrete	1.22	0.61
9830	CO-382	MH-1557	MH-1064	4.37	4.11	2.93	3.01	8.32	1.5	0.011	0.31	2.19	0.22	10.2	64	14,422.00	Box	Concrete	1.2	0.6
1662	EX	MH-1064	MH-1065	4.11	3.69	3.01	2.8	50	1.87	0.019	1.22	0.88	0.48	54.9	64.2	32,254.20	Box	Concrete	1.22	0.61
2520	0 (Polyline)-134	MH-1065	MH-860	3.69	3.48	2.98	2.3	52.02	1.69	0.019	1.84	1.54	0.53	34.2	76.1	35,988.80	Box	Concrete	1.22	0.61
1339	0 (Polyline)-135	MH-860	MH-84	3.48	3.85	2.3	2.28	34.76	2.25	0.011	0.89	0.95	0.56	59	73.2	38,794.20	Box	Concrete	1.22	0.91
4285	0 (Polyline)-149	MH-2450	MH-2451	4.02	3.29	3.31	2.58	50	0.83	0.011	2.08	1.17	0.14	12.1	46.9	7,194.30	Box	Concrete	0.61	0.61
4526	0 (Polyline)-150	MH-2451	MH-115	3.29	3.5	2.58	2.55	44.58	1.57	0.011	0.68	0.36	0.2	56.1	65.6	10,513.10	Box	Concrete	0.91	0.61

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205	0 (Polyline)-151	MH-115	MH-64	3.5	3.47	2.55	2.55	10.8	1.6	0.011	0.69	0.36	0.21	59	66.6	11,692.30	Box	Concrete	0.91	0.61
4948	0 (Polyline)-140	MH-2698	MH-63	3.57	3.61	2.86	2.84	32.09	0.74	0.011	0.29	0.22	0.01	5.4	16.9	588.1	Box	Concrete	0.61	0.61
127	0 (Polyline)-141	MH-63	MH-64	3.61	3.47	2.84	2.55	21.47	0.69	0.011	1.13	1.13	0.03	2.4	42.3	1,484.40	Box	Concrete	0.61	0.61
4856	0 (Polyline)-142	MH-64	MH-84	3.47	3.85	2.55	2.28	54.26	1.24	0.011	1.56	1.14	0.24	20.9	88.4	13,411.40	Box	Concrete	0.91	0.61
312	0 (Polyline)-136	MH-84	MH-186	3.85	3.82	2.28	2.28	8	2.52	0.011	0.94	0.92	0.75	81.3	73.8	53,237.70	Box	Concrete	1.22	0.91
936	0 (Polyline)-148	MH-597	MH-596	3.83	3.6	3.12	2.89	26.88	0.67	0.011	0.74	0.91	0.01	1.4	9.4	646.1	Box	Concrete	0.61	0.61
4435	0 (Polyline)-147	MH-596	MH-186	3.6	3.82	2.89	2.28	50	0.72	0.011	1.29	1.06	0.04	4	61.6	2,232.30	Box	Concrete	0.61	0.61
4845	0 (Polyline)-137	MH-186	MH-2443	3.82	2.95	2.28	1.94	50	1.77	0.011	2.45	3.37	0.82	24.2	92.4	58,373.20	Box	Concrete	1.22	0.91
4268	0 (Polyline)-138	MH-2443	MH-1640	2.95	4.04	1.94	1.92	47.17	2.67	0.011	0.78	0.92	0.86	93.7	172.2	62,507.90	Box	Concrete	1.22	0.91
2613	0 (Polyline)-139	MH-1640	O-47	4.04	3.87	1.92	1.9	46.83	2.67	0.011	0.77	0.92	0.86	93.3	172.5	64,739.90	Box	Concrete	1.22	0.91
4036	0 (Polyline)-260	MH-2346	MH-479	4.1	3.35	3.39	2.64	50	0.84	0.011	2.13	1.18	0.15	12.6	43.7	7,558.20	Box	Concrete	0.61	0.61
759	0 (Polyline)-261	MH-479	MH-480	3.35	3.19	2.64	2.37	20.45	0.89	0.011	2.15	1.1	0.18	16.6	80.3	9,371.50	Box	Concrete	0.61	0.61
4712	0 (Polyline)-169	MH-2623	MH-2527	4.39	4.11	3.68	3.4	50	0.67	0.011	0.64	0.72	0.01	1.7	7.2	624.4	Box	Concrete	0.61	0.61
4471	0 (Polyline)-170	MH-2527	MH-2202	4.11	3.71	3.4	3	50	0.7	0.011	0.91	0.86	0.02	2.7	10	1,272.80	Box	Concrete	0.61	0.61
3722	0 (Polyline)-171	MH-2202	MH-2165	3.71	3.51	3	2.8	50	0.75	0.011	0.84	0.61	0.03	5.6	20.9	1,963.00	Box	Concrete	0.61	0.61
3643	0 (Polyline)-172	MH-2165	MH-2166	3.51	3.1	2.8	2.39	50	0.84	0.011	1.58	0.88	0.11	12.7	66.2	6,658.10	Box	Concrete	0.61	0.61
5764	0 (Polyline)-173(1)	MH-2166	MH-480	3.1	3.19	2.39	2.37	26.77	1.34	0.011	0.37	0.22	0.14	63.5	102.5	8,446.50	Box	Concrete	0.61	0.61
5765	0 (Polyline)-173(2)	MH-480	MH-2237	3.19	2.98	2.37	2.27	23.23	1.16	0.011	0.75	0.63	0.28	44	109.8	18,507.50	Box	Concrete	0.61	0.61
4317	0 (Polyline)-174	MH-2237	MH-2464	2.98	3.17	2.27	2.25	50	1.89	0.011	0.4	0.52	0.3	57.5	118.6	20,339.40	Box	Concrete	1.22	0.61
4834	0 (Polyline)-175	MH-2464	MH-2204	3.17	3.06	2.25	2.22	50	1.96	0.011	0.46	0.52	0.34	65.7	121.1	25,070.10	Box	Concrete	1.22	0.61
3727	0 (Polyline)-176	MH-2204	MH-2205	3.06	3.45	2.22	2.2	50	2.03	0.011	0.53	0.52	0.39	74.8	123.2	30,689.50	Box	Concrete	1.22	0.61
4776	0 (Polyline)-177	MH-2205	MH-2471	3.45	3.09	2.2	2.08	50	1.73	0.011	1.42	2.02	0.45	22.2	89.7	37,007.10	Box	Concrete	1.22	0.91
4338	0 (Polyline)-178	MH-2471	MH-2472	3.09	3.37	2.08	2.05	50	2.2	0.011	0.85	0.92	0.51	55.3	97.3	42,850.00	Box	Concrete	1.22	0.91
4877	0 (Polyline)-179	MH-2472	MH-2014	3.37	3.1	2.05	2.03	50	2.27	0.011	0.88	0.92	0.56	61	99.3	48,690.20	Box	Concrete	1.22	0.91
3319	0 (Polyline)-180	MH-2014	MH-1812	3.1	3.39	2.03	2	50	2.33	0.011	0.54	0.92	0.6	65.4	101.1	53,659.90	Box	Concrete	1.22	0.91
2927	0 (Polyline)-181	MH-1812	MH-1813	3.39	3.82	2	1.98	50	2.4	0.011	0.59	0.92	0.65	71.1	102.5	61,220.10	Box	Concrete	1.22	0.91
3368	0 (Polyline)-182	MH-1813	MH-801	3.82	4.37	1.98	1.95	50	2.46	0.011	0.63	0.92	0.7	75.9	103.8	67,595.60	Box	Concrete	1.22	0.91
1249	0 (Polyline)-183	MH-801	MH-802	4.37	4.03	1.95	1.93	48.61	2.57	0.011	0.54	1.22	0.74	60.9	105.2	74,003.10	Box	Concrete	1.52	0.91
4711	0 (Polyline)-184	MH-802	MH-1160	4.03	3.94	1.93	1.9	50	2.62	0.011	0.58	1.22	0.8	65.5	106.8	82,694.80	Box	Concrete	1.52	0.91
1817	0 (Polyline)-185	MH-1160	MH-1161	3.94	3.71	1.9	1.88	50	2.65	0.011	0.6	1.22	0.83	67.9	108.4	88,562.70	Box	Concrete	1.52	0.91
3845	0 (Polyline)-186	MH-1161	MH-2261	3.71	2.86	1.88	1.85	50	2.64	0.011	0.65	1.35	0.91	66.9	110.1	99,869.60	Box	Concrete	1.52	0.91
4144	0 (Polyline)-187	MH-2261	MH-2394	2.86	3.25	1.85	1.82	50	2.74	0.011	0.66	1.22	0.92	75.5	115.1	1,04,100.00	Box	Concrete	1.52	0.91
4426	0 (Polyline)-188	MH-2394	MH-876	3.25	3.05	1.82	1.8	38	2.88	0.011	0.56	1.53	0.94	61.3	116.4	1,09,190.90	Box	Concrete	1.83	0.91
5692	0 (Polyline)-189(1)	MH-876	MH-606	3.05	3.77	1.8	1.79	32.82	2.88	0.011	0.56	1.53	0.94	61.2	117.6	1,11,368.60	Box	Concrete	1.83	0.91
5693	0 (Polyline)-189(2)	MH-606	MH-877	3.77	3.72	1.79	1.77	29.18	2.87	0.011	0.56	1.53	0.93	60.6	118.7	1,12,016.80	Box	Concrete	1.83	0.91
1460	0 (Polyline)-190	MH-877	MH-937	3.72	3.47	1.77	1.75	50	2.86	0.011	0.55	1.53	0.92	59.9	120	1,12,530.40	Box	Concrete	1.83	0.91

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3831	0 (Polyline)-191	MH-937	MH-598	3.47	3.4	1.75	1.72	50	2.86	0.011	0.55	1.53	0.91	59.4	121.8	1,14,625.50	Box	Concrete	1.83	0.91
939	0 (Polyline)-192	MH-598	O-46	3.4	3.5	1.72	0.96	23.27	2.09	0.011	0.54	12.42	0.89	7.2	164.6	1,15,812.90	Box	Concrete	1.83	0.91
2380	0 (Polyline)-2226	MH-1508	MH-1468	3.6	3.28	2.89	2.57	50	0.72	0.011	0.93	0.78	0.03	3.9	25.5	1,540.50	Box	Concrete	0.61	0.61
2314	0 (Polyline)-2227	MH-1468	MH-1198	3.28	3.33	2.57	2.54	50	1.23	0.011	0.58	0.22	0.11	51.4	36.5	5,870.60	Box	Concrete	0.61	0.61
1877	0 (Polyline)-2228	MH-1198	MH-1199	3.33	3.07	2.54	2.06	44.15	0.89	0.011	1.98	1.01	0.17	16.5	59.2	9,501.40	Box	Concrete	0.61	0.61
720	0 (Polyline)-1087	MH-454	MH-453	4.3	4.35	3.59	3.58	19.66	1.04	0.011	0.51	0.22	0.07	30.8	26	3,365.70	Box	Concrete	0.61	0.61
5687	0 (Polyline)-1086(2)	MH-453	MH-2355	4.35	3.76	3.58	3.05	41.93	0.81	0.011	1.82	1.09	0.11	10.1	29.4	5,731.10	Box	Concrete	0.61	0.61
1084	0 (Polyline)-42	MH-693	MH-692	4.16	4.06	3.45	3.35	31.39	0.87	0.011	1.03	0.54	0.08	15.2	38.3	4,160.00	Box	Concrete	0.61	0.61
3107	0 (Polyline)-41	MH-692	MH-1907	4.06	3.98	3.35	3.27	50	1.19	0.011	0.98	0.37	0.17	46.5	43.9	8,921.50	Box	Concrete	0.61	0.61
4058	0 (Polyline)-40	MH-1907	MH-2355	3.98	3.76	3.27	3.05	50	1.11	0.011	1.61	0.64	0.25	38.3	41.4	13,324.10	Box	Concrete	0.61	0.61
5686	0 (Polyline)-1086(1)	MH-2355	MH-2362	3.76	3.78	3.05	2.77	8.07	1.41	0.011	3.18	4.34	0.37	8.5	56.6	20,417.10	Box	Concrete	1.22	0.61
3076	0 (Polyline)-220	MH-1890	MH-681	3.98	4.03	3.27	3.24	50	1.29	0.011	0.6	0.22	0.12	57.6	36.5	6,293.70	Box	Concrete	0.61	0.61
1067	0 (Polyline)-221	MH-681	MH-682	4.03	3.79	3.24	3	30.26	0.9	0.011	1.72	0.86	0.15	17.4	38.3	8,157.20	Box	Concrete	0.61	0.61
714	0 (Polyline)-215	MH-450	MH-449	3.79	3.72	3.08	3.01	19.56	0.73	0.011	0.73	0.56	0.03	4.9	39.8	1,390.30	Box	Concrete	0.61	0.61
5678	0 (Polyline)-214(2)	MH-449	MH-682	3.72	3.79	3.01	3	20.13	0.93	0.011	0.45	0.22	0.04	20.6	45.8	2,303.30	Box	Concrete	0.61	0.61
5677	0 (Polyline)-214(1)	MH-682	MH-2149	3.79	3.82	3	2.99	29.87	1.59	0.011	0.68	0.36	0.21	58.1	45.1	11,622.90	Box	Concrete	0.91	0.61
4349	0 (Polyline)-213	MH-2149	MH-2362	3.82	3.78	2.99	2.77	55.63	1.28	0.011	1.44	1	0.24	23.9	61.3	13,714.80	Box	Concrete	0.91	0.61
5679	EX	MH-2362	MH-1111	3.78	3.92	2.77	2.72	44.38	2.44	0.019	0.8	0.8	0.6	74.8	43	35,571.10	Box	Concrete	1.22	0.91
1736	EX	MH-1111	MH-1110	3.92	3.33	2.72	2.32	50	1.82	0.019	1.62	2.13	0.59	27.8	35.9	37,117.10	Box	Concrete	1.22	0.91
5689	EX	MH-1110	MH-1199	3.33	3.07	2.32	2.06	42.21	1.9	0.019	1.52	1.9	0.63	33.3	48.2	40,759.20	Box	Concrete	1.22	0.91
5688	0 (Polyline)-210(1)	MH-1199	O-45	3.07	2.91	2.06	1.91	7.79	1.59	0.011	3.39	5.62	0.77	13.8	67.2	51,241.00	Box	Concrete	1.22	0.91
9349	0 (Polyline)-237(1)	MH-3024	MH-1250	3.51	3.73	2.8	2.78	46.71	1.01	0.011	0.5	0.22	0.06	28.2	28.6	3,078.60	Box	Concrete	0.61	0.61
3026	0 (Polyline)-236	MH-1250	MH-1863	3.73	3.2	2.78	2.49	50	0.9	0.011	1.48	0.73	0.13	17.8	32.2	7,174.20	Box	Concrete	0.61	0.61
4077	0 (Polyline)-235	MH-1863	O-180	3.2	2.89	2.49	0.6	50	0.82	0.011	3.21	1.88	0.2	10.8	149.3	11,474.50	Box	Concrete	0.61	0.61
5059	0 (Polyline)-222	MH-2736	MH-459	3.42	3.6	2.71	2.68	50	1.14	0.011	0.55	0.22	0.09	41.2	30.7	4,502.30	Box	Concrete	0.61	0.61
729	0 (Polyline)-223	MH-459	MH-460	3.6	3.1	2.68	2.09	19.92	0.77	0.011	2.5	1.67	0.12	7.3	43.5	6,645.00	Box	Concrete	0.61	0.61
2674	0 (Polyline)-233	MH-1675	MH-1336	3.82	3.88	3.11	3.09	50	1.25	0.011	0.51	0.36	0.08	21.8	23.8	4,013.90	Box	Concrete	0.91	0.61
2103	0 (Polyline)-234	MH-1336	MH-1337	3.88	3.84	3.09	2.74	44.03	1.11	0.011	1.54	1.45	0.14	9.8	39.1	7,794.30	Box	Concrete	0.91	0.61
4983	0 (Polyline)-224	MH-2711	MH-1193	3.7	3.68	2.99	2.96	50	1.22	0.011	0.58	0.22	0.11	50.4	35	5,515.30	Box	Concrete	0.61	0.61
1869	0 (Polyline)-225	MH-1193	MH-1194	3.68	3.48	2.96	2.77	50	0.97	0.011	1.32	0.6	0.15	24.6	44.4	7,953.40	Box	Concrete	0.61	0.61
4668	0 (Polyline)-226	MH-1194	MH-1200	3.48	3.65	2.77	2.75	50	1.66	0.011	0.71	0.36	0.24	66.8	58.2	13,621.10	Box	Concrete	0.91	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
5657	0 (Polyline)-227(1)	MH-1200	MH-1337	3.65	3.84	2.75	2.74	20	1.77	0.011	0.74	0.36	0.29	80.3	56.9	17,476.30	Box	Concrete	0.91	0.61
5658	0 (Polyline)-227(2)	MH-1337	MH-1201	3.84	3.39	2.74	2.68	30.01	1.61	0.011	1.39	0.73	0.44	60.3	53.3	27,130.20	Box	Concrete	0.91	0.61
2010	0 (Polyline)-228	MH-1201	MH-1281	3.39	3.02	2.68	2.31	50	1.38	0.011	2.27	1.4	0.49	34.8	53	30,606.30	Box	Concrete	0.91	0.61
4400	0 (Polyline)-229	MH-1281	MH-1223	3.02	2.95	2.31	2.24	46.04	1.92	0.011	1.27	0.89	0.54	60.9	50.5	34,738.00	Box	Concrete	1.22	0.61
5659	0 (Polyline)-230(1)	MH-1223	MH-460	2.95	3.1	2.24	2.09	15.36	1.59	0.011	2.46	2.33	0.56	23.9	53.1	37,017.80	Box	Concrete	1.22	0.61
5660	0 (Polyline)-230(2)	MH-460	MH-1003	3.1	3.27	2.09	2.07	38.62	2.49	0.011	0.9	1.22	0.67	54.9	35.8	44,573.20	Box	Concrete	1.52	0.91
1566	0 (Polyline)-231	MH-1003	MH-1004	3.27	2.35	2.07	1.34	50	1.84	0.011	2.86	6.54	0.71	10.8	63.7	48,310.10	Box	Concrete	1.52	0.91
2541	0 (Polyline)-232	MH-1004	O-42	2.35	2.41	1.34	-0.24	49.02	1.79	0.011	3.85	9.77	0.79	8.1	182.9	54,474.20	Box	Concrete	1.52	0.91
3688	0 (Polyline)-243	MH-2184	MH-1843	3.4	3.44	2.39	2.37	50	2.03	0.011	0.79	0.92	0.39	42.3	39.2	19,707.40	Box	Concrete	1.22	0.91
2987	0 (Polyline)-244	MH-1843	MH-180	3.44	3.38	2.37	2.35	40.27	2.15	0.011	0.83	0.92	0.47	51.1	33	25,106.80	Box	Concrete	1.22	0.91
303	0 (Polyline)-245	MH-180	MH-181	3.38	3.3	2.35	1.98	17.59	1.48	0.011	2.99	5.96	0.48	8	44.7	26,639.50	Box	Concrete	1.22	0.91
1650	0 (Polyline)-203	MH-1056	MH-1057	3.59	3.57	2.88	2.86	50	0.86	0.011	0.4	0.22	0.03	14.2	21.5	1,548.30	Box	Concrete	0.61	0.61
4040	0 (Polyline)-204	MH-1057	MH-237	3.57	3.07	2.86	2.36	43.39	0.79	0.011	1.66	1.03	0.09	9	39.2	5,198.60	Box	Concrete	0.61	0.61
391	0 (Polyline)-205	MH-237	MH-238	3.07	3.39	2.36	2.35	16.66	1.29	0.011	0.6	0.22	0.12	57.6	56.7	7,153.40	Box	Concrete	0.61	0.61
1810	0 (Polyline)-197	MH-1156	MH-1020	3.73	4.11	3.02	2.99	50	0.89	0.011	0.43	0.22	0.04	16.7	19.3	1,830.60	Box	Concrete	0.61	0.61
1593	0 (Polyline)-198	MH-1020	MH-1021	4.11	3.58	2.99	2.87	50	0.83	0.011	0.85	0.49	0.06	11.6	21.3	3,163.40	Box	Concrete	0.61	0.61
4384	0 (Polyline)-199	MH-1021	MH-1908	3.58	3.44	2.87	2.73	28.9	0.89	0.011	1.3	0.66	0.11	17	27.6	6,579.00	Box	Concrete	0.61	0.61
5669	0 (Polyline)-200(1)	MH-1908	MH-238	3.44	3.39	2.73	2.35	25.76	0.84	0.011	2.13	1.17	0.15	13	43.6	9,173.80	Box	Concrete	0.61	0.61
5670	0 (Polyline)-200(2)	MH-238	MH-1877	3.39	3.4	2.35	2.33	45.42	1.78	0.011	0.75	0.36	0.3	81.7	53.5	18,034.00	Box	Concrete	0.91	0.61
3051	0 (Polyline)-201	MH-1877	MH-178	3.4	3.23	2.33	2.31	40.56	2.01	0.011	0.78	0.52	0.38	72.1	42.7	24,323.10	Box	Concrete	1.22	0.61
300	0 (Polyline)-202	MH-178	MH-179	3.23	3.32	2.31	1.98	17.19	1.46	0.011	2.66	3.21	0.38	11.9	65.1	25,717.10	Box	Concrete	1.22	0.61
4954	0 (Polyline)-2230	MH-2700	MH-2260	3.14	3.51	2.21	2.18	38.66	1.76	0.011	0.59	0.41	0.33	78.9	113.4	16,511.00	Box	Concrete	0.91	0.61
3843	0 (Polyline)-2231	MH-2260	MH-813	3.51	3.23	2.3	2.2	50	1.67	0.011	1.42	0.73	0.49	67.8	100.1	26,336.90	Box	Concrete	0.91	0.61
1267	0 (Polyline)-2232	MH-813	MH-814	3.23	3.51	2.2	2.14	35.45	1.8	0.011	0.99	0.66	0.55	83.3	106.6	30,380.00	Box	Concrete	0.91	0.61
2160	0 (Polyline)-246	MH-1372	MH-1373	3.99	4.11	3.28	3.25	50	1.49	0.011	0.65	0.22	0.17	80.6	57.4	8,812.00	Box	Concrete	0.61	0.61
4937	0 (Polyline)-247	MH-1373	MH-1669	4.11	4.08	3.25	3.23	50	1.57	0.011	0.67	0.36	0.2	55.3	55.5	10,834.10	Box	Concrete	0.91	0.61
2664	0 (Polyline)-248	MH-1669	MH-1248	4.08	4.11	3.23	3.2	50	1.8	0.011	0.75	0.36	0.31	84	48.6	17,567.70	Box	Concrete	0.91	0.61
1957	0 (Polyline)-249	MH-1248	MH-1249	4.11	3.68	3.2	2.97	50	1.36	0.011	1.76	1.11	0.36	32.6	42.5	22,128.60	Box	Concrete	0.91	0.61
5667	0 (Polyline)-250(1)	MH-1249	MH-814	3.68	3.51	2.97	2.14	40.88	1.2	0.011	2.96	2.31	0.39	16.9	75.8	24,568.30	Box	Concrete	0.91	0.61
5668	0 (Polyline)-250(2)	MH-814	MH-1375	3.51	3.52	2.14	2.13	16.77	2.7	0.011	0.98	0.92	0.88	96	72.2	56,390.60	Box	Concrete	1.22	0.91
2587	0 (Polyline)-251	MH-1375	MH-1627	3.52	3.4	2.13	2.11	40.63	2.71	0.011	0.98	0.92	0.89	96.9	71.4	57,937.30	Box	Concrete	1.22	0.91
2945	0 (Polyline)-252	MH-1627	MH-1822	3.4	3.25	2.11	2.09	47.46	2.74	0.011	1.01	0.95	0.94	99	69.8	62,890.70	Box	Concrete	1.22	0.91
3376	0 (Polyline)-253	MH-1822	MH-2040	3.25	3.02	2.09	2.01	52.56	2.36	0.011	1.49	1.53	1.03	67.6	70.2	71,476.10	Box	Concrete	1.22	0.91
4790	0 (Polyline)-254	MH-2040	MH-2159	3.02	3.07	2.05	2.02	40.69	2.73	0.011	1.2	1.12	1.11	98.9	65.4	78,145.60	Box	Concrete	1.22	0.91
5665	0 (Polyline)-255(1)(1)	MH-2159	MH-179	3.07	3.32	2.02	1.99	19.29	2.36	0.011	1.59	1.62	1.11	68.2	63	79,884.80	Box	Concrete	1.22	0.91
5666	0 (Polyline)-255(1)(2)	MH-179	MH-181	3.32	3.3	1.99	1.98	9.46	2.83	0.011	1.46	1.76	1.46	82.9	62.5	1,05,911.30	Box	Concrete	1.52	0.91

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
5664	0 (Polyline)-255(2)	MH-181	MH-2160	3.3	3.05	1.98	1.96	30.6	3.6	0.011	1.17	1.84	1.82	99	59.8	1,32,987.50	Box	Concrete	2.13	0.91
4000	0 (Polyline)-256	MH-2160	MH-2328	3.05	2.92	1.96	1.91	50	3.24	0.011	1.55	2.74	1.83	66.8	55.7	1,35,929.00	Box	Concrete	2.13	0.91
4324	0 (Polyline)-257	MH-2328	MH-2306	2.92	2.86	1.91	1.85	40.23	3.13	0.011	1.75	3.26	1.86	57.2	50.6	1,41,267.20	Box	Concrete	2.13	0.91
5814	CO-15	MH-2306	O-41	2.86	1.92	1.85	-0.24	65.29	2.5	0.011	4.77	14.69	1.9	13	158.4	1,46,664.80	Box	Concrete	2.13	0.91
4722	0 (Polyline)-282	MH-117	MH-2182	3.57	3.39	2.86	2.68	55.45	0.83	0.011	0.98	0.55	0.07	12.1	24.1	3,387.20	Box	Concrete	0.61	0.61
3683	0 (Polyline)-281	MH-2182	MH-2181	3.39	3.1	2.68	2.39	50	0.93	0.011	1.54	0.74	0.15	20.2	44	7,905.00	Box	Concrete	0.61	0.61
4199	0 (Polyline)-280	MH-2181	MH-2061	3.1	3.34	2.39	2.36	50	1.6	0.011	0.68	0.36	0.21	58.9	58.2	11,655.70	Box	Concrete	0.91	0.61
5662	0 (Polyline)-279(2)	MH-2061	MH-28	3.34	3.31	2.36	2.34	42.29	1.64	0.011	0.73	0.38	0.24	63.8	58.2	13,957.00	Box	Concrete	0.91	0.61
3991	0 (Polyline)-273	MH-2324	MH-1885	3.13	3.34	2.42	2.39	50	0.98	0.011	0.48	0.22	0.05	25.5	55.1	2,784.10	Box	Concrete	0.61	0.61
3067	0 (Polyline)-274	MH-1885	MH-1886	3.34	3.24	2.39	2.37	50	1.27	0.011	0.6	0.22	0.12	55.6	57.1	6,622.90	Box	Concrete	0.61	0.61
3402	0 (Polyline)-275	MH-1886	MH-28	3.24	3.31	2.37	2.34	51.68	1.57	0.011	0.68	0.36	0.2	56.2	57.7	12,144.00	Box	Concrete	0.91	0.61
3148	0 (Polyline)-278	MH-28	MH-1927	3.31	3.3	2.34	2.31	57.72	2.11	0.011	0.82	0.52	0.45	85.8	49.3	28,764.90	Box	Concrete	1.22	0.61
4186	0 (Polyline)-277	MH-1927	O-40	3.3	3.5	2.31	-0.29	45.36	1.41	0.011	4.09	5.6	0.47	8.4	205.1	31,933.80	Box	Concrete	1.22	0.61
1923	0 (Polyline)-351	MH-1227	MH-582	3.71	3.87	3	2.98	50	0.96	0.011	0.47	0.22	0.05	22.9	24.5	2,506.90	Box	Concrete	0.61	0.61
915	0 (Polyline)-352	MH-582	MH-583	3.87	3.51	2.98	2.09	33.21	0.76	0.011	2.26	1.58	0.1	6.5	59	5,631.40	Box	Concrete	0.61	0.61
1226	0 (Polyline)-330	MH-786	MH-1102	2.97	2.92	2.26	2.21	35	1.28	0.011	0.99	0.36	0.2	56.3	92.4	10,201.20	Box	Concrete	0.61	0.61
3931	0 (Polyline)-353	MH-2300	MH-1983	4.02	3.44	3.31	2.73	50	0.8	0.011	1.69	1.04	0.1	9.5	33.4	4,970.60	Box	Concrete	0.61	0.61
3253	0 (Polyline)-354	MH-1983	MH-1984	3.44	3.08	2.73	2.37	50	1.05	0.011	1.97	0.82	0.27	32.5	59.1	13,839.00	Box	Concrete	0.61	0.61
3978	0 (Polyline)-355	MH-1984	MH-1101	3.08	2.98	2.37	2.27	50	1.56	0.011	1.4	0.76	0.42	54.9	81.4	21,979.40	Box	Concrete	0.91	0.61
1721	0 (Polyline)-356	MH-1101	MH-1102	2.98	2.92	2.27	2.21	50	1.98	0.011	1.17	0.79	0.54	68.8	92.1	29,704.50	Box	Concrete	1.22	0.61
3963	0 (Polyline)-357	MH-1102	MH-1881	2.92	3.15	2.21	2.14	50	2.13	0.011	1.36	0.86	0.75	87.5	97.9	42,567.50	Box	Concrete	1.22	0.61
3060	0 (Polyline)-358	MH-1881	MH-1286	3.15	3.64	2.14	2.12	50	2.62	0.011	0.96	0.92	0.82	89.4	66.4	48,200.30	Box	Concrete	1.22	0.91
5546	0 (Polyline)-359(1)(1)	MH-1286	MH-38	3.64	3.52	2.12	2.1	37.45	2.64	0.011	0.97	0.92	0.84	91.3	64.6	51,666.90	Box	Concrete	1.22	0.91
2698	0 (Polyline)-343	MH-1688	MH-1689	3.31	3.8	2.6	2.57	50	1.59	0.011	0.68	0.36	0.21	57.6	66.7	10,597.20	Box	Concrete	0.91	0.61
5548	0 (Polyline)-344(1)	MH-1689	MH-2522	3.8	3.53	2.57	2.55	48.24	1.81	0.011	0.75	0.36	0.31	84.5	66.9	16,499.80	Box	Concrete	0.91	0.61
46	0 (Polyline)-332	MH-10	MH-9	3.46	3.45	2.75	2.74	0.76	0.65	0.011	0.7	1.06	0.01	0.8	35	423.6	Box	Concrete	0.61	0.61
4456	0 (Polyline)-331	MH-9	MH-2522	3.45	3.53	2.74	2.55	50	0.83	0.011	1.04	0.59	0.07	11.7	51	3,522.10	Box	Concrete	0.61	0.61
4398	0 (Polyline)-345	MH-2522	MH-2497	3.53	3.67	2.55	2.52	51.76	2.14	0.011	0.83	0.52	0.47	89.9	64.6	26,744.20	Box	Concrete	1.22	0.61
4839	0 (Polyline)-346	MH-2497	MH-2478	3.67	3.91	2.52	2.5	50	2.22	0.011	0.86	0.92	0.53	57.2	36.6	31,719.40	Box	Concrete	1.22	0.91
4354	0 (Polyline)-347	MH-2478	MH-38	3.91	3.52	2.5	2.1	52.37	1.63	0.011	2.28	3.6	0.57	15.9	47.4	36,486.90	Box	Concrete	1.22	0.91
5547	0 (Polyline)-359(1)(2)	MH-38	MH-583	3.52	3.51	2.1	2.09	5.19	3.2	0.011	1.09	1.53	1.37	89.3	63.6	88,982.90	Box	Concrete	1.83	0.91

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
5545	0 (Polyline)-359(2)	MH-583	MH-1287	3.51	3.36	2.09	2.09	7.37	3.26	0.011	1.11	1.53	1.45	94.7	63.3	94,890.80	Box	Concrete	1.83	0.91
3233	0 (Polyline)-360	MH-1287	MH-1973	3.36	3.26	2.09	2.07	50	3.27	0.011	1.11	1.53	1.46	95.4	60.5	96,213.80	Box	Concrete	1.83	0.91
4161	0 (Polyline)-361	MH-1973	MH-2377	3.26	3	2.07	1.99	50	2.82	0.011	1.64	2.63	1.49	56.7	59.5	1,01,381.20	Box	Concrete	1.83	0.91
4112	0 (Polyline)-362	MH-2377	MH-2378	3	3.48	1.99	1.97	50	3.46	0.011	1.12	1.84	1.58	86.1	59.3	1,09,606.00	Box	Concrete	2.13	0.91
4373	0 (Polyline)-363	MH-2378	MH-986	3.48	3.44	1.97	1.94	50	3.49	0.011	1.13	1.84	1.64	89.2	50.3	1,16,693.50	Box	Concrete	2.13	0.91
1540	0 (Polyline)-364	MH-986	MH-987	3.44	2.72	1.94	1.71	50	2.77	0.011	2.41	5.57	1.63	29.4	43.3	1,19,620.80	Box	Concrete	2.13	0.91
3205	0 (Polyline)-365	MH-987	FO-39	2.72	2	1.71	0.3	40.32	2.46	0.011	4.68	15.39	1.67	10.8	68.6	1,23,659.90	Box	Concrete	2.13	0.91
3676	0 (Polyline)-270	MH-2177	MH-2178	3.04	2.85	2.33	2.14	45.81	0.67	0.011	0.56	0.62	0.01	1.8	12.8	557.2	Box	Concrete	0.61	0.61
4752	0 (Polyline)-271	MH-2178	MH-1119	2.85	2.88	2.14	2.12	50	0.88	0.011	0.42	0.22	0.04	16.3	18	1,907.90	Box	Concrete	0.61	0.61
1751	0 (Polyline)-272	MH-1119	MH-1120	2.88	2.89	2.12	1.81	46.61	0.77	0.011	1.18	0.79	0.06	7.3	26.6	3,461.80	Box	Concrete	0.61	0.61
3607	0 (Polyline)-262	MH-2147	MH-2148	2.89	2.99	2.18	2.16	50	1.24	0.011	0.5	0.36	0.08	20.7	30.3	3,799.40	Box	Concrete	0.91	0.61
5000	0 (Polyline)-263	MH-2148	MH-2337	2.99	2.92	2.16	2.13	50	1.65	0.011	0.6	0.52	0.16	29.7	28.3	8,562.60	Box	Concrete	1.22	0.61
5550	0 (Polyline)-264(1)	MH-2337	MH-1120	2.92	2.89	2.13	1.81	40.16	1.45	0.011	1.71	2.1	0.24	11.3	31.6	14,105.50	Box	Concrete	1.22	0.61
139	0 (Polyline)-265	MH-1120	O-38	2.89	2.92	1.81	0.44	13.65	1.37	0.011	4.66	7.4	0.42	5.6	76.9	26,014.90	Box	Concrete	1.22	0.61
1465	0 (Polyline)-269	MH-941	MH-940	2.62	2.62	1.91	1.89	37.69	1.32	0.011	0.61	0.22	0.13	61.3	59.1	6,702.90	Box	Concrete	0.61	0.61
4004	0 (Polyline)-268	MH-940	MH-1525	2.62	2.89	1.89	1.87	50	1.69	0.011	0.72	0.36	0.26	70.3	58.5	13,606.30	Box	Concrete	0.91	0.61
2410	0 (Polyline)-267	MH-1525	MH-1524	2.89	2.82	1.87	1.84	50	1.81	0.011	0.76	0.36	0.31	85.4	53.4	17,531.80	Box	Concrete	0.91	0.61
5003	0 (Polyline)-266	MH-1524	O-37	2.82	2.99	1.84	-1.22	50	1.14	0.011	4.53	4.02	0.47	11.6	219	27,943.30	Box	Concrete	0.91	0.61
1891	0 (Polyline)-1091	MH-1207	MH-541	3.04	2.62	2.33	1.91	50	0.82	0.011	1.53	0.89	0.1	11.1	25.6	4,975.20	Box	Concrete	0.61	0.61
853	0 (Polyline)-1092	MH-541	MH-542	2.62	3.14	1.91	1.7	24.32	0.88	0.011	1.72	0.89	0.14	15.6	43.6	7,227.20	Box	Concrete	0.61	0.61
862	0 (Polyline)-338	MH-548	MH-547	3.54	3.43	2.83	2.72	24.81	0.76	0.011	0.96	0.66	0.05	6.9	46.5	2,291.90	Box	Concrete	0.61	0.61
3504	0 (Polyline)-337	MH-547	MH-1015	3.43	3.42	2.72	2.69	50	1.26	0.011	0.59	0.22	0.12	54.5	56.2	6,080.80	Box	Concrete	0.61	0.61
1583	0 (Polyline)-336	MH-1015	MH-1014	3.42	3.66	2.69	2.67	50	1.34	0.011	0.61	0.22	0.14	63.3	56.1	7,586.10	Box	Concrete	0.61	0.61
3766	0 (Polyline)-335	MH-1014	MH-2223	3.66	3.44	2.67	2.64	50	1.44	0.011	0.64	0.22	0.16	74.6	53.4	9,625.10	Box	Concrete	0.61	0.61
4811	0 (Polyline)-334	MH-2223	MH-1443	3.44	3.74	2.64	2.62	50	1.57	0.011	0.68	0.36	0.2	56.4	50.6	13,197.90	Box	Concrete	0.91	0.61
5541	0 (Polyline)-333(2)	MH-1443	MH-2706	3.74	3.33	2.62	2.6	42.17	1.62	0.011	0.69	0.36	0.22	61.3	48.5	15,194.00	Box	Concrete	0.91	0.61
961	0 (Polyline)-350	MH-613	MH-612	3.57	3.49	2.86	2.78	27.55	0.8	0.011	0.86	0.53	0.05	9.5	21.7	2,523.90	Box	Concrete	0.61	0.61
4969	0 (Polyline)-349	MH-612	MH-2706	3.49	3.33	2.78	2.6	50	0.94	0.011	1.23	0.58	0.12	21.4	37.1	6,437.00	Box	Concrete	0.61	0.61
5540	0 (Polyline)-333(1)	MH-2706	MH-1442	3.33	3.33	2.6	2.59	7.83	1.83	0.011	0.76	0.36	0.32	87.9	42.6	22,602.60	Box	Concrete	0.91	0.61
5019	0 (Polyline)-375	MH-2722	MH-545	2.53	3.38	1.82	1.8	50	1.09	0.011	0.53	0.22	0.08	36	79.9	3,931.80	Box	Concrete	0.61	0.61
859	0 (Polyline)-376	MH-545	MH-546	3.38	3.33	1.8	1.79	24.4	1.24	0.011	0.59	0.22	0.11	52.7	82.4	6,227.70	Box	Concrete	0.61	0.61
4500	0 (Polyline)-366	MH-2540	MH-2321	3.59	3.32	2.88	2.61	50	0.79	0.011	1.12	0.7	0.06	8.7	37.4	3,111.00	Box	Concrete	0.61	0.61
3984	0 (Polyline)-367	MH-2321	MH-2322	3.32	3.61	2.61	2.59	50	1.37	0.011	0.62	0.22	0.14	66.3	57.7	7,518.30	Box	Concrete	0.61	0.61
4659	0 (Polyline)-368	MH-2322	MH-2586	3.61	3.3	2.59	2.56	50	1.58	0.011	0.67	0.22	0.2	91.6	46.7	11,116.30	Box	Concrete	0.61	0.61
5536	0 (Polyline)-369(1)	MH-2586	MH-546	3.3	3.33	2.56	1.79	15.69	1.05	0.011	3.13	3.61	0.2	5.5	55.5	12,060.30	Box	Concrete	0.91	0.61
5538	0 (Polyline)-369(2)(1)	MH-546	MH-1442	3.33	3.33	1.79	1.78	7.26	1.8	0.011	0.75	0.36	0.31	84.3	83.2	18,512.90	Box	Concrete	0.91	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
5539	0 (Polyline)-369(2)(2)	MH-1442	MH-2587	3.33	3	1.78	1.77	27.06	2.3	0.011	0.88	0.92	0.58	63.1	55.6	41,438.20	Box	Concrete	1.22	0.91
4769	0 (Polyline)-370	MH-2587	MH-2616	3	3.28	1.77	1.74	50	2.34	0.011	0.9	0.92	0.61	66.6	54.8	44,543.30	Box	Concrete	1.22	0.91
4693	0 (Polyline)-371	MH-2616	MH-2617	3.28	3.27	1.74	1.72	50	2.45	0.011	0.92	0.92	0.69	75.2	52.1	52,199.10	Box	Concrete	1.22	0.91
5534	0 (Polyline)-372(1)	MH-2617	MH-542	3.27	3.14	1.72	1.7	39.26	2.49	0.011	0.93	0.92	0.72	78.7	44.7	56,669.30	Box	Concrete	1.22	0.91
5535	0 (Polyline)-372(2)	MH-542	MH-2660	3.14	2.4	1.7	1.39	30.11	1.69	0.011	2.82	4.16	0.81	19.6	39.4	65,636.60	Box	Concrete	1.22	0.91
9042	0 (Polyline)-373(1)	MH-2660	MH-2957	2.4	1.81	1.39	0.8	27.46	1.59	0.011	3.65	6.07	0.83	13.6	58.3	67,037.60	Box	Concrete	1.22	0.91
9046	0 (Polyline)-373(2)(2)	MH-2957	O-164	1.81	2.32	0.8	0.5	12.92	1.59	0.011	3.73	6.22	0.84	13.4	94	67,917.20	Box	Concrete	1.22	0.91
2146	0 (Polyline)-1090	MH-1364	MH-1363	2.95	2.69	2.24	1.98	43.58	0.82	0.011	1.29	0.75	0.08	11.2	39.3	4,252.30	Box	Concrete	0.61	0.61
4542	0 (Polyline)-1089	MH-1363	MH-2336	2.69	2.7	1.98	1.95	50	1.56	0.011	0.66	0.22	0.19	88.6	53.5	9,953.90	Box	Concrete	0.61	0.61
4015	0 (Polyline)-1088	MH-2336	O-35	2.7	2.78	1.95	-1.42	50	0.84	0.011	4.48	2.51	0.31	12.4	280.6	17,265.20	Box	Concrete	0.61	0.61
1014	0 (Polyline)-1993	MH-647	MH-646	4.05	4.53	3.34	3.33	28.66	1.12	0.011	0.55	0.22	0.09	39.6	50.8	4,329.60	Box	Concrete	0.61	0.61
3551	0 (Polyline)-1992	MH-646	MH-2122	4.53	4.65	3.33	3.3	50	1.24	0.011	0.59	0.22	0.11	51.8	51.3	5,908.60	Box	Concrete	0.61	0.61
4119	0 (Polyline)-1991	MH-2122	MH-1504	4.65	3.97	3.3	3.26	50	1.25	0.011	0.77	0.28	0.15	53.6	50.9	8,609.90	Box	Concrete	0.61	0.61
2372	0 (Polyline)-1990	MH-1504	MH-1503	3.97	4.41	3.26	3.23	50	1.58	0.011	0.68	0.36	0.21	57.1	49.6	12,508.30	Box	Concrete	0.91	0.61
2468	0 (Polyline)-1989	MH-1503	MH-1558	4.41	3.86	3.23	3.15	50	1.36	0.011	1.08	0.68	0.22	32.8	54.4	14,498.20	Box	Concrete	0.91	0.61
3035	0 (Polyline)-1988	MH-1558	MH-1868	3.86	3.73	3.15	3.02	50	1.36	0.011	1.31	0.83	0.27	32.1	70	17,867.80	Box	Concrete	0.91	0.61
4995	0 (Polyline)-1987	MH-1868	MH-2714	3.73	3.67	3.02	2.96	50	1.61	0.011	1.01	0.53	0.32	60.9	83	22,310.40	Box	Concrete	0.91	0.61
4988	0 (Polyline)-1986	MH-2714	O-98	3.67	3.5	2.96	1.93	47.96	1.19	0.011	3.02	2.38	0.39	16.2	169.2	27,442.90	Box	Concrete	0.91	0.61
2413	0 (Polyline)-1858	MH-1526	MH-1527	3.86	3.79	3.15	3.08	50	0.76	0.011	0.54	0.37	0.02	6.6	63.4	1,256.30	Box	Concrete	0.61	0.61
2798	0 (Polyline)-1859	MH-1527	MH-310	3.79	3.71	3.08	3	41.09	0.85	0.011	0.76	0.41	0.06	13.8	75.4	3,076.60	Box	Concrete	0.61	0.61
501	0 (Polyline)-1860	MH-310	MH-311	3.71	3.76	3	2.5	21.96	0.99	0.011	1.51	2.47	0.05	2.2	122.9	3,076.60	Box	Concrete	0.91	0.61
4946	0 (Polyline)-2288	MH-2697	MH-2133	4.5	4.59	3.79	3.77	50	0.9	0.011	0.43	0.22	0.04	17.4	52.9	1,902.70	Box	Concrete	0.61	0.61
3581	0 (Polyline)-2289	MH-2133	MH-2134	4.59	5	3.77	3.74	50	1.15	0.011	0.56	0.22	0.09	42.6	55.7	5,130.90	Box	Concrete	0.61	0.61
4963	0 (Polyline)-2290	MH-2134	MH-2635	5	4.8	3.74	3.72	50	1.33	0.011	0.61	0.22	0.13	62.5	56.4	8,168.80	Box	Concrete	0.61	0.61
4760	0 (Polyline)-2291	MH-2635	MH-2636	4.8	4.48	3.72	3.69	50	1.51	0.011	0.65	0.22	0.18	83.5	51.7	11,834.00	Box	Concrete	0.61	0.61
5058	0 (Polyline)-2292	MH-2636	MH-1622	4.48	4.55	3.69	3.67	50	1.64	0.011	0.7	0.36	0.23	64.1	41.1	16,081.20	Box	Concrete	0.91	0.61
2579	0 (Polyline)-2293	MH-1622	MH-1623	4.55	4.12	3.67	3.41	50	1.27	0.011	1.69	1.18	0.28	23.8	37.2	20,218.80	Box	Concrete	0.91	0.61
4998	0 (Polyline)-2294	MH-1623	MH-473	4.12	3.65	3.41	2.94	50	1.25	0.011	2.19	1.58	0.34	21.4	66.3	24,784.20	Box	Concrete	0.91	0.61
750	0 (Polyline)-2295	MH-473	MH-474	3.65	3.74	2.94	2.5	20.32	1.44	0.011	2.74	3.41	0.37	10.9	128.4	27,732.20	Box	Concrete	1.22	0.61
2847	0 (Polyline)-2097	MH-1769	MH-1091	4.32	4.12	3.61	3.41	50	0.99	0.011	1.37	0.61	0.16	25.7	34.7	7,942.20	Box	Concrete	0.61	0.61
1705	0 (Polyline)-2098	MH-1091	MH-1092	4.12	3.83	3.41	2.61	39.96	0.88	0.011	2.63	1.36	0.22	15.9	95.1	11,279.10	Box	Concrete	0.61	0.61

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2810	0 (Polyline)-1865	MH-1750	MH-1749	4.26	4.53	3.55	3.53	48.33	1.36	0.011	0.62	0.22	0.14	65.1	60.3	7,123.10	Box	Concrete	0.61	0.61
4684	0 (Polyline)-1864	MH-1749	MH-2589	4.53	4.44	3.53	3.5	50	1.7	0.011	0.72	0.36	0.26	71.5	59.6	14,025.00	Box	Concrete	0.91	0.61
4618	0 (Polyline)-1863	MH-2589	MH-2207	4.44	4.18	3.5	3.47	50	1.79	0.011	0.88	0.43	0.35	82	52.5	20,012.60	Box	Concrete	0.91	0.61
3734	0 (Polyline)-1862	MH-2207	MH-1469	4.18	3.53	3.47	2.82	50	1.26	0.011	2.62	1.85	0.42	22.9	81.2	25,574.80	Box	Concrete	0.91	0.61
2316	0 (Polyline)-1861	MH-1469	MH-439	3.53	3.64	2.82	2.63	50	1.68	0.011	0.63	1.43	0.47	32.6	135.9	28,782.70	Box	Concrete	1.22	0.61
4524	0 (Polyline)-1847	MH-2551	MH-438	3.78	3.79	3.07	3.05	40.56	1.45	0.011	0.43	0.52	0.06	11.8	79.4	3,136.20	Box	Concrete	1.22	0.61
697	0 (Polyline)-1848	MH-438	MH-439	3.79	3.64	3.05	2.63	29.84	1.33	0.011	1.47	2.77	0.1	3.6	115.4	5,416.50	Box	Concrete	1.22	0.61
2318	0 (Polyline)-1881	MH-1471	MH-1470	3.92	4.09	3.21	3.19	45.06	0.94	0.011	0.46	0.22	0.05	21.8	56.2	2,386.10	Box	Concrete	0.61	0.61
2872	0 (Polyline)-1880	MH-1470	MH-439	4.09	3.64	3.19	2.63	52.26	0.83	0.011	1.75	1	0.12	11.6	103.7	6,359.40	Box	Concrete	0.61	0.61
5472	0 (Polyline)-1879(2)(1)	MH-439	MH-1092	3.64	3.83	2.63	2.61	35.36	2.46	0.011	0.46	1.22	0.63	52	101	42,143.20	Box	Concrete	1.52	0.91
5470	0 (Polyline)-1879(1)	MH-1092	MH-1997	3.83	3.97	2.61	2.6	24.43	2.63	0.011	0.57	1.22	0.79	64.7	102.1	54,874.90	Box	Concrete	1.52	0.91
4533	0 (Polyline)-1878	MH-1997	MH-2376	3.97	3.85	2.6	2.58	37.98	2.64	0.011	0.57	1.22	0.79	65	103.1	56,671.90	Box	Concrete	1.52	0.91
4110	0 (Polyline)-1877	MH-2376	MH-2267	3.85	3.74	2.58	2.56	50	2.81	0.011	0.49	1.53	0.82	53.7	104.6	61,500.20	Box	Concrete	1.83	0.91
3861	0 (Polyline)-1876	MH-2267	MH-2179	3.74	3.77	2.56	2.53	50	2.82	0.011	0.5	1.53	0.83	54.3	106.5	66,641.30	Box	Concrete	1.83	0.91
3679	0 (Polyline)-1875	MH-2179	MH-1335	3.77	3.68	2.53	2.51	37.59	2.81	0.011	0.5	1.53	0.82	53.9	108.1	69,426.40	Box	Concrete	1.83	0.91
5467	0 (Polyline)-1874(2)(2)	MH-1335	MH-474	3.68	3.74	2.51	2.5	22.13	2.79	0.011	0.48	1.53	0.81	52.6	109.3	70,393.40	Box	Concrete	1.83	0.91
5466	0 (Polyline)-1874(2)(1)	MH-474	MH-311	3.74	3.76	2.5	2.5	16.5	3.19	0.011	0.57	1.84	1.11	60.2	110	99,068.70	Box	Concrete	2.13	0.91
9913	CO-413	MH-311	O-192	3.76	4	2.49	2.46	4.79	2.57	0.011	0.6	6.3	1.13	18	113.7	1,02,716.10	Box	Concrete	2.1	0.9
4503	0 (Polyline)-1837	MH-2541	MH-592	4.39	4.3	3.68	3.59	50	0.95	0.011	0.92	0.43	0.09	22	44.8	4,800.20	Box	Concrete	0.61	0.61
930	0 (Polyline)-1838	MH-592	MH-593	4.3	4.5	3.59	3.57	25.53	1.33	0.011	0.61	0.22	0.14	62.7	51	7,162.20	Box	Concrete	0.61	0.61
2585	0 (Polyline)-1839	MH-1626	MH-1341	4.53	4.59	3.82	3.8	50	1.16	0.011	0.56	0.22	0.09	43.2	49.3	4,727.70	Box	Concrete	0.61	0.61
2111	0 (Polyline)-1840	MH-1341	MH-1342	4.59	4.6	3.8	3.78	40.95	1.39	0.011	0.63	0.22	0.15	69.3	46.9	8,160.50	Box	Concrete	0.61	0.61
4374	EX (Polyline)-2101	MH-2487	MH-2488	5	4.97	4.29	4.26	43.1	0.85	0.019	0.28	0.15	0.02	13.7	16	1,070.70	Box	Concrete	0.61	0.61
5446	EX (Polyline)-2102(1)	MH-2488	MH-1342	4.97	4.6	4.26	3.78	18.39	0.74	0.019	1.19	0.91	0.05	5	28.8	2,627.70	Box	Concrete	0.61	0.61
5447	EX (Polyline)-2102(2)	MH-1342	MH-2553	4.6	4.5	3.78	3.76	39.48	1.97	0.019	0.44	0.3	0.2	67.3	37.1	11,903.50	Box	Concrete	1.22	0.61
5448	EX (Polyline)-2103(1)	MH-2553	MH-593	4.5	4.5	3.76	3.57	36.97	1.57	0.019	0.98	0.95	0.21	22.4	40.3	13,525.40	Box	Concrete	1.22	0.61
5449	EX (Polyline)-2103(2)	MH-593	MH-2678	4.5	4.5	3.57	3.56	19.67	1.96	0.011	0.76	0.52	0.34	65.4	49.5	22,559.00	Box	Concrete	1.22	0.61
5002	EX (Polyline)-2104	MH-2678	MH-2399	4.5	4.33	3.56	3.55	35.62	1.99	0.011	0.78	0.52	0.37	69.9	42.2	24,574.60	Box	Concrete	1.22	0.61
5450	EX(Polyline)-2105(1)	MH-2399	MH-2235	4.33	4.09	3.55	2.95	24.27	1.53	0.019	2.05	2.12	0.39	18.4	67.1	26,964.90	Box	Concrete	1.22	0.61
1120	0 (Polyline)-1835	MH-716	MH-717	4.05	4.43	3.34	3.12	40.32	0.81	0.011	1.21	0.72	0.08	10.5	65.7	3,806.40	Box	Concrete	0.61	0.61
4359	0 (Polyline)-1833	MH-2480	MH-539	4.81	4.57	4.1	3.86	50	0.88	0.011	1.31	0.68	0.11	15.8	26.8	5,410.30	Box	Concrete	0.61	0.61
850	0 (Polyline)-1834	MH-539	MH-540	4.57	4.3	3.86	3.59	24.29	0.86	0.011	1.9	1.01	0.15	14.5	37.2	7,634.20	Box	Concrete	0.61	0.61
1194	0 (Polyline)-1326	MH-766	MH-765	4.76	4.32	4.05	3.61	33.9	0.7	0.011	1.17	1.1	0.03	2.8	26.3	1,577.20	Box	Concrete	0.61	0.61
5457	0 (Polyline)-1325(2)	MH-765	MH-540	4.32	4.3	3.61	3.59	9.01	0.84	0.011	0.8	0.44	0.06	12.9	43.5	2,938.10	Box	Concrete	0.61	0.61
5456	0 (Polyline)-1325(1)	MH-540	MH-2447	4.3	4.35	3.59	3.57	40.99	1.62	0.011	0.69	0.36	0.22	61.2	39.5	11,738.40	Box	Concrete	0.91	0.61
4836	0 (Polyline)-1324	MH-2447	MH-456	4.35	3.85	3.57	3.14	50	1.21	0.011	1.97	1.51	0.27	17.9	58.6	14,984.90	Box	Concrete	0.91	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
723	0 (Polyline)-1323	MH-456	MH-455	3.85	4.04	3.14	3.13	19.75	1.81	0.011	0.75	0.36	0.31	85.2	83.3	17,563.50	Box	Concrete	0.91	0.61
5455	0 (Polyline)-1322(2)	MH-455	MH-717	4.04	4.43	3.13	3.12	20.74	1.86	0.011	0.77	0.36	0.33	91.4	83.7	19,291.70	Box	Concrete	0.91	0.61
5454	0 (Polyline)-1322(1)	MH-717	MH-776	4.43	4.41	3.12	3.11	29.26	2.05	0.011	0.8	0.52	0.4	77.3	84.5	24,087.90	Box	Concrete	1.22	0.61
5453	0 (Polyline)-1321(2)	MH-776	MH-501	4.41	4.4	3.11	3.09	23.19	2.06	0.011	0.81	0.52	0.41	79.2	85.5	25,552.00	Box	Concrete	1.22	0.61
4195	0 (Polyline)-1317	MH-2416	MH-2152	4.89	4.92	4.18	4.15	50	0.84	0.011	0.39	0.22	0.03	12.5	21	1,368.80	Box	Concrete	0.61	0.61
3617	0 (Polyline)-1318	MH-2152	MH-2153	4.92	4.85	4.15	4.13	37.57	0.92	0.011	0.45	0.22	0.04	19.7	18.5	2,394.70	Box	Concrete	0.61	0.61
5458	0 (Polyline)-1319(1)	MH-2153	MH-2702	4.85	4.99	4.13	3.73	16.86	0.71	0.011	1.74	1.5	0.05	3.6	36.5	3,295.10	Box	Concrete	0.61	0.61
3116	0 (Polyline)-2095	MH-52	MH-1911	4.49	4.78	3.78	3.75	53.19	0.97	0.011	0.48	0.22	0.05	24.6	54	2,685.30	Box	Concrete	0.61	0.61
4958	0 (Polyline)-2094	MH-1911	MH-2702	4.78	4.99	3.75	3.73	50	1.17	0.011	0.56	0.22	0.1	44.1	56.7	5,289.20	Box	Concrete	0.61	0.61
5459	0 (Polyline)-1319(2)	MH-2702	MH-1530	4.99	4.99	3.73	3.71	45.58	1.46	0.011	0.64	0.22	0.17	77.3	55.9	10,270.60	Box	Concrete	0.61	0.61
2420	0 (Polyline)-1320	MH-1530	MH-775	4.99	4.43	3.71	3.68	50	1.52	0.011	0.65	0.22	0.18	83.7	44.7	11,934.90	Box	Concrete	0.61	0.61
5452	0 (Polyline)-1321(1)	MH-775	MH-501	4.43	4.4	3.68	3.09	26.81	0.85	0.011	2.62	1.43	0.19	13.4	60.7	13,295.90	Box	Concrete	0.61	0.61
791	0 (Polyline)-1985	MH-501	MH-500	4.4	4.03	3.09	3.02	21.64	1.77	0.011	1.7	1.32	0.57	43	91.6	39,631.40	Box	Concrete	1.22	0.61
3968	0 (Polyline)-1984	MH-500	MH-2316	4.03	4.09	3.02	3	50	2.32	0.011	0.89	0.92	0.59	64.6	65.4	41,833.00	Box	Concrete	1.22	0.91
4820	0 (Polyline)-1983	MH-2316	MH-2236	4.09	4.24	3	2.97	50	2.39	0.011	0.91	0.92	0.65	70.1	65.9	47,031.70	Box	Concrete	1.22	0.91
3790	0 (Polyline)-1982	MH-2236	MH-2235	4.24	4.09	2.97	2.95	49.07	2.43	0.011	0.92	0.92	0.68	73.3	66	51,010.30	Box	Concrete	1.22	0.91
5451	EX (Polyline)-2105(2)	MH-2235	MH-2400	4.09	4	2.95	2.93	33.81	3.54	0.019	0.66	1.06	1	93.5	65.3	77,975.20	Box	Concrete	2.13	0.91
5021	EX (Polyline)-2106	MH-2400	MH-2533	4	4	2.93	2.91	49.77	3.56	0.019	0.67	1.06	1.01	95.2	63.4	82,074.70	Box	Concrete	2.13	0.91
8985	EX (Polyline)-2107(1)	MH-2533	MH-2948	4	3.81	2.91	2.8	18.96	2.77	0.019	1.56	3.61	1.06	29.3	67.8	88,885.80	Box	Concrete	2.13	0.91
8986	0 (Polyline)-2107(2)	MH-2948	MH-1537	3.81	3.5	2.8	2.49	30.7	2.5	0.011	2.67	8.25	1.05	12.8	91	88,885.80	Box	Concrete	2.13	0.91
10107	0 (Polyline)-2108(1)	MH-1537	MH-3133	3.5	3.5	2.49	2.37	27.81	2.62	0.011	0.56	5.46	1.08	19.9	114.8	92,064.40	Box	Concrete	2.13	0.91
10108	0 (Polyline)-2108(2)	MH-3133	O-191	3.5	3.5	2.49	2.37	12.78	2.51	0.011	0.56	8.05	1.08	13.4	114.4	93,702.20	Box	Concrete	2.13	0.91
4991	0 (Polyline)-1866	MH-2715	MH-1444	4.44	4.4	3.73	3.69	50	0.84	0.011	0.51	0.29	0.04	12.2	35.5	1,791.40	Box	Concrete	0.61	0.61
2275	0 (Polyline)-1867	MH-1444	MH-1117	4.4	4.31	3.69	3.6	50	1.09	0.011	0.98	0.4	0.14	35.7	37.6	7,822.90	Box	Concrete	0.61	0.61
1748	0 (Polyline)-1868	MH-1117	MH-1118	4.31	4.12	3.6	3.41	50	1.06	0.011	1.44	0.6	0.2	32.8	44.4	11,247.90	Box	Concrete	0.61	0.61
4976	0 (Polyline)-1869	MH-1118	MH-1601	4.12	4.13	3.41	3.39	50	1.73	0.011	0.73	0.36	0.27	75.7	45.2	16,282.70	Box	Concrete	0.91	0.61
2543	0 (Polyline)-1870	MH-1601	O-190	4.13	4	3.39	2.48	41.11	1.16	0.011	2.85	2.42	0.32	13.2	100.5	20,210.40	Box	Concrete	0.91	0.61
2559	0 (Polyline)-1979	MH-1611	MH-1612	3.94	3.9	3.23	3.19	50	0.89	0.011	0.6	0.3	0.05	16.9	46.8	2,586.60	Box	Concrete	0.61	0.61
3733	0 (Polyline)-1980	MH-1612	MH-403	3.9	3.91	3.19	3.17	29.99	1.51	0.011	0.65	0.22	0.18	82.9	42.1	9,712.70	Box	Concrete	0.61	0.61
642	0 (Polyline)-1981	MH-403	O-97	3.91	3.77	3.17	3	24.94	0.94	0.011	1.7	0.8	0.17	21.6	50.2	9,712.70	Box	Concrete	0.61	0.61
4680	0 (Polyline)-1976	MH-2611	MH-2612	3.84	3.85	3.13	3.11	50	0.91	0.011	0.44	0.22	0.04	18.4	50.5	2,012.70	Box	Concrete	0.61	0.61

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4943	0 (Polyline)-1977	MH-2612	MH-1718	3.85	3.7	3.11	2.99	50	1	0.011	1.07	0.47	0.13	27.3	60.9	7,122.50	Box	Concrete	0.61	0.61
2750	0 (Polyline)-1978	MH-1718	O-96	3.7	3.51	2.99	1.61	44.96	0.85	0.011	3.09	1.69	0.22	13.2	182.5	12,992.60	Box	Concrete	0.61	0.61
4956	0 (Polyline)-2259	MH-2701	MH-1153	3.92	3.79	3.21	3.08	50	0.7	0.011	0.54	0.49	0.02	3.2	23.6	785.3	Box	Concrete	0.61	0.61
1805	0 (Polyline)-2260	MH-1153	MH-969	3.79	3.78	3.08	3.06	50	0.9	0.011	0.43	0.22	0.04	18	35.2	2,122.40	Box	Concrete	0.61	0.61
1513	0 (Polyline)-2261	MH-969	MH-970	3.78	3.57	3.06	2.86	50	0.81	0.011	1.03	0.61	0.06	10.5	52.9	3,879.70	Box	Concrete	0.61	0.61
4770	0 (Polyline)-2262	MH-970	MH-465	3.57	3.89	2.86	2.84	50	1.22	0.011	0.58	0.22	0.11	50.5	70.3	6,929.70	Box	Concrete	0.61	0.61
738	0 (Polyline)-2263	MH-465	MH-466	3.89	3.52	2.84	2.74	29.44	0.94	0.011	1.18	0.55	0.12	21.7	79.2	8,157.10	Box	Concrete	0.61	0.61
2017	0 (Polyline)-1730	MH-1285	MH-26	3.6	3.92	2.89	2.82	51.33	1.08	0.011	0.87	0.36	0.12	34.6	77.7	6,260.20	Box	Concrete	0.61	0.61
1815	0 (Polyline)-1721	MH-1159	MH-521	3.6	4.03	2.89	2.87	50	1.17	0.011	0.56	0.22	0.1	44.5	79	4,869.00	Box	Concrete	0.61	0.61
823	0 (Polyline)-1722	MH-521	MH-522	4.03	3.91	2.87	2.86	24.36	1.24	0.011	0.59	0.22	0.11	52.4	81.2	6,163.20	Box	Concrete	0.61	0.61
1270	0 (Polyline)-1732	MH-815	MH-461	3.87	4.07	3.16	3.14	50	1.3	0.011	0.6	0.22	0.13	59.3	36.8	6,485.30	Box	Concrete	0.61	0.61
732	0 (Polyline)-1733	MH-461	MH-462	4.07	3.95	3.14	3.01	19.89	0.89	0.011	1.51	0.77	0.13	17	42	7,038.50	Box	Concrete	0.61	0.61
2983	0 (Polyline)-1723	MH-1841	MH-462	3.75	3.95	3.04	3.01	57.13	1.08	0.011	0.53	0.22	0.08	35.4	52.8	3,868.30	Box	Concrete	0.61	0.61
5512	0 (Polyline)-1724(2)(1)	MH-462	MH-522	3.95	3.91	3.01	2.86	4.95	1.08	0.011	2.79	2.89	0.22	7.5	68.1	11,996.80	Box	Concrete	0.91	0.61
5513	0 (Polyline)-1724(2)(2)	MH-522	MH-1495	3.91	3.77	2.86	2.84	37.93	1.85	0.011	0.77	0.36	0.33	90.1	82.2	18,489.00	Box	Concrete	0.91	0.61
5514	0 (Polyline)-1725(1)	MH-1495	MH-26	3.77	3.92	2.84	2.82	26.66	1.88	0.011	0.77	0.36	0.34	93.7	82.6	20,094.90	Box	Concrete	0.91	0.61
5515	0 (Polyline)-1725(2)	MH-26	MH-1186	3.92	3.82	2.82	2.81	23.34	2.1	0.011	0.82	0.52	0.44	84.6	83.1	27,008.10	Box	Concrete	1.22	0.61
1858	0 (Polyline)-1726	MH-1186	MH-1187	3.82	3.5	2.81	2.79	50	2.15	0.011	0.83	0.52	0.47	90.1	84	29,576.20	Box	Concrete	1.22	0.61
1965	0 (Polyline)-1727	MH-1187	MH-1253	3.5	3.61	2.79	2.76	50	2.14	0.011	0.83	0.52	0.47	89.3	85.2	31,090.50	Box	Concrete	1.22	0.61
5418	0 (Polyline)-1728(1)	MH-1253	MH-466	3.61	3.52	2.76	2.74	45.42	2.17	0.011	0.84	0.52	0.49	93.6	86.4	33,791.80	Box	Concrete	1.22	0.61
592	0 (Polyline)-1729	MH-466	FO-87	3.52	3.08	2.74	0.64	23	1.41	0.011	5.2	7.07	0.6	8.6	258.7	43,155.60	Box	Concrete	1.22	0.61
9131	EX	MH-2966	MH-2967	4.99	4.68	4.28	3.97	27.4	0.94	0.019	1.26	0.6	0.13	21.1	46.9	6,393.90	Box	Concrete	0.61	0.61
9133	EX	MH-2967	MH-2968	4.68	5	3.97	3.96	28.46	1.65	0.019	0.39	0.12	0.12	99.3	65.7	6,393.90	Box	Concrete	0.61	0.61
9135	EX	MH-2968	MH-2969	5	5	3.96	3.93	56.15	1.64	0.011	0.7	0.36	0.23	63.8	65.1	12,687.70	Box	Concrete	0.91	0.61
9137	EX	MH-2969	MH-2970	5	5	3.93	3.9	66	1.69	0.011	0.72	0.36	0.25	69.6	66	14,862.90	Box	Concrete	0.91	0.61
9145	EX(1)	MH-2970	MH-2972	5	4.35	3.9	3.64	208.37	1.72	0.011	1.13	0.57	0.42	73.5	66.8	26,688.80	Box	Concrete	0.91	0.61
9146	EX(2)	MH-2972	MH-2971	4.35	4	3.64	3.29	114.12	1.73	0.019	1.05	0.52	0.39	75.3	67.9	28,739.90	Box	Concrete	0.91	0.61
9140	EX	MH-2971	MH-2173	4	3.85	3.29	3.14	165.07	1.73	0.011	0.98	0.49	0.37	74.9	70	28,739.90	Box	Concrete	0.91	0.61
3666	EX (Polyline)-2284	MH-2173	MH-1847	3.85	3.78	3.14	3.07	47.94	2.11	0.019	0.84	0.53	0.45	85.4	71	38,966.00	Box	Concrete	1.22	0.61
2994	EX (Polyline)-2285	MH-1847	MH-1848	3.78	4	3.07	2.99	48.47	2.16	0.019	0.86	0.54	0.49	92.2	66.4	43,573.00	Box	Concrete	1.22	0.61
3334	EX (Polyline)-2286	MH-1848	MH-202	4	4	2.99	2.94	47.78	2.43	0.019	0.75	1.04	0.52	50	33.4	47,001.10	Box	Concrete	1.52	0.91
337	EX (Polyline)-2287	MH-202	MH-203	4	3.68	2.94	2.67	8.76	1.82	0.019	2.29	5.51	0.51	9.3	33.5	48,215.60	Box	Concrete	1.52	0.91
1552	0 (Polyline)-1971	MH-994	MH-995	3.96	4.15	3.25	3.22	50	1.49	0.011	0.65	0.22	0.17	80.3	56.3	8,786.10	Box	Concrete	0.61	0.61
4261	0 (Polyline)-1972	MH-995	MH-2265	4.15	3.98	3.22	3.2	50	1.64	0.011	0.7	0.36	0.23	64	53.1	12,544.10	Box	Concrete	0.91	0.61
3855	0 (Polyline)-1973	MH-2265	MH-2266	3.98	4	3.2	3.18	45.02	1.75	0.011	0.74	0.36	0.28	77.2	43.5	16,103.70	Box	Concrete	0.91	0.61
5420	0 (Polyline)-1974(1)	MH-2266	MH-203	4	3.68	3.18	2.67	11.98	1.09	0.011	3.35	3.34	0.28	8.4	48.8	16,949.60	Box	Concrete	0.91	0.61

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5421	0 (Polyline)-1974(2)	MH-203	MH-3	3.68	4	2.67	2.57	24.59	2.02	0.011	1.86	3.4	0.7	20.6	47.9	65,663.20	Box	Concrete	1.52	0.91
8297	CO-21(1)	MH-2744	MH-2749	3.98	3.94	3.27	3.23	55.68	1.56	0.011	0.78	0.42	0.23	54.8	61.5	11,678.40	Box	Concrete	0.91	0.61
8298	CO-21(2)	MH-2749	MH-2742	3.94	4.48	3.23	3.07	78.49	1.43	0.011	1.25	0.74	0.3	40.3	74.2	15,944.00	Box	Concrete	0.91	0.61
8301	CO-23(2)	MH-2745	MH-2750	4.1	3.84	3.39	3.13	57.35	0.89	0.011	1.29	0.66	0.11	16.5	58.4	5,491.60	Box	Concrete	0.61	0.61
8300	CO-23(1)	MH-2750	MH-2743	3.84	4.34	3.13	3.08	85.76	1.64	0.011	0.7	0.36	0.23	64.2	82.3	12,244.80	Box	Concrete	0.91	0.61
8286	CO-22	MH-2743	MH-2742	4.34	4.48	3.08	3.07	23.94	1.94	0.011	0.76	0.52	0.33	63.7	85	19,465.40	Box	Concrete	1.22	0.61
8295	CO-27	MH-2742	MH-2748	4.48	4.42	3.07	3.05	37.92	2.34	0.011	0.89	0.92	0.61	66.4	57.2	36,767.40	Box	Concrete	1.22	0.91
8294	CO-26	MH-2748	MH-2747	4.42	4.33	3.05	3.02	64.6	2.36	0.011	0.9	0.92	0.63	68.1	56.1	39,255.90	Box	Concrete	1.22	0.91
8292	CO-25	MH-2747	MH-2746	4.33	4.28	3.02	2.99	60.09	2.58	0.011	0.95	0.92	0.79	85.7	46.9	52,844.80	Box	Concrete	1.22	0.91
9949	CO-423	MH-2746	MH-3	4.28	4	2.99	2.57	33.7	1.64	0.011	2.98	4.42	0.78	17.6	46.6	54,056.30	Box	Concrete	1.2	0.9
37	0 (Polyline)-1975	MH-3	O-89	4	3.56	2.57	0.49	32.73	1.81	0.011	5.69	13.73	1.28	9.3	173.1	1,20,446.80	Box	Concrete	1.52	0.91
4131	0 (Polyline)-1710	MH-2387	MH-689	3.2	3.5	2.49	2.46	50	1.08	0.011	0.21	0.22	0.08	35.4	104.8	3,875.20	Box	Concrete	0.61	0.61
1079	0 (Polyline)-1711	MH-689	MH-690	3.5	3.51	2.46	2.45	30.87	1.36	0.011	0.21	0.36	0.12	32.1	107.8	7,317.00	Box	Concrete	0.91	0.61
3159	0 (Polyline)-1707	MH-1933	MH-1704	3.96	3.86	3.25	3.15	50	1	0.011	1	0.44	0.12	27.1	34.7	6,018.00	Box	Concrete	0.61	0.61
5520	0 (Polyline)-1708(1)	MH-1704	MH-690	3.86	3.51	3.15	2.45	48	0.9	0.011	2.33	1.17	0.2	17.5	72.9	10,754.40	Box	Concrete	0.61	0.61
5810	CO-11	MH-690	MH-2172	3.51	3.55	2.45	2.43	26.44	1.87	0.011	0.38	0.52	0.28	54.3	109.7	19,946.70	Box	Concrete	1.22	0.61
835	0 (Polyline)-2238	MH-530	MH-529	3.8	3.47	3.09	2.76	36.03	0.75	0.011	1.31	0.93	0.06	6.2	38.4	2,926.20	Box	Concrete	0.61	0.61
2395	0 (Polyline)-2237	MH-529	MH-1516	3.47	3.46	2.76	2.73	50	1.2	0.011	0.57	0.22	0.1	47.5	61.9	5,310.90	Box	Concrete	0.61	0.61
2651	0 (Polyline)-2236	MH-1516	MH-1662	3.46	3.64	2.73	2.71	50	1.45	0.011	0.62	0.36	0.15	42.2	64.4	8,530.30	Box	Concrete	0.91	0.61
3664	0 (Polyline)-2235	MH-1662	MH-2172	3.64	3.55	2.71	2.43	50	1.21	0.011	1.57	1.2	0.22	18.1	88.1	12,997.90	Box	Concrete	0.91	0.61
5523	0 (Polyline)-1709(2)	MH-2172	O-90	3.55	3.11	2.43	2.29	8.08	1.76	0.011	2.66	7.29	0.48	6.6	82.1	35,102.80	Box	Concrete	1.52	0.91
2747	0 (Polyline)-1702	MH-1716	MH-1717	3.93	3.74	3.22	3.03	50	0.96	0.011	1.29	0.59	0.14	23.1	34.4	6,951.50	Box	Concrete	0.61	0.61
4084	0 (Polyline)-1703	MH-1717	MH-249	3.74	3.34	3.03	2.63	44.98	0.98	0.011	2.04	0.91	0.23	25.3	57.7	12,107.10	Box	Concrete	0.61	0.61
409	0 (Polyline)-1704	MH-249	MH-250	3.34	3.2	2.63	2.49	15.96	1.02	0.011	2.11	0.91	0.26	28.7	87.5	13,902.20	Box	Concrete	0.61	0.61
3218	0 (Polyline)-2160	MH-1966	MH-250	3.26	3.2	2.55	2.49	49.46	1.41	0.011	0.98	0.33	0.24	71.8	96.5	12,135.40	Box	Concrete	0.61	0.61
2114	0 (Polyline)-1684	MH-1343	MH-1344	4.1	4	3.31	3.29	27.89	1.52	0.011	0.61	0.65	0.11	17	50.5	5,616.70	Box	Concrete	1.22	0.61
10048	CO-452	MH-1344	MH-2315	4	4	3.23	3.2	15.53	1.47	0.011	0.88	1.03	0.14	13.2	64.2	7,116.40	Box	Concrete	1.22	0.61
3966	0 (Polyline)-1685	MH-2315	MH-1629	4	3.86	3.45	3.15	56.97	1.48	0.011	1.5	1.7	0.24	14.1	28	12,739.50	Box	Concrete	1.22	0.61
2592	0 (Polyline)-1686	MH-1629	MH-1522	3.86	3.61	3.15	2.9	47.85	1.52	0.011	1.62	1.7	0.3	17.7	31	16,590.40	Box	Concrete	1.22	0.61
5554	0 (Polyline)-1687(1)	MH-1522	MH-250	3.61	3.2	2.9	2.49	12.95	1.4	0.011	2.96	4.15	0.33	7.9	65.7	18,410.40	Box	Concrete	1.22	0.61
5555	0 (Polyline)-1687(2)	MH-250	MH-1523	3.2	3.2	2.49	2.19	46.04	1.76	0.011	2.4	1.88	0.8	42.3	119.8	45,142.60	Box	Concrete	1.22	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
4630	0 (Polyline)-1688	MH-1523	MH-2437	3.2	3.37	2.19	2.08	50	2.05	0.011	1.67	1.92	0.84	43.7	98.9	48,392.20	Box	Concrete	1.22	0.91
4251	0 (Polyline)-1689	MH-2437	MH-1971	3.37	3.47	2.08	2.05	50	2.94	0.011	0.45	2.09	0.88	42	105.5	52,093.30	Box	Concrete	2.13	0.91
3230	0 (Polyline)-1690	MH-1971	MH-1972	3.47	3.5	2.05	2	50.79	2.82	0.011	0.44	2.58	0.86	33.2	109.4	56,697.10	Box	Concrete	2.13	0.91
5516	0 (Polyline)-1691(1)	MH-1972	MH-2661	3.5	3.36	2	1.99	16.76	2.87	0.011	0.43	2.26	0.83	36.5	112.5	58,748.20	Box	Concrete	2.13	0.91
2240	0 (Polyline)-1693	MH-1422	MH-517	3.09	3.2	2.38	2.35	50	1.22	0.011	0.12	0.36	0.07	18.3	108.2	3,373.70	Box	Concrete	0.91	0.61
817	0 (Polyline)-1694	MH-517	MH-518	3.2	3.04	2.35	2.03	22.55	1.03	0.011	0.16	1.93	0.09	4.5	136.3	6,150.10	Box	Concrete	0.91	0.61
4439	0 (Polyline)-1705	MH-2514	MH-323	3.41	3.75	2.7	2.68	40.66	1.05	0.011	0.52	0.22	0.07	32.2	63	3,525.90	Box	Concrete	0.61	0.61
521	0 (Polyline)-1706	MH-323	MH-324	3.75	3.76	2.68	2.66	23.31	1.17	0.011	0.57	0.22	0.1	45.1	64.9	5,256.10	Box	Concrete	0.61	0.61
2819	0 (Polyline)-1700	MH-34	MH-1754	3.96	3.8	3.25	3.09	52.11	0.82	0.011	0.94	0.54	0.06	11.2	31.9	3,093.00	Box	Concrete	0.61	0.61
4178	0 (Polyline)-1699	MH-1754	MH-1795	3.8	3.72	3.09	3.01	39.9	1.17	0.011	1.1	0.42	0.19	44.1	39.5	9,831.40	Box	Concrete	0.61	0.61
5553	0 (Polyline)-1698(2)	MH-1795	MH-324	3.72	3.76	3.01	2.66	19.32	1.11	0.011	2.3	2.17	0.21	9.8	47.2	11,562.40	Box	Concrete	0.91	0.61
5552	0 (Polyline)-1698(1)	MH-324	MH-1794	3.76	3.53	2.66	2.64	40.83	1.84	0.011	0.76	0.36	0.32	88.9	64.3	18,065.20	Box	Concrete	0.91	0.61
3262	0 (Polyline)-1697	MH-1794	MH-1435	3.53	3.19	2.64	2.48	50	1.42	0.011	1.55	0.92	0.36	39.2	75.7	21,243.30	Box	Concrete	0.91	0.61
5519	0 (Polyline)-1696(2)	MH-1435	MH-518	3.19	3.04	2.48	2.03	6.89	1.11	0.011	4.34	4.15	0.39	9.3	125.4	23,457.80	Box	Concrete	0.91	0.61
5518	0 (Polyline)-1696(1)	MH-518	MH-1434	3.04	3.33	2.03	2.01	43.11	2.02	0.011	0.35	0.92	0.39	41.9	109.9	30,333.40	Box	Concrete	1.22	0.91
4829	0 (Polyline)-1695	MH-1434	MH-2661	3.33	3.36	2.01	1.99	50	2.04	0.011	0.36	0.92	0.4	43.2	112	33,448.40	Box	Concrete	1.22	0.91
5517	0 (Polyline)-1691(2)	MH-2661	MH-1358	3.36	3.25	1.99	1.95	32.45	2.88	0.011	0.54	2.79	1.04	37.2	114.8	93,425.60	Box	Concrete	2.13	0.91
2138	0 (Polyline)-1692	MH-1358	FO-88	3.25	3.19	1.95	1.93	34.99	3.07	0.011	0.53	1.97	1.04	52.7	117.4	96,213.10	Box	Concrete	2.13	0.91
285	0 (Polyline)-1646	MH-169	MH-168	3.83	3.72	3.12	3.01	14.78	0.67	0.011	0.75	0.83	0.01	1.8	10.9	748.8	Box	Concrete	0.61	0.61
3263	0 (Polyline)-1645	MH-168	MH-422	3.72	3.81	3.01	2.75	44.68	0.77	0.011	1.12	0.75	0.05	7.4	37.7	2,821.70	Box	Concrete	0.61	0.61
3602	0 (Polyline)-1642	MH-2144	MH-2145	3.58	3.71	2.87	2.84	50	1.83	0.011	0.7	0.52	0.26	50.1	52.9	13,281.90	Box	Concrete	1.22	0.61
3852	0 (Polyline)-1643	MH-2145	MH-355	3.71	3.78	2.84	2.77	50	1.84	0.011	1.23	0.91	0.46	50.6	55.5	24,693.90	Box	Concrete	1.22	0.61
5524	0 (Polyline)-1644(1)	MH-355	MH-422	3.78	3.81	2.77	2.75	12.91	1.84	0.011	1.35	1.76	0.51	28.8	39.5	28,074.60	Box	Concrete	1.22	0.91
671	0 (Polyline)-1648	MH-422	MH-421	3.81	4.04	2.75	2.74	18.49	2.29	0.011	0.88	0.92	0.58	62.6	35.7	32,332.20	Box	Concrete	1.22	0.91
3510	0 (Polyline)-1647	MH-421	O-95	4.04	3.58	2.74	0.29	50	1.44	0.011	4.16	9.11	0.57	6.2	159.6	32,332.20	Box	Concrete	1.22	0.91
4450	0 (Polyline)-1712	MH-2519	MH-1837	4.74	4.26	4.03	3.7	50	0.98	0.011	1.74	0.78	0.19	24.7	52.3	9,826.20	Box	Concrete	0.61	0.61
2976	0 (Polyline)-1713	MH-1837	MH-1594	4.26	3.83	3.7	3.65	50	1.62	0.011	0.95	0.31	0.29	95.9	58	15,179.80	Box	Concrete	0.61	0.61
2531	0 (Polyline)-1714	MH-1594	MH-1048	3.83	3.6	3.65	3.52	50	1.5	0.011	1.48	0.49	0.4	82.2	65.2	21,914.90	Box	Concrete	0.61	0.61
5556	0 (Polyline)-1715(1)	MH-1048	MH-3126	3.6	3.83	3.52	3.5	17.11	1.76	0.011	1.13	0.56	0.44	79.3	57.3	24,548.10	Box	Concrete	0.91	0.61
10051	0 (Polyline)-2271(1)	MH-3126	MH-349	3.83	3.93	3.5	3.48	13.04	1.69	0.011	1.26	0.64	0.44	69.8	72.8	25,086.70	Box	Concrete	0.91	0.61
3892	0 (Polyline)-2270	MH-349	MH-2283	3.93	3.58	3.48	3.4	50	1.87	0.011	1.38	0.65	0.61	93.2	66.6	34,531.20	Box	Concrete	0.91	0.61
4689	0 (Polyline)-2269	MH-2283	MH-2615	3.58	3.7	3.4	3.38	50	2.72	0.011	0.88	0.82	0.81	98	47.4	47,524.30	Box	Concrete	1.22	0.91
5559	0 (Polyline)-2267(2)	MH-2615	MH-2410	3.7	3.5	3.38	3.34	52.01	2.48	0.011	1.15	1.14	0.88	77.5	49	55,004.60	Box	Concrete	1.22	0.91
4181	0 (Polyline)-1682	MH-2311	MH-2410	3.83	3.5	3.32	3.34	50	0.89	0.011	0.27	0.19	0.1	51.4	34.9	5,031.40	Box	Concrete	0.61	0.61
5558	0 (Polyline)-2267(1)	MH-1185	MH-2410	3.59	3.5	2.88	2.79	47.99	2.03	0.011	0.89	1.84	0.98	53.5	74.1	63,975.90	Box	Concrete	1.22	0.91
1855	0 (Polyline)-2266	MH-1185	MH-1184	3.59	3.5	3.02	2.88	55.33	2.13	0.011	1.81	2.01	1.01	50.3	47.7	68,420.40	Box	Concrete	1.22	0.91

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2735	0 (Polyline)-2264	MH-1709	MH-1710	4.56	3.97	3.85	3.26	50	0.95	0.011	2.24	1.04	0.23	22.3	46.4	11,794.40	Box	Concrete	0.61	0.61
3909	0 (Polyline)-2265	MH-1710	MH-1184	3.97	3.5	3.26	3.02	44.58	1.2	0.011	1.92	0.72	0.35	47.9	50.4	17,804.10	Box	Concrete	0.61	0.61
10055	CO-454	MH-1184	O-202	3.5	3.96	2.6	2.5	8.17	1.83	0.011	3.49	4.56	1.3	28.6	47.5	90,041.90	Box	Concrete	1.22	0.91
3341	0 (Polyline)-1640	MH-2023	MH-679	3.4	3.67	2.69	2.66	50	1.84	0.011	0.76	0.36	0.32	88.3	71.6	16,246.40	Box	Concrete	0.91	0.61
1064	0 (Polyline)-1641	MH-679	MH-680	3.67	3.74	2.66	2.65	30.4	1.88	0.011	0.77	0.36	0.34	93.6	70.6	18,164.90	Box	Concrete	0.91	0.61
1468	0 (Polyline)-1628	MH-942	MH-943	3.74	3.85	3.03	3.01	50	1	0.011	0.49	0.22	0.06	27.2	76.7	2,971.10	Box	Concrete	0.61	0.61
2070	0 (Polyline)-1629	MH-943	MH-1317	3.85	4.01	3.01	2.98	50	1.24	0.011	0.59	0.22	0.11	51.9	80	6,172.60	Box	Concrete	0.61	0.61
3569	0 (Polyline)-1630	MH-1317	MH-2102	4.01	3.84	2.98	2.96	50	1.65	0.011	0.71	0.36	0.24	65.9	82.7	14,228.80	Box	Concrete	0.91	0.61
3512	0 (Polyline)-1631	MH-2102	MH-1162	3.84	4.08	2.96	2.93	50	2.03	0.011	0.79	0.52	0.39	74.8	85	24,917.70	Box	Concrete	1.22	0.61
1820	0 (Polyline)-1632	MH-1162	MH-1163	4.08	3.95	2.93	2.91	50	2.21	0.011	0.86	0.92	0.52	56.5	57.9	35,020.70	Box	Concrete	1.22	0.91
3080	0 (Polyline)-1633	MH-1163	MH-1552	3.95	3.96	2.91	2.88	50	2.34	0.011	0.89	0.92	0.61	66.2	57.8	42,458.90	Box	Concrete	1.22	0.91
2458	0 (Polyline)-1634	MH-1552	MH-1553	3.96	3.88	2.88	2.86	50	2.38	0.011	0.9	0.92	0.64	69.3	57	46,070.70	Box	Concrete	1.22	0.91
3391	0 (Polyline)-1635	MH-1553	MH-755	3.88	4.04	2.86	2.83	50	2.44	0.011	0.92	0.92	0.69	74.8	55	51,567.10	Box	Concrete	1.22	0.91
1179	0 (Polyline)-1636	MH-755	MH-756	4.04	4.13	2.83	2.81	50	2.56	0.011	0.95	0.92	0.78	84.4	46	60,292.40	Box	Concrete	1.22	0.91
5526	0 (Polyline)-1637(1)	MH-756	MH-680	4.13	3.74	2.81	2.65	30.65	1.8	0.011	2.23	2.98	0.79	26.5	42.7	63,515.00	Box	Concrete	1.22	0.91
5527	0 (Polyline)-1637(2)	MH-680	MH-955	3.74	3.6	2.65	2.59	19.36	2.07	0.011	1.97	2.24	1.03	45.9	47.4	83,290.50	Box	Concrete	1.22	0.91
1489	0 (Polyline)-1638	MH-955	MH-712	3.6	3.69	2.59	2.57	50	2.94	0.011	1	1.53	1.02	66.8	41.3	83,290.50	Box	Concrete	1.83	0.91
1114	0 (Polyline)-1639	MH-712	O-94	3.69	3.44	2.57	0.19	35.67	2.05	0.011	4.99	17.66	1	5.7	148.7	83,290.50	Box	Concrete	1.83	0.91
1343	0 (Polyline)-1500	MH-862	MH-482	4.16	4.12	3.45	3.41	50	0.9	0.011	0.56	0.28	0.05	17.9	53.2	2,534.80	Box	Concrete	0.61	0.61
764	0 (Polyline)-1501	MH-482	MH-483	4.12	4.07	3.41	2.61	20.37	0.71	0.011	2.24	1.92	0.07	3.7	122.3	3,841.50	Box	Concrete	0.61	0.61
4581	0 (Polyline)-1502	MH-2574	MH-2484	4.64	4.33	3.93	3.62	50	0.74	0.011	1.03	0.76	0.04	5.3	22.4	2,069.00	Box	Concrete	0.61	0.61
4367	0 (Polyline)-1503	MH-2484	MH-1060	4.33	4.14	3.62	3.43	50	0.95	0.011	1.29	0.6	0.13	22.6	46.9	7,102.50	Box	Concrete	0.61	0.61
1656	0 (Polyline)-1504	MH-1060	MH-1061	4.14	4.02	3.43	3.31	50	1.16	0.011	1.2	0.46	0.2	43.5	69.1	10,943.10	Box	Concrete	0.61	0.61
2921	0 (Polyline)-1505	MH-1061	MH-65	4.02	4.08	3.31	3.3	27.5	1.76	0.011	0.67	0.52	0.22	42	77.4	12,405.30	Box	Concrete	1.22	0.61
130	0 (Polyline)-1506	MH-65	MH-66	4.08	3.97	3.3	2.64	26.05	1.38	0.011	2.45	3.72	0.24	6.4	132.3	13,850.30	Box	Concrete	1.22	0.61
3302	0 (Polyline)-1507	MH-2004	MH-184	4.32	4.38	3.61	3.59	29.29	1.1	0.011	0.54	0.22	0.08	36.8	26.8	4,028.80	Box	Concrete	0.61	0.61
309	0 (Polyline)-1508	MH-184	MH-185	4.38	4.19	3.59	2.66	28.61	0.75	0.011	2.39	1.74	0.1	5.7	104	5,288.90	Box	Concrete	0.61	0.61
4239	0 (Polyline)-1485	MH-2432	MH-990	4.28	4.23	3.57	3.52	50	0.89	0.011	0.56	0.28	0.05	16.8	59.7	2,403.20	Box	Concrete	0.61	0.61
1546	0 (Polyline)-1486	MH-990	MH-991	4.23	4.49	3.52	3.5	50	1.36	0.011	0.62	0.22	0.14	65.9	63.1	7,756.50	Box	Concrete	0.61	0.61
4987	0 (Polyline)-1487	MH-991	MH-2469	4.49	4.61	3.5	3.47	50	1.45	0.011	0.64	0.22	0.16	75.7	62.6	9,576.70	Box	Concrete	0.61	0.61
4332	0 (Polyline)-1488	MH-2469	MH-1427	4.61	4.64	3.47	3.45	50	1.54	0.011	0.66	0.36	0.19	52.9	62.9	12,117.30	Box	Concrete	0.91	0.61

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2249	0 (Polyline)-1489	MH-1427	MH-1428	4.64	4.44	3.45	3.42	50	1.59	0.011	0.68	0.36	0.21	58.1	64.5	14,235.80	Box	Concrete	0.91	0.61
4502	0 (Polyline)-1490	MH-1428	MH-361	4.44	4.2	3.42	3.4	50	1.74	0.011	0.73	0.36	0.28	76.1	65	19,492.20	Box	Concrete	0.91	0.61
578	0 (Polyline)-1491	MH-361	MH-362	4.2	4.15	3.4	2.68	15.17	1.09	0.011	3.5	3.52	0.29	8.1	124.2	21,039.00	Box	Concrete	0.91	0.61
2974	0 (Polyline)-1509	MH-1836	MH-119	4.59	4.28	3.88	2.73	55.24	0.76	0.011	2.04	1.4	0.09	6.8	102.1	4,779.50	Box	Concrete	0.61	0.61
4709	0 (Polyline)-1492	MH-2622	MH-773	4.45	4.29	3.74	3.58	50	0.88	0.011	1.06	0.54	0.09	16.2	48	4,464.60	Box	Concrete	0.61	0.61
1206	0 (Polyline)-1493	MH-773	MH-774	4.29	4.11	3.58	3.1	50	1.18	0.011	2.48	0.95	0.43	45.2	94.6	22,527.60	Box	Concrete	0.61	0.61
4560	0 (Polyline)-1494	MH-774	MH-2565	4.11	4.68	3.1	3.08	50	2.34	0.011	0.9	0.92	0.61	66.8	87.2	32,889.20	Box	Concrete	1.22	0.91
4702	0 (Polyline)-1495	MH-2565	MH-469	4.68	4.33	3.08	3.06	38.51	2.5	0.011	0.94	0.92	0.73	79.2	88.6	40,933.90	Box	Concrete	1.22	0.91
744	0 (Polyline)-1496	MH-469	MH-470	4.33	4.26	3.06	2.76	31.58	1.68	0.011	2.66	3.99	0.74	18.6	105.2	43,241.40	Box	Concrete	1.22	0.91
2485	0 (Polyline)-1529	MH-1568	MH-1569	4.53	4.21	3.82	3.5	50	1.03	0.011	1.82	0.77	0.23	30.2	90.7	11,854.00	Box	Concrete	0.61	0.61
3973	0 (Polyline)-1530	MH-1569	MH-1157	4.21	4.22	3.5	3.21	50	1.57	0.011	1.23	1.23	0.68	55.4	149.2	35,378.30	Box	Concrete	0.91	0.61
1812	0 (Polyline)-1531	MH-1157	MH-1158	4.22	4.26	3.21	2.98	50	1.8	0.011	1.67	1.1	0.93	84	180.1	49,607.80	Box	Concrete	0.91	0.61
2691	0 (Polyline)-1532	MH-1158	MH-1684	4.26	4.65	2.98	2.96	50	2.82	0.011	0.72	1.22	0.99	81.7	124.9	54,567.90	Box	Concrete	1.52	0.91
3655	0 (Polyline)-1533	MH-1684	MH-739	4.65	4.72	2.96	2.93	50	2.84	0.011	0.74	1.22	1.02	84	125.8	59,709.80	Box	Concrete	1.52	0.91
1155	0 (Polyline)-1534	MH-739	MH-740	4.72	4.33	2.93	2.91	32.88	2.84	0.011	0.74	1.22	1.02	84.2	126.4	63,755.70	Box	Concrete	1.52	0.91
1314	0 (Polyline)-1480	MH-244	MH-844	4.4	4.24	3.69	3.53	60.54	0.76	0.011	0.75	0.51	0.03	6.8	82.3	1,765.10	Box	Concrete	0.61	0.61
2967	0 (Polyline)-1479	MH-844	MH-508	4.24	4.37	3.53	3.5	50	1.25	0.011	0.59	0.22	0.12	53.5	97.7	6,257.10	Box	Concrete	0.61	0.61
9806	CO-374	MH-508	MH-393	4.37	4.38	3.5	3.35	57.81	1.17	0.011	0.61	0.47	0.22	46.2	110.9	12,728.40	Box	Concrete	0.6	0.6
3246	0 (Polyline)-1463	MH-1979	MH-1647	5.4	4.69	4.69	3.98	50	0.98	0.011	2.58	1.15	0.29	25.5	59.1	14,875.20	Box	Concrete	0.61	0.61
2624	0 (Polyline)-1464	MH-1647	MH-1648	4.69	4.51	3.98	3.75	48.87	1.48	0.011	1.99	0.67	0.53	79.2	71.3	27,096.40	Box	Concrete	0.61	0.61
4307	0 (Polyline)-2138	MH-2460	MH-1128	5.06	4.48	4.35	3.77	50	0.83	0.011	1.82	1.05	0.12	11.5	48.3	6,080.40	Box	Concrete	0.61	0.61
5716	0 (Polyline)-2139(1)	MH-1128	MH-1648	4.48	4.51	3.77	3.75	38.43	1.71	0.011	0.73	0.36	0.27	73.1	71.1	13,748.00	Box	Concrete	0.91	0.61
5717	0 (Polyline)-2139(2)	MH-1648	MH-1129	4.51	4.49	3.75	3.48	36.81	1.6	0.011	2.61	1.38	0.82	59.3	85.9	44,312.30	Box	Concrete	0.91	0.61
4206	0 (Polyline)-2140	MH-1129	MH-2420	4.49	4.46	3.48	3.2	24.77	1.69	0.011	2.97	4.39	0.86	19.5	84.1	46,876.10	Box	Concrete	1.22	0.91
4580	0 (Polyline)-2141	MH-2420	MH-1758	4.46	4.5	3.2	3.17	47.3	2.72	0.011	0.83	0.95	0.92	97.3	101	50,794.90	Box	Concrete	1.22	0.91
2826	0 (Polyline)-2142	MH-1758	MH-393	4.5	4.38	3.17	3.15	52.33	2.86	0.011	0.73	1.18	1.02	85.8	101.4	58,955.10	Box	Concrete	1.52	0.91
627	0 (Polyline)-2143	MH-393	MH-3079	4.38	4	3.35	3.09	115.46	2.36	0.011	1.91	1.95	1.33	68.1	90.1	85,075.90	Box	Concrete	1.22	0.91
9814	CO-375	MH-3079	MH-3080	4	4	3.09	3.05	45.29	2.77	0.011	0.94	1.57	1.26	80.7	104.8	85,075.90	Box	Concrete	1.5	0.9
9815	CO-376	MH-3080	MH-3081	4	5	3.05	2.97	42.57	2.45	0.011	0.91	2.28	1.23	53.7	124.8	85,075.90	Box	Concrete	1.5	0.9
9818	CO-378	MH-3081	MH-3082	5	4.71	2.97	2.93	36.68	2.63	0.011	0.88	1.74	1.19	68.5	129.1	85,075.90	Box	Concrete	1.5	0.9
9819	CO-379	MH-3082	MH-3083	4.71	4.24	2.93	3.09	28.75	2.29	0.011	0.86	3.93	1.16	29.5	120.6	85,075.90	Box	Concrete	1.5	0.9
2577	0 (Polyline)-1511	MH-1621	MH-5	4.24	4.09	3.53	3.38	50.53	1.02	0.011	1.23	0.53	0.16	29.3	104.9	7,858.20	Box	Concrete	0.61	0.61
891	0 (Polyline)-2134	MH-567	MH-566	4.64	4.2	3.93	3.49	25.72	0.73	0.011	1.62	1.26	0.06	4.7	69.2	3,002.20	Box	Concrete	0.61	0.61
3863	0 (Polyline)-2133	MH-566	MH-2268	4.2	4.69	3.49	3.46	50	1.17	0.011	0.26	0.22	0.1	44.1	107.6	4,880.00	Box	Concrete	0.61	0.61
4459	0 (Polyline)-2132	MH-2268	MH-2075	4.69	4.4	3.46	3.44	50	1.48	0.011	0.46	0.22	0.17	79	110	10,380.30	Box	Concrete	0.61	0.61
3455	0 (Polyline)-2131	MH-2075	MH-1567	4.4	4.1	3.44	3.39	37.34	1.34	0.011	0.57	0.34	0.21	63.2	113	14,342.20	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
5807	0 (Polyline)-2130(2)(2)	MH-1567	MH-5	4.1	4.09	3.39	3.38	26.28	1.65	0.011	0.43	0.36	0.24	65.2	115.9	16,576.70	Box	Concrete	0.91	0.61
9812	0 (Polyline)-2130(2)(1)	MH-5	MH-3083	4.09	4.24	3.38	2.91	8.69	1.38	0.011	0.47	5.4	0.35	6.4	154.7	25,283.90	Box	Concrete	1.22	0.61
9813	0 (Polyline)-2130(2)(1)	MH-3083	MH-740	4.24	4.33	3.38	2.91	5.3	1.56	0.011	1.98	6.91	1.47	21.3	152.8	1,10,359.80	Box	Concrete	1.22	0.61
5804	0 (Polyline)-2130(1)	MH-740	MH-1566	4.33	4	3	2.9	20.65	2.55	0.011	2.1	2.8	2.33	83.2	119	1,74,760.20	Box	Concrete	1.22	0.91
4840	0 (Polyline)-2129	MH-1566	MH-2507	4	4.26	2.9	2.8	51.75	3.05	0.011	1.41	3.08	2.35	76.3	138.5	1,77,247.70	Box	Concrete	1.83	0.91
4422	0 (Polyline)-2128	MH-2507	MH-1455	4.26	4.41	2.88	2.8	50	3.18	0.011	1.42	2.72	2.37	87.2	133.3	1,83,371.40	Box	Concrete	1.83	0.91
2293	0 (Polyline)-2127	MH-1455	MH-1454	4.41	4.55	2.85	2.8	50	3.48	0.011	1.23	2.7	2.38	88.2	129.1	1,88,679.90	Box	Concrete	2.13	0.91
3801	0 (Polyline)-2126	MH-1454	MH-2240	4.55	4.42	2.83	2.78	50	3.54	0.011	1.24	2.57	2.4	93.6	126.9	1,95,315.20	Box	Concrete	2.13	0.91
4806	0 (Polyline)-2125	MH-2240	MH-1032	4.42	4.5	2.8	2.76	40.64	3.5	0.011	1.25	2.7	2.42	89.6	125.1	2,00,202.50	Box	Concrete	2.13	0.91
5797	0 (Polyline)-2124(2)	MH-1032	MH-470	4.5	4.26	2.78	2.74	44.12	3.54	0.011	1.24	2.58	2.41	93.4	123.3	2,02,841.40	Box	Concrete	2.13	0.91
5796	0 (Polyline)-2124(1)	MH-470	MH-1031	4.26	4	2.76	2.74	27.12	3.87	0.011	1.56	3.53	2.9	82.4	90.9	2,48,612.40	Box	Concrete	2.13	1.22
5799	0 (Polyline)-2123(2)	MH-1031	MH-119	4	4.28	2.74	2.72	33.51	4.07	0.011	1.41	3.07	2.92	95	91.7	2,51,820.00	Box	Concrete	2.13	1.22
4828	0 (Polyline)-2122	MH-119	MH-703	4.28	4.37	2.73	2.7	54.6	4.12	0.011	1.41	3.04	3	98.6	91.5	2,61,947.80	Box	Concrete	2.13	1.22
5794	0 (Polyline)-2121(2)(1)	MH-703	MH-362	4.37	4.15	2.71	2.68	38.68	4.02	0.011	1.47	3.23	2.96	91.6	91.5	2,63,775.40	Box	Concrete	2.13	1.22
5792	0 (Polyline)-2121(1)	MH-362	MH-2271	4.15	4	2.68	2.66	25.25	3.85	0.011	1.72	3.91	3.16	81	92.5	2,85,801.90	Box	Concrete	2.13	1.22
5801	0 (Polyline)-2120(2)	MH-2271	MH-185	4	4.19	2.67	2.66	21.37	4.36	0.011	1.34	3.32	3.15	94.9	92.3	2,86,923.80	Box	Concrete	2.44	1.22
5800	0 (Polyline)-2120(1)	MH-185	MH-2446	4.19	4.09	2.66	2.65	14.81	4.38	0.011	1.35	3.32	3.2	96.3	92.6	2,93,378.10	Box	Concrete	2.44	1.22
5791	0 (Polyline)-2119(2)	MH-2446	MH-66	4.09	3.97	2.65	2.64	22.45	4.38	0.011	1.35	3.32	3.19	96.1	92.9	2,94,532.10	Box	Concrete	2.44	1.22
5790	0 (Polyline)-2119(1)	MH-66	MH-2445	3.97	4.17	2.64	2.63	26.83	4.88	0.011	1.12	3.37	3.33	98.8	93.3	3,09,719.50	Box	Concrete	2.44	1.22
5789	0 (Polyline)-2118(2)	MH-2445	MH-483	4.17	4.07	2.63	2.61	43.69	4.43	0.011	1.36	3.32	3.31	99.5	93.8	3,11,559.40	Box	Concrete	2.44	1.22
5787	0 (Polyline)-2117(2)	MH-483	MH-2062	4.07	3.9	2.61	2.58	33.43	4.21	0.011	1.54	3.87	3.33	85.9	94.7	3,17,038.30	Box	Concrete	2.44	1.22
3140	0 (Polyline)-1498	MH-30	MH-1923	3.97	4.11	3.26	3.23	51.78	0.97	0.011	0.47	0.22	0.05	23.8	82.5	2,603.70	Box	Concrete	0.61	0.61
3428	0 (Polyline)-1497	MH-1923	MH-2062	4.11	3.9	3.23	2.58	50	0.78	0.011	1.69	1.1	0.09	7.9	137.5	4,810.60	Box	Concrete	0.61	0.61
5786	0 (Polyline)-2117(1)	MH-2062	O-56	3.9	3.79	2.58	2.54	23.61	3.7	0.011	2.19	6.41	3.36	52.4	96.9	3,23,024.70	Box	Concrete	2.44	1.22
3239	0 (Polyline)-1535	MH-1976	MH-1735	4.53	4.22	3.82	3.51	50	0.86	0.011	1.44	0.76	0.11	14.6	55.9	5,633.60	Box	Concrete	0.61	0.61
2782	0 (Polyline)-1536	MH-1735	MH-102	4.22	4.42	3.51	3.4	54.64	1.37	0.011	1.16	0.72	0.24	33.5	91.4	12,644.40	Box	Concrete	0.91	0.61
10057	0 (Polyline)-1540(1)	MH-3127	MH-702	4.34	4.77	3.33	2.7	25.16	0.66	0.011	0.05	1.53	0.02	1.3	169.4	1,029.10	Box	Concrete	0.61	0.61
4907	0 (Polyline)-1539	MH-702	MH-2578	4.77	4.6	3.35	3.33	50	1.05	0.011	0.13	0.22	0.05	22.3	115.4	3,535.90	Box	Concrete	0.61	0.61
4590	0 (Polyline)-1538	MH-2578	MH-1869	4.6	4.39	3.38	3.35	50	1.35	0.011	0.23	0.22	0.09	39.6	110.2	7,775.70	Box	Concrete	0.61	0.61
5803	0 (Polyline)-1537(2)	MH-1869	MH-102	4.39	4.42	3.4	3.38	45.36	1.65	0.011	0.35	0.22	0.13	60.1	103.6	12,975.20	Box	Concrete	0.61	0.61
5813	CO-14	MH-102	MH-691	4.42	4.45	3.4	3.35	37.94	1.83	0.011	1.05	0.35	0.28	80.4	98.7	29,757.70	Box	Concrete	0.61	0.61

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10061	CO-455	MH-691	MH-3128	4.45	4.35	3.35	3.3	45.25	1.83	0.011	1	0.32	0.31	97.4	87.5	33,444.50	Box	Concrete	0.61	0.61
10062	CO-456	MH-3128	O-203	4.35	3.5	3.3	2.7	53.09	1.32	0.011	2.57	1.03	0.39	37.9	112.3	42,272.80	Box	Concrete	0.61	0.61
2903	0 (Polyline)-1523	MH-1799	MH-1800	3.63	3.92	2.92	2.89	50	1.46	0.011	0.08	0.52	0.06	11.9	106.2	3,161.50	Box	Concrete	1.22	0.61
3696	0 (Polyline)-1524	MH-1800	MH-625	3.92	4.22	2.89	2.87	50	1.54	0.011	0.52	0.92	0.1	11.1	73.9	8,197.30	Box	Concrete	1.22	0.91
982	0 (Polyline)-1525	MH-625	MH-626	4.22	4.35	2.87	2.85	28.93	1.59	0.011	0.55	0.92	0.13	13.7	76	10,613.50	Box	Concrete	1.22	0.91
3153	0 (Polyline)-1521	MH-1930	MH-570	4.46	4.64	3.75	3.72	50	0.97	0.011	0.48	0.22	0.05	24.6	62.2	2,694.80	Box	Concrete	0.61	0.61
897	0 (Polyline)-1522	MH-570	MH-571	4.64	4.58	3.72	3.71	31.9	1.25	0.011	0.59	0.22	0.12	53.7	64.6	6,404.50	Box	Concrete	0.61	0.61
3440	0 (Polyline)-1513	MH-2069	MH-1080	4.91	4.81	4.2	4.1	50	0.92	0.011	0.87	0.42	0.08	19.9	40.7	4,222.50	Box	Concrete	0.61	0.61
1687	0 (Polyline)-1514	MH-1080	MH-992	4.81	4.61	4.1	3.9	50	1.18	0.011	1.62	0.62	0.28	46	46.5	15,063.70	Box	Concrete	0.61	0.61
5712	0 (Polyline)-1515(1)	MH-992	MH-571	4.61	4.58	3.9	3.71	27.63	1.29	0.011	1.98	1.34	0.35	25.8	52.7	18,859.40	Box	Concrete	0.91	0.61
5713	0 (Polyline)-1515(2)	MH-571	MH-993	4.58	4.72	3.71	3.7	22.37	2.12	0.011	0.82	0.52	0.45	86.2	64.7	26,136.00	Box	Concrete	1.22	0.61
3267	0 (Polyline)-1516	MH-993	MH-1643	4.72	4.61	3.7	3.68	43.67	2.18	0.011	0.84	0.52	0.49	94.7	61.7	29,156.80	Box	Concrete	1.22	0.61
5710	0 (Polyline)-1517(1)	MH-1643	MH-50	4.61	4.49	3.68	3.66	20.24	2.2	0.011	0.87	0.53	0.52	98.1	56.4	32,664.20	Box	Concrete	1.22	0.61
4046	0 (Polyline)-2183	MH-2350	MH-2349	4.58	4.65	3.87	3.85	50	1.26	0.011	0.59	0.22	0.12	54.5	42.5	5,963.30	Box	Concrete	0.61	0.61
4044	0 (Polyline)-2184	MH-2349	MH-50	4.65	4.49	3.85	3.66	52.97	1.1	0.011	1.41	0.57	0.21	37.3	46.9	11,449.10	Box	Concrete	0.61	0.61
5711	0 (Polyline)-1517(2)	MH-50	MH-1644	4.49	4.36	3.66	3.35	35.97	1.68	0.011	2.57	2.19	0.71	32.6	54.1	45,519.50	Box	Concrete	1.22	0.61
5708	0 (Polyline)-1518(1)	MH-1644	MH-626	4.36	4.35	3.35	2.85	25.6	1.58	0.011	3.38	5.74	0.73	12.8	56.7	47,598.30	Box	Concrete	1.22	0.91
5709	0 (Polyline)-1518(2)	MH-626	MH-2247	4.35	3.69	2.85	2.68	24.41	1.7	0.011	2.36	3.44	0.69	20.1	86.5	59,863.60	Box	Concrete	1.22	0.91
4736	0 (Polyline)-1519	MH-2247	MH-1309	3.69	3.64	2.68	2.63	50	2.32	0.011	1.21	1.76	0.74	41.9	98.6	64,006.60	Box	Concrete	1.52	0.91
2055	0 (Polyline)-1520	MH-1309	O-59	3.64	3.79	2.63	2.34	46.48	1.95	0.011	0.52	4.27	0.72	16.9	116.4	64,006.60	Box	Concrete	1.52	0.91
1117	0 (Polyline)-1358	MH-715	MH-714	4.97	4.95	4.26	3.5	31.6	0.68	0.011	1.36	1.49	0.03	1.8	52.1	1,397.40	Box	Concrete	0.61	0.61
3210	0 (Polyline)-1457	MH-1961	MH-1962	5.45	4.8	4.74	4.09	50	0.85	0.011	2.03	1.1	0.15	13.6	47.2	7,558.10	Box	Concrete	0.61	0.61
4678	0 (Polyline)-1458	MH-1962	MH-2576	4.8	4.96	4.09	3.95	50	1.36	0.011	1.37	0.86	0.28	32.9	75.5	14,601.60	Box	Concrete	0.91	0.61
4585	0 (Polyline)-1459	MH-2576	MH-2483	4.96	5.01	3.95	3.88	50	2.18	0.011	1.32	1.44	0.78	54.1	59.1	41,448.90	Box	Concrete	1.22	0.91
4365	0 (Polyline)-1460	MH-2483	MH-2107	5.01	4.89	3.88	3.86	50	2.7	0.011	0.98	0.92	0.88	96	56.5	48,612.10	Box	Concrete	1.22	0.91
3521	0 (Polyline)-1461	MH-2107	MH-836	4.89	5	3.86	3.83	50	2.8	0.011	1	1.22	0.97	80.1	45.7	56,053.30	Box	Concrete	1.52	0.91
1302	0 (Polyline)-1462	MH-836	MH-837	5	4.88	3.83	3.51	35.97	1.99	0.011	2.75	5.16	0.99	19.2	51.7	59,611.50	Box	Concrete	1.52	0.91
1480	0 (Polyline)-1477	MH-950	MH-797	5.31	4.93	4.6	4.22	50	0.73	0.011	1.1	0.85	0.04	4.9	17.3	2,109.80	Box	Concrete	0.61	0.61
1243	0 (Polyline)-1478	MH-797	MH-798	4.93	4.8	4.22	3.79	35.08	0.79	0.011	1.69	1.06	0.09	8.8	47.7	4,885.30	Box	Concrete	0.61	0.61
1026	0 (Polyline)-2137	MH-655	MH-867	4.93	4.62	4.22	3.91	36.88	0.74	0.011	1.19	0.88	0.05	5.5	42.8	2,452.10	Box	Concrete	0.61	0.61
2058	0 (Polyline)-2135	MH-1311	MH-869	4.76	4.77	4.05	4.02	50	1.15	0.011	0.56	0.22	0.09	42.9	52.5	4,691.60	Box	Concrete	0.61	0.61
5714	0 (Polyline)-2136(1)	MH-869	MH-867	4.77	4.62	4.02	3.91	42.08	1.03	0.011	1.16	0.49	0.15	30	61.4	8,084.90	Box	Concrete	0.61	0.61
1352	0 (Polyline)-1482	MH-867	MH-868	4.62	4.77	3.91	3.89	50	1.6	0.011	0.69	0.36	0.22	59.5	70.4	12,158.20	Box	Concrete	0.91	0.61
1504	0 (Polyline)-1483	MH-868	MH-964	4.77	4.78	3.89	3.86	50	1.7	0.011	0.72	0.36	0.26	70.9	71.9	15,483.90	Box	Concrete	0.91	0.61
2792	0 (Polyline)-1484	MH-964	MH-985	4.78	4.71	3.86	3.84	48.24	2.04	0.011	0.8	0.52	0.4	76.3	73	25,675.70	Box	Concrete	1.22	0.61
1538	0 (Polyline)-1465	MH-985	MH-828	4.71	4.99	3.84	3.81	50	2.19	0.011	0.85	0.52	0.5	95.9	72.7	33,929.80	Box	Concrete	1.22	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
5718	0 (Polyline)-1466(1)	MH-828	MH-798	4.99	4.8	3.81	3.79	19.36	1.97	0.011	1.12	1.35	0.52	38.3	48.8	36,174.40	Box	Concrete	1.22	0.91
5719	0 (Polyline)-1466(2)	MH-798	MH-829	4.8	4.86	3.79	3.78	30.65	2.33	0.011	0.89	0.92	0.61	65.7	48.3	42,858.70	Box	Concrete	1.22	0.91
2740	0 (Polyline)-1467	MH-829	MH-1712	4.86	4.8	3.78	3.75	50	2.37	0.011	0.9	0.92	0.63	68.4	41	45,594.60	Box	Concrete	1.22	0.91
2764	0 (Polyline)-1468	MH-1712	MH-1195	4.8	4.54	3.75	3.53	50	1.77	0.011	2.02	2.77	0.68	24.6	50	51,082.80	Box	Concrete	1.22	0.91
5720	0 (Polyline)-1469(1)	MH-1195	MH-837	4.54	4.88	3.53	3.51	31.89	2.46	0.011	0.93	0.92	0.7	76.4	65	53,693.70	Box	Concrete	1.22	0.91
5721	0 (Polyline)-1469(2)	MH-837	MH-714	4.88	4.95	3.51	3.5	23.96	3.27	0.011	1.11	1.53	1.46	95.7	64.1	1,14,365.30	Box	Concrete	1.83	0.91
5723	0 (Polyline)-1470(2)	MH-714	MH-885	4.95	4.94	3.5	3.48	44.14	3.28	0.011	1.11	1.53	1.48	96.5	61.1	1,17,070.60	Box	Concrete	1.83	0.91
4574	0 (Polyline)-1471	MH-885	MH-1934	4.94	4.85	3.48	3.45	50	3.4	0.011	1.1	1.84	1.49	81.3	57.2	1,21,374.60	Box	Concrete	2.13	0.91
3162	0 (Polyline)-1472	MH-1934	MH-1043	4.85	4.49	3.45	3.43	50	3.44	0.011	1.11	1.84	1.55	84.2	49.2	1,28,530.30	Box	Concrete	2.13	0.91
1629	0 (Polyline)-1473	MH-1043	MH-1044	4.49	4.16	3.43	3.15	50	2.72	0.011	2.56	6.14	1.62	26.4	51	1,37,180.40	Box	Concrete	2.13	0.91
4748	0 (Polyline)-1474	MH-1044	MH-1331	4.16	4.14	3.15	3.12	50	3.54	0.011	1.15	1.84	1.72	93.4	52	1,46,957.00	Box	Concrete	2.13	0.91
2095	0 (Polyline)-1475	MH-1331	MH-576	4.14	3.89	3.12	2.88	50	2.78	0.011	2.51	5.74	1.74	30.3	45.3	1,52,027.40	Box	Concrete	2.13	0.91
906	0 (Polyline)-1476	MH-576	O-62	3.89	3.85	2.88	2.14	33.02	2.53	0.011	4.17	12.28	1.8	14.6	92.8	1,58,692.10	Box	Concrete	2.13	0.91
4462	0 (Polyline)-1451	MH-2524	MH-2473	4.14	4.3	3.43	3.4	50	1.09	0.011	0.53	0.22	0.08	36.5	73.2	3,996.50	Box	Concrete	0.61	0.61
4344	0 (Polyline)-1452	MH-2473	MH-220	4.3	4.21	3.4	3.38	42.52	1.37	0.011	0.62	0.22	0.14	66.5	75.6	7,858.40	Box	Concrete	0.61	0.61
365	0 (Polyline)-1453	MH-220	MH-221	4.21	4.22	3.38	3.31	16.89	0.98	0.011	1.39	0.63	0.15	24.7	82	8,991.20	Box	Concrete	0.61	0.61
1973	0 (Polyline)-1649	MH-1258	MH-134	4.84	4.39	4.13	3.68	50	0.83	0.011	1.63	0.92	0.11	12.2	26	5,661.60	Box	Concrete	0.61	0.61
234	0 (Polyline)-1650	MH-134	MH-135	4.39	4.47	3.68	3.35	6.51	0.75	0.011	3.04	2.19	0.13	5.9	51.8	6,695.90	Box	Concrete	0.61	0.61
3283	0 (Polyline)-1375	MH-1790	MH-1726	4.53	4.39	3.38	3.35	50	1.64	0.011	0.59	0.92	0.15	16.5	49.5	7,718.40	Box	Concrete	1.22	0.91
5747	0 (Polyline)-1374(2)	MH-1726	MH-135	4.39	4.47	3.35	3.35	12.96	1.82	0.011	0.7	0.92	0.25	27.5	51	13,761.60	Box	Concrete	1.22	0.91
5746	0 (Polyline)-1374(1)	MH-135	MH-1649	4.47	4.45	3.35	3.33	37.04	2.02	0.011	0.79	0.92	0.38	41.6	51.7	21,109.80	Box	Concrete	1.22	0.91
2627	0 (Polyline)-1373	MH-1649	MH-1404	4.45	3.83	3.33	2.82	50	1.6	0.011	2.53	4.17	0.58	14	81.6	33,625.50	Box	Concrete	1.22	0.91
5749	0 (Polyline)-1372(2)	MH-1404	MH-400	3.83	4	2.82	2.79	45.78	2.48	0.011	0.48	1.22	0.66	54.2	130.9	38,618.30	Box	Concrete	1.52	0.91
2753	0 (Polyline)-1371	MH-1720	MH-1403	4.08	4.05	3.45	3.42	73.28	2.18	0.011	0.51	1.38	0.16	11.7	61.4	8,222.20	Box	Concrete	1.83	0.91
5748	0 (Polyline)-1372(1)	MH-1403	MH-400	4.05	4	2.79	2.79	4.22	2.18	0.011	0.11	1.53	0.18	12	131.9	10,535.60	Box	Concrete	1.83	0.91
636	0 (Polyline)-1446	MH-400	MH-399	4	3.95	3.24	2.79	16.89	1.33	0.011	1.4	2.65	0.78	29.2	156.5	49,776.20	Box	Concrete	0.91	0.61
5751	0 (Polyline)-1445(2)	MH-399	MH-436	3.95	4.33	3.36	3.24	23.71	1.68	0.011	1.4	1.13	0.78	68.9	166.8	50,638.00	Box	Concrete	0.91	0.61
4305	0 (Polyline)-1444	MH-2459	MH-953	4.62	4.11	3.91	3.4	50	0.86	0.011	1.83	0.97	0.14	14.6	72.7	7,177.70	Box	Concrete	0.61	0.61
5750	0 (Polyline)-1445(1)	MH-953	MH-436	4.11	4.33	3.4	3.39	26.29	1.52	0.011	0.49	0.22	0.18	84.2	147.7	9,417.10	Box	Concrete	0.61	0.61
694	0 (Polyline)-1380	MH-436	MH-2607	4.33	4.19	3.64	3.39	33.18	1.65	0.011	1.66	1.42	0.92	65	118.6	60,886.50	Box	Concrete	0.91	0.61
4669	0 (Polyline)-1381	MH-2607	MH-1653	4.19	4.21	3.48	3.25	50	1.83	0.011	1.73	1.09	0.96	87.7	153.7	64,267.20	Box	Concrete	0.91	0.61

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2636	0 (Polyline)-1382	MH-1653	MH-1565	4.21	4.22	3.45	3.2	50	1.82	0.011	1.8	1.15	1	86.9	147.9	68,289.90	Box	Concrete	0.91	0.61
2480	0 (Polyline)-1383	MH-1565	MH-176	4.22	4.04	3.51	3.2	50	1.79	0.011	1.92	1.28	1.06	83.2	109.9	73,820.60	Box	Concrete	0.91	0.61
297	0 (Polyline)-1384	MH-176	MH-177	4.04	4.16	3.4	3.24	7.79	1.48	0.011	4.08	2.33	1.06	45.7	90.7	74,927.20	Box	Concrete	0.91	0.61
3534	0 (Polyline)-1407	MH-2115	MH-241	4.57	4.67	3.86	3.83	50	1.55	0.011	0.66	0.22	0.19	88.1	54	9,632.70	Box	Concrete	0.61	0.61
397	0 (Polyline)-1408	MH-241	MH-242	4.67	4.67	3.83	3.83	10.42	1.61	0.011	0.69	0.36	0.22	61	49.5	11,932.90	Box	Concrete	0.91	0.61
5763	0 (Polyline)-1443(2)	MH-591	MH-242	4.74	4.67	4.03	3.83	25.49	0.69	0.011	0.87	0.86	0.02	2.4	32.3	1,055.70	Box	Concrete	0.61	0.61
5762	0 (Polyline)-1443(1)	MH-242	MH-590	4.67	4.62	3.83	3.83	6.97	1.66	0.011	0.71	0.36	0.24	66.3	48.8	13,136.60	Box	Concrete	0.91	0.61
2062	0 (Polyline)-1442	MH-590	MH-1303	4.62	4.5	3.83	3.79	39.52	1.58	0.011	0.92	0.49	0.28	56.5	44.4	15,284.60	Box	Concrete	0.91	0.61
5761	0 (Polyline)-1441(2)	MH-1303	MH-177	4.5	4.16	3.79	3.33	44.08	1.24	0.011	2.29	1.66	0.35	20.9	61.3	19,857.90	Box	Concrete	0.91	0.61
5760	0 (Polyline)-1441(1)	MH-177	MH-1302	4.16	4.24	3.33	3.22	12.93	1.94	0.011	3.08	2.13	1.36	63.6	90.6	95,760.70	Box	Concrete	1.22	0.61
5759	0 (Polyline)-1440(2)	MH-1302	MH-221	4.24	4.22	3.32	3.2	18.31	2	0.011	2.84	1.9	1.36	71.6	94.2	96,313.10	Box	Concrete	1.22	0.61
5758	0 (Polyline)-1440(1)	MH-221	MH-1255	4.22	4.02	3.31	3.01	31.69	1.96	0.011	3.32	2.27	1.5	65.8	88.7	1,06,267.60	Box	Concrete	1.22	0.61
1967	0 (Polyline)-1439	MH-1255	MH-1254	4.02	3.98	3.01	2.56	50	1.99	0.011	3.3	3.92	1.54	39.4	85.8	1,10,400.70	Box	Concrete	1.22	0.91
3508	0 (Polyline)-1447	MH-2100	MH-296	3.9	3.89	3.19	3.16	50	0.95	0.011	0.46	0.22	0.05	22.1	69.6	2,421.20	Box	Concrete	0.61	0.61
480	0 (Polyline)-1448	MH-296	MH-297	3.89	3.87	3.16	2.59	12.71	0.71	0.011	2.4	2.06	0.08	3.7	118.8	4,159.10	Box	Concrete	0.61	0.61
3478	0 (Polyline)-1426	MH-2085	MH-2086	4.61	4.42	3.9	3.71	42.54	0.67	0.011	0.56	0.65	0.01	1.6	24	530.9	Box	Concrete	0.61	0.61
3545	0 (Polyline)-1427	MH-2086	MH-2120	4.42	4.37	3.71	3.66	50	1.4	0.011	0.83	0.5	0.18	36.5	39.3	9,915.40	Box	Concrete	0.91	0.61
3638	0 (Polyline)-1428	MH-2120	MH-1210	4.37	3.8	3.66	3.09	50	1.22	0.011	2.31	1.73	0.33	19.1	77.7	18,775.40	Box	Concrete	0.91	0.61
1896	0 (Polyline)-1429	MH-1210	MH-1211	3.8	4	3.09	2.91	36.45	1.39	0.011	0.73	1.15	0.41	35.4	142.3	23,466.40	Box	Concrete	0.91	0.61
4126	0 (Polyline)-1359	MH-2384	MH-1993	4.95	4.95	4.24	4.21	50	1.02	0.011	0.5	0.22	0.06	29.1	36.5	3,180.30	Box	Concrete	0.61	0.61
3277	0 (Polyline)-1360	MH-1993	MH-1175	4.95	4.45	4.21	3.74	50	0.94	0.011	2.01	0.94	0.2	21.7	52.6	11,239.40	Box	Concrete	0.61	0.61
1841	0 (Polyline)-1361	MH-1175	MH-1112	4.45	4.56	3.74	3.72	50	1.86	0.011	0.77	0.36	0.33	91.8	67	18,745.80	Box	Concrete	0.91	0.61
1739	0 (Polyline)-1362	MH-1112	MH-938	4.56	4.72	3.72	3.69	50	2	0.011	0.78	0.52	0.37	71	65.9	22,142.80	Box	Concrete	1.22	0.61
9825	0 (Polyline)-1363(1)	MH-938	MH-3086	4.72	4.5	3.69	3.67	23.29	1.88	0.011	1.06	0.77	0.43	55.6	67.2	27,037.20	Box	Concrete	1.22	0.61
4783	0 (Polyline)-1454	MH-2643	MH-2644	5.73	4.49	5.02	3.78	50	0.88	0.011	2.95	1.52	0.24	15.9	52.5	12,298.90	Box	Concrete	0.61	0.61
5041	0 (Polyline)-1455	MH-2644	MH-1808	4.49	4.09	3.78	3.38	50	1.25	0.011	2.37	0.87	0.46	53.3	90	23,706.00	Box	Concrete	0.61	0.61
2918	0 (Polyline)-1456	MH-1808	MH-1809	4.09	4.32	3.38	3.31	48.77	1.96	0.011	0.78	0.88	0.58	65.9	147.4	30,447.30	Box	Concrete	1.22	0.61
5725	0 (Polyline)-1369(2)	MH-997	MH-768	4.11	3.67	2.74	2.66	54.91	2.07	0.011	0.1	2.64	0.17	6.3	106.5	8,485.80	Box	Concrete	1.83	0.91
1197	0 (Polyline)-1368	MH-768	MH-767	3.67	3.9	2.89	2.66	34.03	1.42	0.011	0.15	3.36	0.17	5.1	123.4	13,192.60	Box	Concrete	1.22	0.91
5727	0 (Polyline)-1367(2)	MH-767	MH-1809	3.9	4.32	3.31	2.89	36.27	1.39	0.011	0.17	4.43	0.19	4.2	124.1	16,308.80	Box	Concrete	1.22	0.91
5726	0 (Polyline)-1367(1)	MH-1809	MH-1174	4.32	4.52	3.46	3.31	13.73	1.55	0.011	2.45	4.31	0.5	11.6	92.8	48,318.40	Box	Concrete	1.22	0.91
2799	0 (Polyline)-1366	MH-1174	MH-1743	4.52	4.56	3.55	3.46	50	1.85	0.011	1.34	1.73	0.52	29.9	79.5	50,156.80	Box	Concrete	1.22	0.91
3017	0 (Polyline)-1365	MH-1743	MH-1858	4.56	4.34	3.63	3.55	50	1.97	0.011	1.37	0.94	0.63	66.9	101.8	61,627.40	Box	Concrete	1.22	0.61
3858	0 (Polyline)-1364	MH-1858	MH-939	4.34	4.5	3.67	3.63	49.23	2.22	0.011	1.09	0.67	0.66	99.8	86.6	66,445.20	Box	Concrete	1.22	0.61
9826	0 (Polyline)-1363(2)	MH-3086	MH-939	4.5	4.5	3.69	3.67	26.82	1.87	0.011	0.95	0.71	0.71	99.3	72.5	72,225.30	Box	Concrete	1.22	0.61
9829	CO-381	MH-3086	MH-1211	4.5	4	3.68	3	65.29	1.73	0.011	3.01	2.28	0.96	42.2	104.9	99,262.50	Box	Concrete	1.2	0.6

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3301	0 (Polyline)-1430	MH-1211	MH-1559	4	4.05	3	2.88	61.67	2.36	0.011	1.75	1.8	1.22	67.7	98.2	1,26,417.70	Box	Concrete	1.22	0.91
2470	0 (Polyline)-1431	MH-1559	MH-1560	4.05	4.26	2.92	2.86	50	2.59	0.011	1.51	1.45	1.26	86.9	99.5	1,33,229.00	Box	Concrete	1.22	0.91
4543	0 (Polyline)-1432	MH-1560	MH-2558	4.26	4.33	2.86	2.8	50	2.68	0.011	1.19	1.4	1.32	94.4	101	1,41,089.90	Box	Concrete	1.22	0.91
4631	0 (Polyline)-1433	MH-2558	MH-1914	4.33	4.01	2.8	2.7	50	2.51	0.011	0.99	2.43	1.37	56.5	105.1	1,48,874.00	Box	Concrete	1.52	0.91
3122	0 (Polyline)-1434	MH-1914	MH-1045	4.01	4.17	2.7	2.66	50	2.93	0.011	1.02	1.54	1.41	91.4	109.2	1,55,043.80	Box	Concrete	1.52	0.91
1632	0 (Polyline)-1435	MH-1045	MH-1046	4.17	3.62	2.66	2.61	50	2.85	0.011	1.03	1.68	1.42	84.8	110.3	1,59,201.40	Box	Concrete	1.52	0.91
4162	0 (Polyline)-1436	MH-1046	MH-297	3.62	3.87	2.61	2.59	52.12	3.25	0.011	0.86	1.53	1.43	93.6	111.2	1,63,304.50	Box	Concrete	1.83	0.91
5753	0 (Polyline)-1437(2)	MH-297	MH-793	3.87	4	2.59	2.57	26.78	3.27	0.011	0.87	1.53	1.46	95.1	111.4	1,69,554.00	Box	Concrete	1.83	0.91
5756	0 (Polyline)-1438(1)(1)	MH-793	MH-1254	4	3.98	2.57	2.56	25.19	3.27	0.011	0.87	1.53	1.45	94.9	111.6	1,70,939.20	Box	Concrete	1.83	0.91
5757	0 (Polyline)-1438(1)(2)	MH-1254	MH-396	3.98	3.59	2.56	2.52	32.94	3.31	0.011	1.43	2.4	2.38	99.2	111.6	2,82,462.90	Box	Concrete	1.83	0.91
630	0 (Polyline)-1450	MH-396	MH-395	3.59	3.69	2.98	2.54	16.87	2.35	0.011	5.02	10.98	2.38	21.7	93.5	2,84,450.90	Box	Concrete	1.83	0.91
3853	0 (Polyline)-1449	MH-395	O-183	3.69	3.94	3.23	2.98	50	2.74	0.011	2.88	4.81	2.4	49.8	56.1	2,86,429.00	Box	Concrete	1.83	0.91
2434	0 (Polyline)-1424	MH-1539	MH-1538	4.31	3.91	3.6	3.2	46.32	0.73	0.011	1.13	0.9	0.04	4.4	39.5	2,006.70	Box	Concrete	0.61	0.61
3904	0 (Polyline)-1423	MH-1538	MH-1945	3.91	4.17	3.2	3.18	50	1.25	0.011	0.59	0.22	0.11	53.1	67.7	6,002.30	Box	Concrete	0.61	0.61
3181	0 (Polyline)-1422	MH-1945	MH-1944	4.17	4.28	3.18	3.15	50	1.49	0.011	0.64	0.36	0.17	46.4	70.2	9,485.70	Box	Concrete	0.91	0.61
1703	0 (Polyline)-1385	MH-1090	MH-254	4.81	4.81	4.1	4.07	50	0.97	0.011	0.48	0.22	0.05	24.6	20.9	2,687.00	Box	Concrete	0.61	0.61
417	0 (Polyline)-1386	MH-254	MH-255	4.81	4.59	4.07	3.29	12.36	0.69	0.011	2.46	2.43	0.06	2.5	59.7	3,294.80	Box	Concrete	0.61	0.61
2971	0 (Polyline)-1388	MH-139	MH-1489	4.08	4.48	3.37	3.34	56.63	1.14	0.011	0.24	0.22	0.09	41.5	104.7	4,539.50	Box	Concrete	0.61	0.61
2347	0 (Polyline)-1387	MH-1489	MH-1488	4.48	4.54	3.34	3.31	49.84	1.34	0.011	0.37	0.22	0.14	63.4	107.8	8,527.40	Box	Concrete	0.61	0.61
4128	0 (Polyline)-1412	MH-2385	MH-2386	5.32	4.46	4.61	3.75	50	0.81	0.011	2.13	1.26	0.13	10.3	50	6,616.70	Box	Concrete	0.61	0.61
4597	0 (Polyline)-1413	MH-2386	MH-2392	4.46	4.41	3.75	3.63	36.12	1.2	0.011	1.5	0.56	0.27	47.8	81.4	13,894.40	Box	Concrete	0.61	0.61
3726	0 (Polyline)-1378	MH-1756	MH-222	4.6	4.32	3.9	3.85	50	1.64	0.011	0.99	0.51	0.33	63.8	74.9	16,604.20	Box	Concrete	0.91	0.61
368	0 (Polyline)-1379	MH-222	MH-223	4.32	4.5	3.85	3.8	51.22	1.78	0.011	1.04	0.51	0.41	81.4	80.2	21,803.20	Box	Concrete	0.91	0.61
9823	CO-380	MH-223	MH-2392	4.5	4.41	3.8	3.69	89.25	1.92	0.011	1.23	0.57	0.57	99.1	80.6	31,084.70	Box	Concrete	0.91	0.61
4140	0 (Polyline)-1414	MH-2392	MH-2393	4.41	4.5	3.69	3.6	61.94	2.21	0.011	1.46	0.89	0.88	99.4	78	51,792.70	Box	Concrete	1.22	0.61
5641	0 (Polyline)-1415(1)	MH-2393	MH-2081	4.5	4.5	3.6	3.5	45.81	2.11	0.011	1.72	1.1	0.93	84.9	80	56,815.60	Box	Concrete	1.22	0.61
3466	0 (Polyline)-1425	MH-2080	MH-2081	4.51	4.5	3.8	3.58	49.76	0.92	0.011	1.34	0.64	0.13	20	52.8	6,510.80	Box	Concrete	0.61	0.61
5812	CO-13	MH-2081	MH-1488	4.5	4.54	3.58	3.31	62.25	2	0.011	2.28	1.53	1.09	71.1	89.9	68,034.10	Box	Concrete	1.22	0.61
5811	CO-12	MH-1488	MH-255	4.54	4.59	3.31	3.27	45.66	2.65	0.011	1.33	1.26	1.16	92	72.2	80,496.60	Box	Concrete	1.22	0.91
5646	0 (Polyline)-1418(2)	MH-255	MH-2309	4.59	4.5	3.29	3.25	46.01	2.74	0.011	1.3	1.22	1.2	99.1	65.5	85,269.00	Box	Concrete	1.22	0.91
4183	0 (Polyline)-1419	MH-2309	MH-2055	4.5	4.5	3.27	3.23	52.19	2.88	0.011	1.2	1.43	1.24	86.8	53.8	89,827.40	Box	Concrete	1.52	0.91

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
5766	0 (Polyline)-1420(1)	MH-2055	MH-1944	4.5	4.28	3.24	3.15	33.72	2.36	0.011	1.97	2.82	1.26	44.7	47.1	94,015.60	Box	Concrete	1.52	0.91
5767	0 (Polyline)-1420(2)	MH-1944	O-65	4.28	3.88	3.15	1.68	19.68	1.81	0.011	6.15	14.88	1.37	9.2	100.2	1,03,501.30	Box	Concrete	1.52	0.91
2478	0 (Polyline)-1390	MH-1564	MH-982	4	4.15	3.29	3.27	50	0.99	0.011	0.49	0.22	0.06	26.6	25.9	2,904.60	Box	Concrete	0.61	0.61
1533	0 (Polyline)-1391	MH-982	MH-40	4.15	3.79	3.27	2.34	40.93	0.77	0.011	2.18	1.46	0.11	7.3	69.9	5,893.10	Box	Concrete	0.61	0.61
2915	0 (Polyline)-1409	MH-1806	MH-1807	3.81	3.17	3.1	2.46	50	0.95	0.011	2.35	1.09	0.24	22.2	75.8	12,312.30	Box	Concrete	0.61	0.61
3276	0 (Polyline)-1410	MH-1807	MH-675	3.17	3.35	2.46	2.43	50	1.86	0.011	0.59	0.36	0.33	90.9	110.4	17,011.10	Box	Concrete	0.91	0.61
1058	0 (Polyline)-1411	MH-675	MH-676	3.35	3.81	2.43	2.42	29.98	1.98	0.011	0.48	0.52	0.36	68.8	111.4	19,895.40	Box	Concrete	1.22	0.61
453	0 (Polyline)-1406	MH-279	MH-278	5.15	4.68	4.44	3.97	24.22	0.7	0.011	1.49	1.35	0.04	3.1	20.5	2,134.80	Box	Concrete	0.61	0.61
2801	0 (Polyline)-1405	MH-278	MH-1693	4.68	4.52	3.97	3.81	37.85	0.94	0.011	1.34	0.63	0.14	21.4	35.5	6,951.70	Box	Concrete	0.61	0.61
2705	0 (Polyline)-1404	MH-1693	MH-1692	4.52	4.32	3.81	3.61	50	1.13	0.011	1.55	0.61	0.25	40.8	46.3	13,005.60	Box	Concrete	0.61	0.61
3851	0 (Polyline)-1403	MH-1692	MH-1463	4.32	4.02	3.61	3.31	50	1.15	0.011	1.93	0.75	0.32	42.7	58.5	17,215.40	Box	Concrete	0.61	0.61
2305	0 (Polyline)-1402	MH-1463	MH-1462	4.02	3.81	3.31	3.1	50	1.43	0.011	1.85	0.63	0.46	73.8	68.8	25,595.10	Box	Concrete	0.61	0.61
5638	0 (Polyline)-1401(2)	MH-1462	MH-676	3.81	3.81	3.1	2.42	42.13	1.16	0.011	3.19	1.23	0.54	43.7	91.2	30,311.60	Box	Concrete	0.61	0.61
5637	0 (Polyline)-1401(1)	MH-676	MH-1935	3.81	3.97	2.42	2.41	19.83	2.72	0.011	0.98	1.22	0.9	73.6	75.3	52,316.90	Box	Concrete	1.52	0.91
3164	0 (Polyline)-1400	MH-1935	MH-1646	3.97	4.05	2.41	2.39	38.04	2.75	0.011	0.99	1.22	0.92	75.7	75.8	54,825.40	Box	Concrete	1.52	0.91
2621	0 (Polyline)-1399	MH-1646	MH-1645	4.05	3.92	2.39	2.36	50	2.79	0.011	1	1.22	0.96	79.1	76.5	59,406.40	Box	Concrete	1.52	0.91
3115	0 (Polyline)-1398	MH-1645	MH-1499	3.92	3.86	2.36	2.34	48.43	2.81	0.011	1.01	1.22	0.98	80.9	77.2	63,845.80	Box	Concrete	1.52	0.91
5640	0 (Polyline)-1397(2)	MH-1499	MH-40	3.86	3.79	2.34	2.34	6.22	2.79	0.011	1	1.22	0.97	79.4	77.5	65,122.00	Box	Concrete	1.52	0.91
4120	0 (Polyline)-1392	MH-2381	MH-40	4.06	3.79	3.35	2.34	52.97	0.75	0.011	1.84	1.33	0.08	5.8	67.6	3,936.70	Box	Concrete	0.61	0.61
5639	0 (Polyline)-1397(1)	MH-40	MH-1498	3.79	3.95	2.34	2.31	45.37	3.02	0.011	1.03	1.53	1.13	73.6	78.1	76,243.00	Box	Concrete	1.83	0.91
3936	0 (Polyline)-1396	MH-1498	MH-1924	3.95	3.69	2.31	2.29	50	3.04	0.011	1.04	1.53	1.15	75.2	79.2	79,978.40	Box	Concrete	1.83	0.91
3142	0 (Polyline)-1395	MH-1924	MH-1446	3.69	3.39	2.29	2.26	50	3.06	0.011	1.04	1.53	1.18	76.9	80.4	84,243.50	Box	Concrete	1.83	0.91
2277	0 (Polyline)-1394	MH-1446	O-92	3.39	3.49	2.26	-0.1	50	2.37	0.011	4.53	17.89	1.18	6.6	211	86,989.00	Box	Concrete	2.13	0.91
4346	0 (Polyline)-1674	MH-2474	MH-2475	4.91	4.04	4.2	3.33	50	0.88	0.011	2.45	1.27	0.2	15.6	50.5	10,073.00	Box	Concrete	0.61	0.61
5012	0 (Polyline)-1675	MH-2475	MH-2710	4.04	3.95	3.33	3.24	50	1.61	0.011	1.36	0.71	0.43	60.3	69.2	22,185.60	Box	Concrete	0.91	0.61
4980	0 (Polyline)-1676	MH-2710	MH-2535	3.95	3.87	3.24	3.19	50	2.12	0.011	1.14	0.72	0.63	86.8	73.7	33,165.60	Box	Concrete	1.22	0.61
4488	0 (Polyline)-1677	MH-2535	MH-1556	3.87	3.84	3.19	3.13	50	2.2	0.011	1.3	0.8	0.78	97.1	68	42,719.50	Box	Concrete	1.22	0.61
2464	0 (Polyline)-1678	MH-1556	MH-1124	3.84	3.73	3.13	2.72	50	1.76	0.011	2.71	2.13	0.89	42	80.1	50,964.50	Box	Concrete	1.22	0.61
1760	0 (Polyline)-1679	MH-1124	MH-1125	3.73	3.85	2.72	2.54	50	2.15	0.011	2.02	3.27	0.97	29.7	75.7	56,380.30	Box	Concrete	1.52	0.91
3144	0 (Polyline)-1680	MH-1125	MH-122	3.85	3.65	2.54	2.51	50	2.86	0.011	1.02	1.22	1.04	85.8	86.4	61,823.50	Box	Concrete	1.52	0.91
216	0 (Polyline)-1681	MH-122	O-93	3.65	3.66	2.51	2.42	6.08	1.93	0.011	3.22	6.51	1	15.3	92	61,823.50	Box	Concrete	1.52	0.91
3886	0 (Polyline)-302	MH-2279	MH-2280	4.27	4.46	3.56	3.54	50	0.77	0.011	0.32	0.22	0.02	7.3	53.4	801.8	Box	Concrete	0.61	0.61
4863	0 (Polyline)-303	MH-2280	MH-2650	4.46	4.71	3.54	3.51	50	0.97	0.011	0.48	0.22	0.05	24.5	57.2	3,058.50	Box	Concrete	0.61	0.61
4797	0 (Polyline)-304	MH-2650	MH-2396	4.71	4.76	3.51	3.49	50	1.25	0.011	0.59	0.22	0.12	53.7	59.5	7,392.10	Box	Concrete	0.61	0.61
4148	0 (Polyline)-305	MH-2396	MH-2397	4.76	4.76	3.49	3.46	50	1.58	0.011	0.66	0.22	0.2	90.9	56.1	13,390.30	Box	Concrete	0.61	0.61
4716	0 (Polyline)-306	MH-2397	MH-1631	4.76	4.3	3.46	3.44	50	1.73	0.011	0.73	0.36	0.27	75.4	45.4	19,574.60	Box	Concrete	0.91	0.61

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2596	0 (Polyline)-307	MH-1631	MH-608	4.3	3.93	3.44	3.22	50	1.34	0.011	1.67	1.07	0.33	30.5	39.4	24,422.60	Box	Concrete	0.91	0.61
955	0 (Polyline)-308	MH-608	MH-609	3.93	3.48	3.22	1.96	33.52	1.13	0.011	3.48	3.15	0.34	11	99.5	26,273.00	Box	Concrete	0.91	0.61
5067	0 (Polyline)-318	MH-2739	MH-2688	4.2	3.55	3.49	2.84	50	0.69	0.011	1.15	1.1	0.03	2.7	14.2	1,505.80	Box	Concrete	0.61	0.61
4915	0 (Polyline)-319	MH-2688	MH-2196	3.55	3.21	2.84	2.5	50	0.79	0.011	1.27	0.79	0.07	8.9	41.9	3,699.40	Box	Concrete	0.61	0.61
3712	0 (Polyline)-320	MH-2196	MH-2197	3.21	3.73	2.5	2.48	50	1.24	0.011	0.59	0.22	0.11	52.3	66.7	6,117.60	Box	Concrete	0.61	0.61
4179	0 (Polyline)-321	MH-2197	MH-2338	3.73	2.94	2.48	2.23	50	0.95	0.011	1.45	0.67	0.15	22	87.4	8,690.10	Box	Concrete	0.61	0.61
4020	0 (Polyline)-322	MH-2338	MH-2302	2.94	2.87	2.23	2.16	50	1.23	0.011	0.52	0.38	0.19	51.4	111.7	11,758.40	Box	Concrete	0.61	0.61
3937	0 (Polyline)-323	MH-2302	MH-381	2.87	3.74	2.16	2.13	50	1.61	0.011	0.4	0.36	0.22	61.1	134.4	14,721.40	Box	Concrete	0.91	0.61
609	0 (Polyline)-324	MH-381	MH-382	3.74	3.83	2.13	2.05	16.11	1.22	0.011	0.4	1.19	0.22	18.8	142.5	16,093.70	Box	Concrete	0.91	0.61
5054	0 (Polyline)-309	MH-2734	MH-2250	2.84	3.43	2.13	2.11	48.94	1	0.011	0.16	0.22	0.06	27.5	141.1	3,012.20	Box	Concrete	0.61	0.61
3819	0 (Polyline)-310	MH-2250	MH-2169	3.43	3.36	2.11	2.08	50	1.38	0.011	0.39	0.22	0.15	67.9	144	9,778.00	Box	Concrete	0.61	0.61
3653	0 (Polyline)-311	MH-2169	MH-888	3.36	3.7	2.08	2.06	50	1.56	0.011	0.36	0.36	0.2	55	146.6	14,403.80	Box	Concrete	0.91	0.61
5647	0 (Polyline)-312(1)	MH-888	MH-382	3.7	3.83	2.06	2.05	25.4	1.59	0.011	0.38	0.36	0.21	57.6	148.7	16,555.70	Box	Concrete	0.91	0.61
5648	0 (Polyline)-312(2)	MH-382	MH-826	3.83	3.9	2.05	2.03	24.61	2.05	0.011	0.55	0.52	0.41	77.8	149.8	33,452.50	Box	Concrete	1.22	0.61
1287	0 (Polyline)-313	MH-826	MH-827	3.9	3.88	2.03	2.01	50	2.07	0.011	0.38	0.92	0.42	45.8	101.8	35,361.80	Box	Concrete	1.22	0.91
2704	0 (Polyline)-314	MH-827	MH-1314	3.88	3.9	2.01	1.98	50	2.1	0.011	0.4	0.92	0.44	48	103.9	39,591.80	Box	Concrete	1.22	0.91
8988	0 (Polyline)-315(1)(1)	MH-1314	MH-2949	3.9	3.73	1.98	1.97	18.8	2.17	0.011	0.44	0.92	0.49	53.3	105.3	46,724.90	Box	Concrete	1.22	0.91
8989	EX (Polyline)-315(1)(2	)MH-2949	MH-609	3.73	3.48	1.97	1.96	26.42	2.66	0.019	0.35	0.7	0.48	68.5	106.1	46,724.90	Box	Concrete	1.52	0.91
5650	EX (Polyline)-315(2)	MH-609	MH-1315	3.48	3.58	1.96	1.96	4.79	3.27	0.019	0.38	1.06	0.74	69.6	106.5	73,893.10	Box	Concrete	2.13	0.91
4766	EX (Polyline)-316	MH-1315	MH-1377	3.58	3.15	1.96	1.93	50	3.31	0.019	0.4	1.06	0.77	72.5	107.3	77,410.00	Box	Concrete	2.13	0.91
2169	EX (Polyline)-317	MH-1377	O-143	3.15	3.21	1.93	1.91	43.63	3.38	0.019	0.43	1.06	0.84	78.9	108.4	88,830.80	Box	Concrete	2.13	0.91
4493	EX (Polyline)-2161	MH-2537	MH-2500	3.63	3.45	2.92	2.74	50	0.89	0.019	0.66	0.34	0.06	16.4	43.9	2,807.90	Box	Concrete	0.61	0.61
4406	EX (Polyline)-2162	MH-2500	MH-559	3.45	3.42	2.74	2.71	50	1.53	0.019	0.41	0.14	0.12	85.9	52.2	6,270.60	Box	Concrete	0.61	0.61
8991	EX (Polyline)-2163(1)	MH-559	MH-2950	3.42	3.39	2.71	2.68	23.74	1.39	0.019	0.56	0.19	0.13	68.7	39.2	7,932.80	Box	Concrete	0.61	0.61
8992	0 (Polyline)-2163(2)	MH-2950	MH-560	3.39	3.38	2.68	2.66	7.04	0.97	0.011	1.15	0.52	0.13	24.4	31.3	7,932.80	Box	Concrete	0.61	0.61
4813	EX (Polyline)-339	MH-2656	MH-2657	3.54	3.57	2.83	2.81	50	0.87	0.019	0.24	0.12	0.02	15	21.1	951.9	Box	Concrete	0.61	0.61
4925	EX (Polyline)-340	MH-2657	MH-2605	3.57	3.38	2.81	2.67	50	0.85	0.019	0.55	0.3	0.04	13.8	27	2,484.50	Box	Concrete	0.61	0.61
5542	EX (Polyline)-341(1)	MH-2605	MH-560	3.38	3.38	2.67	2.66	18.52	1.09	0.019	0.31	0.12	0.04	35.8	32.5	2,974.70	Box	Concrete	0.61	0.61
5543	0 (Polyline)-341(2)	MH-560	O-126	3.38	1.86	2.66	-0.25	33.55	0.75	0.011	3.92	2.85	0.16	5.8	273.1	11,334.70	Box	Concrete	0.61	0.61
2767	0 (Polyline)-386	MH-1727	MH-1728	3.15	3.65	2.44	2.41	50	1.07	0.011	0.52	0.22	0.07	33.9	75.3	3,709.90	Box	Concrete	0.61	0.61
4197	0 (Polyline)-387	MH-1728	MH-272	3.65	3.37	2.41	2.39	50	1.57	0.011	0.66	0.22	0.19	89.6	77	10,603.20	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
444	0 (Polyline)-388	MH-272	MH-273	3.37	3.28	2.39	2.27	11.78	1.15	0.011	1.89	1.63	0.2	12.5	86.8	11,918.80	Box	Concrete	0.91	0.61
4417	EX (Polyline)-377	MH-2504	MH-2505	3.35	3.51	2.64	2.61	50.22	0.95	0.011	0.47	0.22	0.05	22.4	80.3	2,454.80	Box	Concrete	0.61	0.61
4522	EX (Polyline)-378	MH-2505	MH-2550	3.51	3.7	2.61	2.59	42.09	1.36	0.011	0.62	0.22	0.14	66	83.2	7,890.20	Box	Concrete	0.61	0.61
4691	EX (Polyline)-379	MH-2550	MH-745	3.7	4.02	2.59	2.56	63.25	2.08	0.019	0.47	0.3	0.25	81	85.2	14,435.80	Box	Concrete	1.22	0.61
1164	EX (Polyline)-380	MH-745	MH-746	4.02	3.96	2.56	2.54	33.09	2.2	0.019	0.49	0.53	0.3	55.7	58	19,854.70	Box	Concrete	1.22	0.91
3502	0 (Polyline)-1929	MH-2098	MH-1803	4.18	4.57	3.47	3.45	39.09	1.81	0.011	0.75	0.36	0.31	84.8	64.3	15,599.20	Box	Concrete	0.91	0.61
2910	EX	MH-1803	MH-1804	4.57	4.27	3.45	3.26	60.64	2	0.019	1.14	0.76	0.54	70.7	62.2	28,574.50	Box	Concrete	1.22	0.61
3474	EX (Polyline)-1931	MH-1804	MH-2084	4.27	4.24	3.26	3.07	50	2.24	0.019	1.28	1.95	0.7	36.1	44.3	38,825.00	Box	Concrete	1.52	0.91
4356	EX0 (Polyline)-1932	MH-2084	MH-1190	4.24	4.16	3.07	2.9	50	2.37	0.019	1.27	1.81	0.82	45.2	49.7	46,778.60	Box	Concrete	1.52	0.91
5528	EX (Polyline)-1933(1)	MH-1190	MH-746	4.16	3.96	3.04	2.54	39.85	2.09	0.019	2.06	3.51	0.9	25.7	47.2	53,474.70	Box	Concrete	1.52	0.91
5529	0 (Polyline)-1933(2)	MH-746	MH-1191	3.96	3.97	2.54	2.54	10.15	2.93	0.011	1.04	1.22	1.12	91.9	57.6	77,846.40	Box	Concrete	1.52	0.91
4743	0 (Polyline)-1934	MH-1191	MH-1974	3.97	3.52	2.54	2.51	50	2.85	0.011	1.12	1.33	1.13	84.7	49.7	79,173.40	Box	Concrete	1.52	0.91
5530	0 (Polyline)-1935(1)	MH-1974	MH-273	3.52	3.28	2.51	2.27	17.57	1.97	0.011	3.31	6.36	1.14	17.9	53.6	81,848.80	Box	Concrete	1.52	0.91
5531	0 (Polyline)-1935(2)	MH-273	MH-865	3.28	3.21	2.27	2.2	32.43	2.46	0.011	1.85	2.53	1.32	52	68	95,150.90	Box	Concrete	1.52	0.91
1349	0 (Polyline)-1936	MH-865	MH-866	3.21	3.28	2.2	2.17	50	3.18	0.011	1.08	1.53	1.33	87.2	70.8	97,564.60	Box	Concrete	1.83	0.91
5818	CO-19	MH-866	O-127	3.28	3.21	2.17	2.17	17.27	3.17	0.011	1.08	1.53	1.32	86.6	70.5	99,807.20	Box	Concrete	1.83	0.91
4218	0 (Polyline)-389	MH-2425	MH-1272	3.17	3.17	2.46	2.44	50	1.58	0.011	0.66	0.22	0.2	90.8	56.3	9,926.00	Box	Concrete	0.61	0.61
1996	0 (Polyline)-390	MH-1272	MH-1273	3.17	3.06	2.44	2.35	50	1.26	0.011	1.12	0.41	0.22	54	51.7	11,863.40	Box	Concrete	0.61	0.61
2944	0 (Polyline)-391	MH-1273	MH-405	3.06	3.09	2.35	2.32	50	1.66	0.011	0.71	0.36	0.24	66.6	48.3	13,546.50	Box	Concrete	0.91	0.61
645	0 (Polyline)-392	MH-405	MH-406	3.09	2.85	2.32	2.06	17.21	1.14	0.011	2.31	2.03	0.24	12	69.9	14,554.60	Box	Concrete	0.91	0.61
589	0 (Polyline)-385	MH-369	MH-368	3.25	3.02	2.54	2.31	15.53	0.7	0.011	1.28	1.18	0.03	2.9	41.4	1,751.80	Box	Concrete	0.61	0.61
3656	0 (Polyline)-384	MH-368	MH-1107	3.02	3.1	2.31	2.28	50	1.47	0.011	0.64	0.22	0.17	77.8	59.6	8,588.70	Box	Concrete	0.61	0.61
1730	0 (Polyline)-383	MH-1107	MH-1106	3.1	2.77	2.28	2.06	50	1.01	0.011	1.48	0.64	0.18	28.2	76.1	9,871.90	Box	Concrete	0.61	0.61
5423	0 (Polyline)-382(2)	MH-1106	MH-406	2.77	2.85	2.06	2.06	6.77	1.57	0.011	0.66	0.22	0.19	89.7	94.1	10,877.10	Box	Concrete	0.61	0.61
5422	0 (Polyline)-382(1)	MH-406	O-128	2.85	2.97	2.06	-0.4	84.75	1.18	0.011	3.46	2.77	0.43	15.6	291.2	25,993.40	Box	Concrete	0.91	0.61
3824	0 (Polyline)-433	MH-2253	MH-747	3.57	3.97	2.86	2.83	50	1.02	0.011	0.5	0.22	0.06	29.2	49.4	3,192.30	Box	Concrete	0.61	0.61
1167	0 (Polyline)-434	MH-747	MH-748	3.97	3.84	2.83	2.82	33.26	1.24	0.011	0.59	0.22	0.11	51.7	50.8	6,140.20	Box	Concrete	0.61	0.61
4278	EX (Polyline)-424	MH-2448	MH-1108	4.35	4.5	3.64	3.61	54.54	1.18	0.019	0.33	0.12	0.06	45.5	30.9	2,878.50	Box	Concrete	0.61	0.61
8997	EX (Polyline)-425(1)	MH-1108	MH-2952	4.5	4.2	3.61	3.49	25.21	0.92	0.019	0.79	0.38	0.08	19.7	28	4,376.50	Box	Concrete	0.61	0.61
8998	0 (Polyline)-425(2)	MH-2952	MH-1109	4.2	4.4	3.49	3.47	40.87	1.07	0.011	0.52	0.22	0.07	33.7	26.4	4,376.50	Box	Concrete	0.61	0.61
4204	0 (Polyline)-426	MH-1109	MH-2419	4.4	3.66	3.47	2.95	50	0.8	0.011	1.63	0.99	0.1	9.8	28.7	6,258.60	Box	Concrete	0.61	0.61
5428	0 (Polyline)-427(1)	MH-2419	MH-748	3.66	3.84	2.95	2.82	46.94	0.99	0.011	1.13	0.5	0.13	26	42.8	8,705.30	Box	Concrete	0.61	0.61
5429	0 (Polyline)-427(2)	MH-748	MH-2588	3.84	3.5	2.82	2.79	18.39	1.31	0.011	1.06	0.38	0.22	59.6	47.7	15,371.30	Box	Concrete	0.61	0.61
4616	0 (Polyline)-428	MH-2588	MH-2520	3.5	3.6	2.79	2.77	34.67	1.63	0.011	0.7	0.36	0.23	63.3	37.9	15,899.40	Box	Concrete	0.91	0.61
4452	0 (Polyline)-429	MH-2520	MH-343	3.6	3.19	2.77	2.48	50	1.22	0.011	1.66	1.25	0.24	18.8	28.3	16,795.50	Box	Concrete	0.91	0.61
551	0 (Polyline)-430	MH-343	MH-344	3.19	2.99	2.48	1.98	19.84	1.1	0.011	2.65	2.56	0.23	9.1	41.8	16,940.00	Box	Concrete	0.91	0.61

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3905	0 (Polyline)-439	MH-2288	MH-429	3.29	3.28	2.58	2.56	50	0.89	0.011	0.42	0.22	0.04	16.6	39.7	1,817.00	Box	Concrete	0.61	0.61
683	0 (Polyline)-440	MH-429	MH-430	3.28	3.44	2.56	2.43	18.69	0.78	0.011	1.23	0.8	0.06	7.9	52.1	3,518.60	Box	Concrete	0.61	0.61
1123	0 (Polyline)-438	MH-718	MH-719	3.72	3.71	3.01	2.7	32.2	0.7	0.011	1	0.94	0.03	2.8	46.8	1,339.60	Box	Concrete	0.61	0.61
2899	0 (Polyline)-420	MH-1797	MH-1781	4	3.66	3.29	2.95	50	0.81	0.011	1.33	0.79	0.08	10.1	46.7	4,081.40	Box	Concrete	0.61	0.61
2867	0 (Polyline)-421	MH-1781	MH-1782	3.66	3.94	2.95	2.93	50	1.58	0.011	0.68	0.36	0.2	56.4	74.9	10,697.20	Box	Concrete	0.91	0.61
9000	0 (Polyline)-422(1)	MH-1782	MH-2953	3.94	3.9	2.93	2.92	18.72	1.65	0.011	0.71	0.36	0.24	65.9	76.5	13,295.90	Box	Concrete	0.91	0.61
9001	EX (Polyline)-422(2)	MH-2953	MH-1425	3.9	3.83	2.92	2.9	31.29	2.05	0.019	0.46	0.3	0.23	77.2	77.3	13,295.90	Box	Concrete	1.22	0.61
9003	EX (Polyline)-423(1)	MH-1425	MH-2954	3.83	4.06	2.9	2.89	29.47	2.18	0.019	0.49	0.3	0.29	94.3	77.6	17,281.80	Box	Concrete	1.22	0.61
9004	0 (Polyline)-423(2)	MH-2954	MH-1426	4.06	4.2	2.89	2.88	17.81	1.84	0.011	0.71	0.52	0.27	51.5	78.1	17,281.80	Box	Concrete	1.22	0.61
58	EX (Polyline)-405	MH-18	MH-17	4.5	3.93	3.79	3.22	19.38	0.77	0.019	1.41	0.96	0.07	7	34.2	3,379.60	Box	Concrete	0.61	0.61
4464	EX (Polyline)-404	MH-17	MH-1536	3.93	4.23	3.22	3.2	50	1.54	0.019	0.38	0.12	0.11	86.2	38.2	5,517.40	Box	Concrete	0.61	0.61
5435	EX (Polyline)-403(2)	MH-1536	MH-1426	4.23	4.2	3.2	2.88	26.84	1.17	0.019	1.24	1.02	0.15	14.3	52.1	8,396.80	Box	Concrete	0.91	0.61
5434	EX (Polyline)-403(1)	MH-1426	MH-1535	4.2	4.5	2.88	2.86	35.58	2.47	0.019	0.54	0.53	0.41	76.9	51.4	27,006.00	Box	Concrete	1.22	0.91
4082	0 (Polyline)-402	MH-1535	MH-1846	4.5	4.35	2.86	2.84	37.6	2.1	0.011	0.82	0.92	0.44	47.6	50.2	30,117.00	Box	Concrete	1.22	0.91
8995	0 (Polyline)-401(2)	MH-1846	MH-2951	4.35	4.34	2.84	2.84	11.71	2.12	0.011	0.83	0.92	0.45	49.3	50.4	32,140.90	Box	Concrete	1.22	0.91
8994	EX+ (Polyline)-401(1)	MH-2951	MH-1845	4.34	4.32	2.84	2.82	38.29	2.56	0.019	0.55	0.53	0.45	84.5	47.3	32,140.90	Box	Concrete	1.22	0.91
3989	EX (Polyline)-400	MH-1845	MH-719	4.32	3.71	2.82	2.7	50.51	1.97	0.019	0.95	1.14	0.44	38.4	46.3	32,743.10	Box	Concrete	1.22	0.91
4883	EX (Polyline)-399	MH-719	MH-2677	3.71	3.72	2.7	2.68	49.49	2.57	0.019	0.55	0.53	0.45	84.9	39.1	34,992.70	Box	Concrete	1.22	0.91
5427	EX (Polyline)-398(2)	MH-2677	MH-430	3.72	3.44	2.68	2.43	41.31	1.76	0.019	1.33	1.84	0.44	24	36	36,121.00	Box	Concrete	1.22	0.91
5426	EX (Polyline)-398(1)	MH-430	MH-2409	3.44	3.5	2.43	2.42	14.64	2.64	0.019	0.56	0.53	0.49	91.3	36.7	40,392.10	Box	Concrete	1.22	0.91
4175	EX (Polyline)-397	MH-2409	MH-2057	3.5	3.16	2.42	2.15	44.08	1.79	0.019	1.4	1.89	0.48	25.7	29.6	40,732.80	Box	Concrete	1.22	0.91
5425	EX (Polyline)-396(2)	MH-2057	MH-344	3.16	2.99	2.15	1.98	16.17	1.71	0.019	1.65	2.4	0.49	20.5	31.6	41,857.70	Box	Concrete	1.22	0.91
5424	EX (Polyline)-396(1)	MH-344	MH-2056	2.99	2.17	1.98	1.16	33.83	1.68	0.019	2.48	3.72	0.69	18.7	73.1	59,574.20	Box	Concrete	1.22	0.91
3586	EX (Polyline)-395	MH-2056	O-105	2.17	1.99	1.16	-0.55	50	2.14	0.019	0.43	7.34	0.72	9.8	206.2	62,268.30	Box	Concrete	1.83	0.91
4193	0 (Polyline)-2174	MH-2415	MH-1915	4.21	3.95	3.5	3.24	50	0.75	0.011	0.98	0.7	0.04	6.1	18.9	2,161.50	Box	Concrete	0.61	0.61
3124	0 (Polyline)-2175	MH-1915	MH-1889	3.95	3.47	3.24	2.76	50	0.83	0.011	1.67	0.95	0.11	11.9	30.1	5,961.30	Box	Concrete	0.61	0.61
3074	0 (Polyline)-2176	MH-1889	MH-197	3.47	3.31	2.76	2.6	50	1.04	0.011	1.3	0.55	0.17	31.2	35.2	9,249.90	Box	Concrete	0.61	0.61
329	0 (Polyline)-2177	MH-197	MH-198	3.31	3.11	2.6	2.4	8.36	0.84	0.011	2.69	1.5	0.19	12.5	44.2	10,536.20	Box	Concrete	0.61	0.61
3974	0 (Polyline)-435	MH-2318	MH-1729	3.82	3.28	3.11	2.57	50	0.79	0.011	1.58	1.01	0.08	8.4	26.2	4,280.20	Box	Concrete	0.61	0.61
5432	0 (Polyline)-436(1)	MH-1729	MH-198	3.28	3.11	2.57	2.4	41.19	0.99	0.011	1.4	0.62	0.16	26.4	42.6	8,521.10	Box	Concrete	0.61	0.61
5433	0 (Polyline)-436(2)	MH-198	MH-735	3.11	3.02	2.4	2.31	8.81	1.09	0.011	2.4	0.97	0.35	36.6	48	19,883.60	Box	Concrete	0.61	0.61

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1149	0 (Polyline)-437	MH-735	MH-736	3.02	3.02	2.31	2.15	39.82	1.61	0.011	1.58	1.46	0.37	25.4	42.2	20,918.00	Box	Concrete	1.22	0.61
1525	0 (Polyline)-419	MH-977	MH-762	4.29	3.4	3.58	2.69	38.35	0.72	0.011	1.84	1.48	0.06	4.3	34.4	3,233.50	Box	Concrete	0.61	0.61
1188	0 (Polyline)-418	MH-762	MH-761	3.4	3.7	2.69	2.66	50	1.23	0.011	0.58	0.22	0.11	50.6	52	5,631.70	Box	Concrete	0.61	0.61
4159	0 (Polyline)-417	MH-761	MH-2402	3.7	3.45	2.66	2.64	50	1.37	0.011	0.62	0.22	0.14	66.8	50.3	7,979.70	Box	Concrete	0.61	0.61
4569	0 (Polyline)-416	MH-2402	MH-2119	3.45	3.44	2.64	2.61	50	1.61	0.011	0.69	0.36	0.22	60.8	45.9	13,129.90	Box	Concrete	0.91	0.61
3543	0 (Polyline)-415	MH-2119	MH-1608	3.44	3.24	2.61	2.53	50	1.45	0.011	1.11	0.65	0.27	42	39.8	17,320.30	Box	Concrete	0.91	0.61
2554	0 (Polyline)-414	MH-1608	MH-1138	3.24	2.88	2.53	2.17	50	1.25	0.011	1.91	1.38	0.29	21.4	47.3	19,657.30	Box	Concrete	0.91	0.61
5431	0 (Polyline)-413(2)	MH-1138	MH-736	2.88	3.02	2.17	2.15	39.61	1.86	0.011	0.77	0.36	0.33	91.4	54.1	22,462.80	Box	Concrete	0.91	0.61
5430	0 (Polyline)-413(1)	MH-736	MH-1137	3.02	2.78	2.15	2.07	10.4	1.65	0.011	2.42	2.12	0.64	30.2	50.2	44,567.50	Box	Concrete	1.22	0.61
3755	0 (Polyline)-412	MH-1137	MH-1591	2.78	2.32	2.07	1.61	44.66	1.63	0.011	2.64	2.38	0.66	27.6	69.2	45,889.50	Box	Concrete	1.22	0.61
5819	CO-20	MH-1591	O-32	2.32	2.27	1.61	-0.65	205.92	1.62	0.011	2.69	2.45	0.66	26.8	260.9	46,419.60	Box	Concrete	1.22	0.61
9166	EX	MH-2980	MH-2976	3.5	3.5	2.79	2.77	42.3	0.94	0.019	0.27	0.12	0.03	21.5	50.3	1,364.20	Box	Concrete	0.61	0.61
9158	EX	MH-2976	MH-2977	3.5	3.5	2.77	2.74	55.92	1.12	0.019	0.32	0.12	0.05	39.2	52.8	2,843.40	Box	Concrete	0.61	0.61
9160	EX	MH-2977	MH-2978	3.5	3.5	2.74	2.7	76.77	1.34	0.019	0.36	0.12	0.08	62.9	52.7	5,336.40	Box	Concrete	0.61	0.61
9175	EX(1)	MH-2978	MH-2981	3.5	3.5	2.7	2.67	57.77	1.52	0.019	0.38	0.12	0.1	83.6	37.8	8,156.20	Box	Concrete	0.61	0.61
9176	EX(2)	MH-2981	O-174	3.5	3.23	2.67	2	9.4	0.77	0.019	2.23	1.5	0.11	7.2	18.6	9,153.30	Box	Concrete	0.61	0.61
4202	0 (Polyline)-477	MH-2418	MH-1093	3.89	3.72	3.18	3.01	50	0.9	0.011	1.12	0.56	0.1	17.4	59.7	4,974.50	Box	Concrete	0.61	0.61
1708	0 (Polyline)-478	MH-1093	MH-1094	3.72	3.9	3.01	2.98	50	1.35	0.011	0.62	0.22	0.14	64.2	74.2	7,278.00	Box	Concrete	0.61	0.61
5335	CO-7	MH-1094	MH-21	3.9	3.94	2.98	2.95	56.4	1.58	0.011	0.67	0.22	0.2	91.5	74.6	11,113.50	Box	Concrete	0.61	0.61
4923	0 (Polyline)-406	MH-2690	MH-21	3.98	3.94	3.27	2.95	51.23	0.93	0.011	1.6	0.76	0.15	20.2	52.4	7,825.30	Box	Concrete	0.61	0.61
5334	0 (Polyline)-480(2)	MH-21	MH-1393	3.94	3.56	2.95	2.85	43.64	1.55	0.011	1.43	0.47	0.41	87.1	68.8	24,857.60	Box	Concrete	0.61	0.61
3990	0 (Polyline)-481	MH-1393	MH-2082	3.56	2.95	2.85	2.24	50	1.16	0.011	2.76	1.07	0.46	43.1	64.9	28,753.70	Box	Concrete	0.61	0.61
3469	0 (Polyline)-482	MH-2082	MH-1784	2.95	2.77	2.24	1.76	50	1.24	0.011	2.57	0.95	0.49	52	59	31,418.60	Box	Concrete	0.61	0.61
2874	0 (Polyline)-483	MH-1784	MH-700	2.77	3.33	1.76	1.73	50	2.21	0.011	0.85	0.92	0.51	55.8	35.2	33,400.60	Box	Concrete	1.22	0.91
1096	0 (Polyline)-484	MH-700	O-30	3.33	2.38	1.73	0.95	31.77	1.48	0.011	3.22	6.47	0.51	7.9	39.6	34,533.20	Box	Concrete	1.22	0.91
1846	0 (Polyline)-571	MH-1178	MH-1179	3.28	3.11	2.57	2.4	50	0.73	0.011	0.72	0.56	0.03	4.6	11.6	1,313.40	Box	Concrete	0.61	0.61
1944	0 (Polyline)-572	MH-1179	MH-1240	3.11	2.92	2.4	2.21	50	0.78	0.011	0.9	0.59	0.05	7.7	15.3	2,430.10	Box	Concrete	0.61	0.61
3062	0 (Polyline)-573	MH-1240	MH-1882	2.92	2.82	2.21	2.11	50	0.82	0.011	0.75	0.44	0.05	10.9	16.9	2,677.20	Box	Concrete	0.61	0.61
4731	0 (Polyline)-574	MH-1882	MH-1937	2.82	2.64	2.11	1.93	50	0.81	0.011	0.97	0.57	0.06	10.5	18.1	3,591.70	Box	Concrete	0.61	0.61
3170	0 (Polyline)-575	MH-1937	MH-207	2.64	2.53	1.93	1.82	32.45	0.85	0.011	1.05	0.57	0.08	13.3	22.2	4,789.60	Box	Concrete	0.61	0.61
345	0 (Polyline)-576	MH-207	MH-208	2.53	1.99	1.82	0.98	30.86	0.77	0.011	2.35	1.59	0.11	7.1	41.3	7,280.60	Box	Concrete	0.61	0.61
3659	0 (Polyline)-547	MH-2171	MH-1946	3.41	2.98	2.7	2.27	50	0.84	0.011	1.63	0.9	0.12	12.8	42	5,847.80	Box	Concrete	0.61	0.61
3184	0 (Polyline)-548	MH-1946	MH-1947	2.98	2.9	2.27	2.19	50	1.29	0.011	1.06	0.38	0.22	57.4	60.5	11,323.10	Box	Concrete	0.61	0.61
3505	0 (Polyline)-549	MH-1947	MH-1576	2.9	3.07	2.19	2.16	50	1.83	0.011	0.76	0.36	0.32	88	59.8	17,262.80	Box	Concrete	0.91	0.61
2500	0 (Polyline)-550	MH-1576	MH-1577	3.07	3.13	2.16	2.14	50	1.99	0.011	0.77	0.52	0.36	69.2	56.4	20,702.20	Box	Concrete	1.22	0.61
4085	0 (Polyline)-551	MH-1577	MH-564	3.13	2.91	2.14	2.11	50	2.05	0.011	0.8	0.52	0.4	77.1	51.9	24,469.00	Box	Concrete	1.22	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
888	0 (Polyline)-552	MH-564	MH-565	2.91	2.76	2.11	2.04	25.72	1.68	0.011	1.47	1.24	0.42	33.4	54.1	26,771.70	Box	Concrete	1.22	0.61
1146	0 (Polyline)-546	MH-734	MH-733	3.54	3.61	2.83	2.81	32.5	1.07	0.011	0.53	0.22	0.07	34.2	30.3	3,741.30	Box	Concrete	0.61	0.61
2660	0 (Polyline)-545	MH-733	MH-1127	3.61	3.23	2.81	2.52	50	0.92	0.011	1.51	0.74	0.14	19.1	37	7,497.70	Box	Concrete	0.61	0.61
1763	0 (Polyline)-544	MH-1127	MH-1126	3.23	3.23	2.52	2.49	50	1.6	0.011	0.69	0.36	0.22	59.7	37.9	11,868.00	Box	Concrete	0.91	0.61
1955	0 (Polyline)-543	MH-1126	MH-1247	3.23	2.79	2.49	2.08	50	1.19	0.011	1.84	1.47	0.23	15.7	45.7	13,497.00	Box	Concrete	0.91	0.61
2777	0 (Polyline)-542	MH-1247	MH-1732	2.79	2.78	2.08	2.06	50	1.67	0.011	0.71	0.36	0.25	68	60.4	14,786.30	Box	Concrete	0.91	0.61
5320	0 (Polyline)-541(2)	MH-1732	MH-565	2.78	2.76	2.06	2.04	30.96	1.68	0.011	0.71	0.36	0.25	68.7	60	15,999.30	Box	Concrete	0.91	0.61
5319	0 (Polyline)-541(1)	MH-565	MH-1891	2.76	3.02	2.04	2	24.5	1.98	0.011	1.41	0.96	0.65	68.2	57.7	43,658.10	Box	Concrete	1.22	0.61
3078	0 (Polyline)-540	MH-1891	MH-208	3.02	1.99	2.03	0.98	44.54	1.53	0.011	3.47	3.59	0.66	18.4	54.3	44,455.80	Box	Concrete	1.22	0.61
762	0 (Polyline)-539	MH-208	FO-28	1.99	2.28	0.98	0.27	18.31	1.52	0.011	4.37	8.11	0.8	9.8	78.4	54,292.10	Box	Concrete	1.22	0.91
1849	0 (Polyline)-536	MH-1180	MH-1181	2.77	2.64	2.06	1.93	41.19	0.7	0.011	0.59	0.55	0.02	2.8	26.3	790.8	Box	Concrete	0.61	0.61
933	0 (Polyline)-457	MH-595	MH-594	2.86	3.21	2.15	2.03	26.9	0.72	0.011	0.79	0.65	0.03	4.1	40.1	1,327.60	Box	Concrete	0.61	0.61
1619	0 (Polyline)-518	MH-1037	MH-1038	2.85	2.93	2.14	2.09	39.17	0.75	0.011	0.49	0.34	0.02	6.2	46.7	1,075.10	Box	Concrete	0.61	0.61
5313	0 (Polyline)-511(1)	MH-1695	MH-1038	2.82	2.93	2.11	2.09	30.56	0.77	0.011	0.32	0.22	0.02	7.4	49.5	810.9	Box	Concrete	0.61	0.61
5314	0 (Polyline)-511(2)	MH-1038	MH-1696	2.93	2.98	2.09	2.08	19.44	1	0.011	0.49	0.22	0.06	26.8	51.3	3,170.70	Box	Concrete	0.61	0.61
3008	0 (Polyline)-512	MH-1696	MH-1854	2.98	3.25	2.08	2.06	50	1.18	0.011	0.57	0.22	0.1	45.4	52.5	5,554.30	Box	Concrete	0.61	0.61
4223	0 (Polyline)-513	MH-1854	MH-1148	3.25	2.97	2.06	2.03	50	1.35	0.011	0.62	0.22	0.14	64	52	8,491.70	Box	Concrete	0.61	0.61
5311	0 (Polyline)-514(1)	MH-1148	MH-594	2.97	3.21	2.03	2.03	9.38	1.38	0.011	0.62	0.22	0.15	68.1	50.4	9,790.70	Box	Concrete	0.61	0.61
5312	0 (Polyline)-514(2)	MH-594	MH-1149	3.21	2.87	2.03	2.01	32.43	1.49	0.011	0.65	0.22	0.17	80.3	44.1	11,647.00	Box	Concrete	0.61	0.61
5315	0 (Polyline)-515(1)	MH-1149	MH-1181	2.87	2.64	2.01	1.93	28.96	1.08	0.011	1.3	0.53	0.18	34.6	37.7	12,762.30	Box	Concrete	0.61	0.61
5316	0 (Polyline)-515(2)	MH-1181	MH-1656	2.64	2.46	1.93	1.75	29.25	1.01	0.011	1.71	0.75	0.21	27.6	41.5	14,511.00	Box	Concrete	0.61	0.61
2641	0 (Polyline)-516	MH-1656	MH-568	2.46	2.66	1.75	1.72	50	1.62	0.011	0.69	0.36	0.22	61.3	38.3	15,784.40	Box	Concrete	0.91	0.61
894	0 (Polyline)-517	MH-568	FO-27	2.66	2.54	1.72	0.27	38.05	1.08	0.011	3.04	3.18	0.23	7.3	103.4	17,152.40	Box	Concrete	0.91	0.61
4516	0 (Polyline)-501	MH-2547	MH-1370	2.54	2.82	1.83	1.81	50	0.79	0.011	0.34	0.22	0.02	8.7	47.3	956.3	Box	Concrete	0.61	0.61
2157	0 (Polyline)-502	MH-1370	MH-1371	2.82	3.11	1.81	1.78	50	1.07	0.011	0.52	0.22	0.07	33.9	50.4	4,185.10	Box	Concrete	0.61	0.61
4844	0 (Polyline)-503	MH-1371	MH-1827	3.11	3.31	1.78	1.76	50	1.23	0.011	0.58	0.22	0.11	50.6	51.8	6,844.70	Box	Concrete	0.61	0.61
2954	0 (Polyline)-504	MH-1827	MH-1288	3.31	3.09	1.76	1.73	50	1.42	0.011	0.63	0.22	0.16	72	48.5	10,497.40	Box	Concrete	0.61	0.61
2022	0 (Polyline)-505	MH-1288	MH-1289	3.09	2.92	1.73	1.71	50	1.6	0.011	0.69	0.36	0.21	59.2	39.8	15,231.30	Box	Concrete	0.91	0.61
4431	0 (Polyline)-506	MH-1289	MH-777	2.92	2.15	1.71	1.44	50	1.27	0.011	1.7	1.2	0.28	23	37.9	20,439.80	Box	Concrete	0.91	0.61
1212	0 (Polyline)-507	MH-777	O-24	2.15	1.82	1.44	0.61	34.28	1.17	0.011	3.05	2.52	0.36	14.2	74.6	27,190.30	Box	Concrete	0.91	0.61
958	0 (Polyline)-449	MH-610	MH-611	2.82	2.84	2.11	2.1	27.3	0.85	0.011	0.4	0.22	0.03	13.7	50.5	1,495.60	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
374	0 (Polyline)-535	MH-227	MH-226	2.96	2.96	2.25	2.24	22.64	0.9	0.011	0.43	0.22	0.04	17.6	26.6	1,927.50	Box	Concrete	0.61	0.61
5310	0 (Polyline)-534(2)	MH-226	MH-611	2.96	2.84	2.24	2.1	20.49	0.77	0.011	1.2	0.81	0.06	7.1	39.2	3,050.30	Box	Concrete	0.61	0.61
5309	0 (Polyline)-534(1)	MH-611	MH-870	2.84	3.05	2.1	2.09	16.41	1.2	0.011	0.57	0.22	0.1	48	51.7	5,551.60	Box	Concrete	0.61	0.61
4357	0 (Polyline)-533	MH-870	MH-2479	3.05	3.07	2.09	2.06	50	1.29	0.011	0.6	0.22	0.12	57.5	51.2	6,816.50	Box	Concrete	0.61	0.61
4385	0 (Polyline)-532	MH-2479	MH-1989	3.07	3.2	2.06	2.04	50	1.44	0.011	0.64	0.22	0.16	75.2	42.7	9,604.40	Box	Concrete	0.61	0.61
3268	0 (Polyline)-531	MH-1989	MH-1988	3.2	2.97	2.04	1.73	50	0.97	0.011	1.68	0.76	0.19	24.5	47.9	11,871.00	Box	Concrete	0.61	0.61
767	0 (Polyline)-530	MH-485	MH-484	2.59	2.66	1.88	1.86	20.49	0.89	0.011	0.42	0.22	0.04	16.6	54.5	1,814.00	Box	Concrete	0.61	0.61
4483	0 (Polyline)-529	MH-484	MH-936	2.66	2.58	1.86	1.84	50	1.07	0.011	0.53	0.22	0.07	34.1	56.7	3,883.30	Box	Concrete	0.61	0.61
1457	0 (Polyline)-528	MH-936	MH-935	2.58	2.9	1.84	1.81	50	1.25	0.011	0.59	0.22	0.11	52.8	58.7	6,520.40	Box	Concrete	0.61	0.61
4825	0 (Polyline)-527	MH-935	MH-1513	2.9	2.68	1.81	1.79	50	1.28	0.011	0.6	0.22	0.12	56.4	59.7	7,529.30	Box	Concrete	0.61	0.61
2389	0 (Polyline)-526	MH-1513	MH-1512	2.68	2.92	1.79	1.76	50	1.3	0.011	0.6	0.22	0.13	58.4	60.6	8,438.00	Box	Concrete	0.61	0.61
2922	0 (Polyline)-525	MH-1512	MH-1238	2.92	2.96	1.76	1.74	50	1.34	0.011	0.61	0.22	0.14	62.9	61.1	9,564.80	Box	Concrete	0.61	0.61
5308	0 (Polyline)-524(2)	MH-1238	MH-1988	2.96	2.97	1.74	1.73	19.96	1.39	0.011	0.63	0.22	0.15	69.1	61.2	11,068.00	Box	Concrete	0.61	0.61
5307	0 (Polyline)-524(1)	MH-1988	MH-1237	2.97	2.96	1.73	1.71	30.04	1.83	0.011	0.76	0.36	0.32	88.1	59.5	24,221.70	Box	Concrete	0.91	0.61
4253	0 (Polyline)-523	MH-1237	MH-1506	2.96	3.05	1.71	1.69	50	1.85	0.011	0.77	0.36	0.33	90	48.6	25,431.10	Box	Concrete	0.91	0.61
2375	0 (Polyline)-522	MH-1506	MH-1505	3.05	1.67	1.69	0.96	50	1.2	0.011	2.53	1.97	0.33	16.9	50.8	27,022.80	Box	Concrete	0.91	0.61
4232	0 (Polyline)-521	MH-1505	MH-2285	1.67	2.01	0.96	0.93	50	2.04	0.011	0.8	0.52	0.4	76.8	61.5	32,900.50	Box	Concrete	1.22	0.61
3896	0 (Polyline)-520	MH-2285	MH-1764	2.01	1.79	0.93	0.91	50	2.08	0.011	0.81	0.52	0.43	81.3	59	35,882.20	Box	Concrete	1.22	0.61
2836	0 (Polyline)-519	MH-1764	O-23	1.79	1.72	0.91	0.61	50	1.59	0.011	1.91	1.8	0.44	24.2	82.6	37,920.50	Box	Concrete	1.22	0.61
1311	0 (Polyline)-1964	MH-843	MH-842	4.18	4.11	3.47	3.4	35.88	0.75	0.011	0.64	0.45	0.03	6.3	13	1,431.00	Box	Concrete	0.61	0.61
2689	0 (Polyline)-1963	MH-842	MH-1683	4.11	3.92	3.4	3.21	50	0.78	0.011	0.9	0.58	0.05	8.1	18.8	2,503.00	Box	Concrete	0.61	0.61
3675	0 (Polyline)-1962	MH-1683	MH-1217	3.92	3.4	3.21	2.69	50	0.81	0.011	1.68	0.99	0.1	10.5	41.5	5,802.10	Box	Concrete	0.61	0.61
1905	0 (Polyline)-1961	MH-1217	MH-1216	3.4	3.63	2.69	2.66	50	1.63	0.011	0.7	0.36	0.23	63.5	59.5	13,156.00	Box	Concrete	0.91	0.61
4105	0 (Polyline)-1960	MH-1216	MH-2083	3.63	3.83	2.66	2.64	50	1.67	0.011	0.71	0.36	0.24	67.3	59.1	14,903.40	Box	Concrete	0.91	0.61
3471	0 (Polyline)-1959	MH-2083	MH-1562	3.83	3.63	2.64	2.61	50	1.73	0.011	0.73	0.36	0.27	75	57.4	17,792.00	Box	Concrete	0.91	0.61
2473	0 (Polyline)-1958	MH-1562	MH-1561	3.63	3.41	2.61	2.59	50	1.78	0.011	0.75	0.36	0.3	81.6	51.5	20,315.40	Box	Concrete	0.91	0.61
3100	0 (Polyline)-1957	MH-1561	MH-1903	3.41	3.05	2.59	2.04	50	1.29	0.011	2.51	1.7	0.44	25.7	68.3	31,276.90	Box	Concrete	0.91	0.61
4505	0 (Polyline)-1956	MH-1903	MH-2140	3.05	3.5	2.04	2.01	67.23	2.25	0.011	0.87	0.92	0.55	59.5	60.4	39,634.40	Box	Concrete	1.22	0.91
9203	0 (Polyline)-1955(1)	MH-2140	MH-2992	3.5	3.5	2.01	2	17.17	2.32	0.011	0.89	0.92	0.6	64.9	60.7	45,517.00	Box	Concrete	1.22	0.91
9204	0 (Polyline)-1955(2)	MH-2992	MH-1472	3.5	3.52	2	1.99	21.42	2.34	0.011	0.89	0.92	0.61	66	60.7	46,860.90	Box	Concrete	1.22	0.91
3090	0 (Polyline)-39	MH-1898	MH-1897	4.23	3.55	3.52	2.84	49.21	0.79	0.011	1.79	1.13	0.1	8.5	40.2	4,874.50	Box	Concrete	0.61	0.61
4673	0 (Polyline)-38	MH-1897	MH-2609	3.55	3.65	2.84	2.82	50	1.74	0.011	0.73	0.36	0.28	76.5	56.3	14,388.00	Box	Concrete	0.91	0.61
4855	0 (Polyline)-37	MH-2609	MH-1473	3.65	3.75	2.82	2.79	50	2.06	0.011	0.81	0.52	0.41	79.1	47.1	22,689.90	Box	Concrete	1.22	0.61
5685	0 (Polyline)-36(2)	MH-1473	MH-129	3.75	3.59	2.79	2.63	35.5	1.64	0.011	1.77	1.56	0.46	29.3	48	26,459.60	Box	Concrete	1.22	0.61
2980	0 (Polyline)-33	MH-1839	MH-1840	3.4	3.53	2.69	2.66	50	1.77	0.011	0.74	0.36	0.29	80.5	63.8	14,811.80	Box	Concrete	0.91	0.61
4496	0 (Polyline)-34	MH-1840	MH-129	3.53	3.59	2.66	2.63	56.26	1.86	0.011	0.77	0.36	0.33	91.2	59.6	17,722.70	Box	Concrete	0.91	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
5684	0 (Polyline)-36(1)	MH-129	MH-1472	3.59	3.52	2.63	1.99	14.5	1.5	0.011	4.5	4.94	0.77	15.6	73.4	45,323.70	Box	Concrete	1.22	0.61
5682	0 (Polyline)-1954(1)	MH-1472	MH-1458	3.52	3.05	1.99	1.96	44.19	3.06	0.011	1.05	1.53	1.18	77.2	60	92,563.80	Box	Concrete	1.83	0.91
3883	0 (Polyline)-1953	MH-1458	MH-2150	3.05	3.18	1.96	1.94	50	3.07	0.011	1.05	1.53	1.18	77.2	58.3	95,339.40	Box	Concrete	1.83	0.91
3613	0 (Polyline)-1952	MH-2150	MH-1133	3.18	3.09	1.94	1.91	50	3.1	0.011	1.06	1.53	1.22	79.9	55.3	1,00,964.60	Box	Concrete	1.83	0.91
1772	0 (Polyline)-1951	MH-1133	MH-1132	3.09	3.09	1.91	1.89	50	3.09	0.011	1.05	1.53	1.22	79.7	47.4	1,02,979.70	Box	Concrete	1.83	0.91
4999	0 (Polyline)-1950	MH-1132	MH-2467	3.09	2.08	1.89	1.07	50	2.24	0.011	3.53	8.74	1.33	15.2	42.4	1,14,918.70	Box	Concrete	1.83	0.91
4325	0 (Polyline)-1949	MH-2467	MH-2466	2.08	1.89	1.07	0.88	50	2.52	0.011	2.23	4.22	1.42	33.5	56.2	1,23,262.20	Box	Concrete	1.83	0.91
4994	0 (Polyline)-1948	MH-2466	MH-1682	1.89	2.83	0.88	0.86	50	3.41	0.011	1.1	1.84	1.5	81.5	69	1,31,862.70	Box	Concrete	2.13	0.91
2685	0 (Polyline)-1947	MH-1682	MH-1681	2.83	3.07	0.86	0.83	50	3.43	0.011	1.11	1.84	1.53	83.2	68.7	1,37,861.40	Box	Concrete	2.13	0.91
2965	0 (Polyline)-1946	MH-1681	MH-1832	3.07	2.83	0.83	0.81	50	3.43	0.011	1.11	1.84	1.54	83.5	68.3	1,41,533.90	Box	Concrete	2.13	0.91
4993	0 (Polyline)-1945	MH-1832	MH-2686	2.83	2.2	0.81	0.78	50	3.5	0.011	1.13	1.84	1.66	90.1	67.3	1,56,157.80	Box	Concrete	2.13	0.91
4911	0 (Polyline)-1944	MH-2686	MH-1192	2.2	2.85	0.78	0.76	50	3.54	0.011	1.15	1.84	1.72	93.4	65.4	1,64,543.00	Box	Concrete	2.13	0.91
1867	0 (Polyline)-1943	MH-1192	MH-1088	2.85	3.07	0.76	0.73	50.28	3.54	0.011	1.15	1.84	1.72	93.7	62.4	1,68,041.70	Box	Concrete	2.13	0.91
1698	0 (Polyline)-1942	MH-1088	FO-144	3.07	2.88	0.73	0.71	49.82	3.57	0.011	1.16	1.84	1.78	96.8	53	1,76,786.60	Box	Concrete	2.13	0.91
2085	0 (Polyline)-1939	MH-1326	MH-965	3.6	3.9	2.89	2.87	50	0.86	0.011	0.4	0.22	0.03	14	47.1	1,525.90	Box	Concrete	0.61	0.61
5653	0 (Polyline)-1940(1)	MH-965	MH-2363	3.9	3.87	2.87	2.84	47.69	1.41	0.011	0.63	0.22	0.15	71.2	42.7	8,641.20	Box	Concrete	0.61	0.61
4075	0 (Polyline)-284	MH-291	MH-2363	4.06	3.87	3.35	2.84	62.52	0.85	0.011	1.59	0.87	0.11	13.2	30.8	5,823.00	Box	Concrete	0.61	0.61
994	0 (Polyline)-1941	MH-2363	O-142	3.87	4.3	2.84	2.72	30.73	1.33	0.011	1.57	1.03	0.3	29.2	35.4	18,030.90	Box	Concrete	0.91	0.61
3430	0 (Polyline)-577	MH-2063	MH-1256	3.7	4.4	2.99	2.96	50	1.89	0.011	0.78	0.36	0.34	94.7	82.9	17,428.90	Box	Concrete	0.91	0.61
1970	0 (Polyline)-578	MH-1256	MH-1257	4.4	4.14	2.96	2.94	42.21	2.05	0.011	0.8	0.52	0.4	77	84	21,498.50	Box	Concrete	1.22	0.61
4427	0 (Polyline)-325	MH-2509	MH-2510	4.46	4.19	3.75	3.48	50	0.95	0.011	1.52	0.71	0.16	22.3	35.6	7,979.70	Box	Concrete	0.61	0.61
5651	0 (Polyline)-326(1)	MH-2510	MH-1257	4.19	4.14	3.48	2.94	26.65	0.89	0.011	2.71	1.38	0.23	16.8	62.5	12,040.00	Box	Concrete	0.61	0.61
5652	0 (Polyline)-326(2)	MH-1257	MH-2653	4.14	4.28	2.94	2.93	23.36	2.38	0.011	0.9	0.92	0.64	69.4	56.5	35,671.80	Box	Concrete	1.22	0.91
4804	0 (Polyline)-327	MH-2653	MH-2621	4.28	4.14	2.93	2.9	50	2.44	0.011	0.92	0.92	0.68	74.3	54.9	39,111.30	Box	Concrete	1.22	0.91
4707	0 (Polyline)-328	MH-2621	MH-401	4.14	4.43	2.9	2.88	50	2.56	0.011	0.95	0.92	0.77	84	46.9	46,441.00	Box	Concrete	1.22	0.91
639	0 (Polyline)-329	MH-401	O-141	4.43	4.06	2.88	2.72	15.35	1.71	0.011	2.85	4.16	0.85	20.3	34.7	53,398.50	Box	Concrete	1.22	0.91
3523	0 (Polyline)-865	MH-2108	MH-2109	3.38	3.51	2.67	2.64	50	1.24	0.011	0.59	0.22	0.11	52	43	5,684.90	Box	Concrete	0.61	0.61
3673	0 (Polyline)-866	MH-2109	MH-2176	3.51	3.25	2.64	2.54	50	1.12	0.011	1.12	0.45	0.17	39	40.6	9,423.90	Box	Concrete	0.61	0.61
3826	0 (Polyline)-867	MH-2176	MH-1957	3.25	2.82	2.54	2.11	50	0.98	0.011	2	0.89	0.23	25.6	41.3	12,889.70	Box	Concrete	0.61	0.61
3203	0 (Polyline)-868	MH-1957	MH-1176	2.82	3.12	2.11	2.08	50	1.86	0.011	0.72	0.52	0.28	53.1	35.9	16,043.10	Box	Concrete	1.22	0.61
1843	0 (Polyline)-869	MH-1176	MH-1177	3.12	3.21	2.08	1.63	41.11	1.45	0.011	2.02	4.32	0.28	6.6	29.7	17,528.50	Box	Concrete	1.22	0.91

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
4302	0 (Polyline)-878	MH-2458	MH-731	3.65	3.68	2.94	2.91	50	1.29	0.011	0.6	0.22	0.13	58.3	70.6	6,374.90	Box	Concrete	0.61	0.61
1143	0 (Polyline)-879	MH-731	MH-732	3.68	3.86	2.91	2.84	32.45	1.14	0.011	1.14	0.45	0.18	41.1	76.5	9,947.60	Box	Concrete	0.61	0.61
4170	0 (Polyline)-880	MH-2741	MH-1866	3.66	3.96	2.95	2.92	50	1.04	0.011	0.51	0.22	0.07	30.8	78.2	3,364.00	Box	Concrete	0.61	0.61
3032	0 (Polyline)-881	MH-1866	MH-1867	3.96	4.01	2.92	2.9	50	1.3	0.011	0.6	0.22	0.13	58.4	81.3	6,928.60	Box	Concrete	0.61	0.61
4703	0 (Polyline)-882	MH-1867	MH-215	4.01	3.95	2.9	2.88	40.39	1.43	0.011	0.64	0.22	0.16	74.2	83.4	9,474.30	Box	Concrete	0.61	0.61
357	0 (Polyline)-883	MH-215	MH-82	3.95	4.07	2.88	2.87	18.88	1.46	0.011	0.64	0.22	0.17	77.7	84.4	10,539.20	Box	Concrete	0.61	0.61
3111	0 (Polyline)-884	MH-1909	MH-435	4.13	4.12	3.42	3.39	50	1.59	0.011	0.68	0.36	0.21	58.6	39.4	10,786.80	Box	Concrete	0.91	0.61
692	0 (Polyline)-885	MH-435	MH-204	4.12	4.07	3.39	2.93	18.97	1.12	0.011	2.77	2.54	0.27	10.5	54.1	14,392.00	Box	Concrete	0.91	0.61
351	0 (Polyline)-864	MH-2740	MH-211	3.72	4.02	3.01	3	20.08	0.94	0.011	0.46	0.22	0.05	21.6	68.9	2,360.40	Box	Concrete	0.61	0.61
3350	0 (Polyline)-863	MH-211	MH-1965	4.02	3.95	3	2.98	39.08	1.23	0.011	0.58	0.22	0.11	51	70.6	5,777.30	Box	Concrete	0.61	0.61
3215	0 (Polyline)-862	MH-1965	MH-1964	3.95	3.88	2.98	2.95	50	1.65	0.011	0.71	0.36	0.24	65.6	72.4	13,237.40	Box	Concrete	0.91	0.61
4467	0 (Polyline)-861	MH-1964	MH-204	3.88	4.07	2.95	2.93	50	1.73	0.011	0.73	0.36	0.27	75.5	73.8	16,233.90	Box	Concrete	0.91	0.61
5220	CO-2	MH-204	MH-82	4.07	4.07	2.93	2.87	8.87	1.62	0.011	2.08	1.9	0.5	26.5	79.5	31,797.90	Box	Concrete	1.22	0.61
154	0 (Polyline)-859	MH-82	MH-81	4.07	4.06	2.87	2.85	26.78	2.42	0.011	0.92	0.92	0.67	72.6	56.3	43,269.20	Box	Concrete	1.22	0.91
2125	0 (Polyline)-858	MH-81	MH-732	4.06	3.86	2.85	2.84	27.51	2.42	0.011	0.92	0.92	0.67	73.2	55.1	44,869.30	Box	Concrete	1.22	0.91
1676	0 (Polyline)-857	MH-732	MH-1073	3.86	4.06	2.84	2.82	39.79	2.63	0.011	0.96	0.92	0.83	90	47.4	56,170.70	Box	Concrete	1.22	0.91
5221	CO-3	MH-1073	MH-1008	4.06	3.5	2.82	2.49	27.87	1.68	0.011	3.01	4.49	0.85	18.9	54.8	58,943.30	Box	Concrete	1.22	0.91
1572	EX	MH-1008	MH-1007	3.5	3.62	2.49	2.48	27.11	3.28	0.019	0.64	0.89	0.85	96.5	68.8	59,732.50	Box	Concrete	1.83	0.91
4304	EX	MH-1007	MH-2439	3.62	3.65	2.48	2.45	50	3.28	0.019	0.64	0.89	0.85	96.3	67.5	61,239.90	Box	Concrete	1.83	0.91
4254	EX	MH-2439	MH-2438	3.65	3.5	2.45	2.43	50	3.26	0.019	0.64	0.89	0.84	94.3	65.7	63,039.30	Box	Concrete	1.83	0.91
4765	EX	MH-2438	MH-2372	3.5	3.56	2.43	2.41	41.8	3.24	0.019	0.64	0.89	0.82	92.4	63.8	65,202.00	Box	Concrete	1.83	0.91
5399	EX	MH-2372	MH-636	3.56	3.5	2.41	2.39	21.44	3.21	0.019	0.63	0.89	0.8	90.4	62.4	66,051.00	Box	Concrete	1.83	0.91
3720	0 (Polyline)-876	MH-2201	MH-1517	3.63	3.73	2.92	2.9	50	1.58	0.011	0.68	0.36	0.21	57.3	39.3	10,548.30	Box	Concrete	0.91	0.61
2397	0 (Polyline)-877	MH-1517	MH-108	3.73	3.67	2.9	2.72	45.57	1.3	0.011	1.53	1.03	0.27	26.4	44.5	14,583.20	Box	Concrete	0.91	0.61
4136	0 (Polyline)-870	MH-2390	MH-107	3.45	3.5	2.74	2.72	44.67	1.23	0.011	0.58	0.22	0.11	51	55.2	5,577.30	Box	Concrete	0.61	0.61
193	0 (Polyline)-871	MH-107	MH-108	3.5	3.67	2.72	2.72	10.43	1.42	0.011	0.63	0.22	0.16	72.9	55.2	8,490.80	Box	Concrete	0.61	0.61
3363	0 (Polyline)-872	MH-108	MH-2033	3.67	3.61	2.72	2.6	50	1.76	0.011	1.44	1.13	0.47	41.8	63.2	26,105.40	Box	Concrete	1.22	0.61
4642	0 (Polyline)-873	MH-2033	MH-412	3.61	3.85	2.6	2.57	50	2.29	0.011	0.88	0.92	0.57	62.1	46.1	32,537.00	Box	Concrete	1.22	0.91
656	0 (Polyline)-874	MH-412	MH-413	3.85	3.77	2.57	2.57	17.88	2.35	0.011	0.9	0.92	0.62	67	42.7	36,948.70	Box	Concrete	1.22	0.91
5222	CO-4	MH-413	MH-636	3.77	3.5	2.57	2.39	38.63	1.75	0.011	1.96	2.74	0.64	23.2	51.5	38,849.80	Box	Concrete	1.22	0.91
5398	EX	MH-636	MH-2371	3.5	3.61	2.39	2.35	36.77	3.22	0.019	0.99	1.38	1.26	91.4	57.3	1,05,900.60	Box	Concrete	1.83	0.91
4641	EX	MH-2371	MH-2564	3.61	3.49	2.38	2.17	50	2.74	0.019	1.52	2.54	1.26	49.7	49.6	1,07,767.30	Box	Concrete	1.83	0.91
4557	EX	MH-2564	MH-2532	3.49	3.48	2.17	1.98	50	2.96	0.019	1.47	4.53	1.3	28.6	41.4	1,12,396.90	Box	Concrete	2.13	1.22
4480	EX	MH-2532	MH-2531	3.48	3.32	1.98	1.95	50	3.85	0.019	0.72	1.63	1.32	80.9	38.3	1,16,122.00	Box	Concrete	2.13	1.22
4662	EX	MH-2531	MH-2327	3.32	2.96	1.95	1.64	58.76	2.88	0.019	1.63	5.3	1.3	24.4	32.3	1,18,425.00	Box	Concrete	2.13	1.22
5401	0 (Polyline)-847(2)	MH-2327	MH-1177	2.96	3.21	1.64	1.63	17.43	3.27	0.011	1.05	2.81	1.28	45.6	31.9	1,19,325.80	Box	Concrete	2.13	1.22

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5400	0 (Polyline)-847(1)	MH-1177	O-132	3.21	2.5	1.63	1.18	15.49	2.46	0.011	4.21	21.43	1.46	6.8	22.9	1,37,509.00	Box	Concrete	2.13	1.22
2958	0 (Polyline)-1299	MH-1829	MH-1830	4.25	4.58	3.54	3.51	50	1	0.011	0.49	0.22	0.06	27.3	58	2,982.00	Box	Concrete	0.61	0.61
3662	0 (Polyline)-1300	MH-1830	MH-2015	4.58	4.38	3.51	3.49	50	1.56	0.011	0.66	0.22	0.19	88.9	56	10,572.60	Box	Concrete	0.61	0.61
3321	0 (Polyline)-1301	MH-2015	MH-663	4.38	3.88	3.49	3.17	50	1.17	0.011	2	0.77	0.34	44.9	60.8	20,268.30	Box	Concrete	0.61	0.61
1040	0 (Polyline)-1302	MH-663	MH-664	3.88	3.82	3.17	3.11	50	1.79	0.011	1.18	0.57	0.47	82.6	68	28,603.90	Box	Concrete	0.91	0.61
3000	0 (Polyline)-1303	MH-664	MH-671	3.82	3.72	3.11	3.01	50	1.74	0.011	1.43	0.71	0.54	76.6	61.9	33,937.80	Box	Concrete	0.91	0.61
1052	0 (Polyline)-1304	MH-671	MH-672	3.72	3.86	3.01	2	29.67	1.23	0.011	4.04	3	0.59	19.6	96.6	38,145.90	Box	Concrete	0.91	0.61
4460	0 (Polyline)-1651	MH-2523	MH-1451	4.84	3.89	4.13	3.18	50	0.83	0.011	2.34	1.33	0.16	11.9	73.7	7,990.70	Box	Concrete	0.61	0.61
2288	0 (Polyline)-1652	MH-1451	MH-919	3.89	4.02	3.18	3.15	50	1.75	0.011	0.51	0.36	0.28	77.7	119.5	14,540.20	Box	Concrete	0.91	0.61
1433	0 (Polyline)-1653	MH-919	MH-920	4.02	4.26	3.15	3.13	50	1.99	0.011	0.49	0.52	0.37	69.9	121.4	20,448.10	Box	Concrete	1.22	0.61
3492	0 (Polyline)-1654	MH-920	MH-1633	4.26	4.24	3.13	3.1	50	2.16	0.011	0.84	0.92	0.48	52.6	83.1	29,735.20	Box	Concrete	1.22	0.91
2600	0 (Polyline)-1655	MH-1633	MH-1634	4.24	3.86	3.1	2.85	50	1.7	0.011	1.99	2.9	0.58	20.1	97.5	37,963.30	Box	Concrete	1.22	0.91
2688	0 (Polyline)-1656	MH-1634	MH-751	3.86	3.87	2.85	2.83	50	2.41	0.011	0.6	0.92	0.66	71.9	114.1	44,184.30	Box	Concrete	1.22	0.91
1173	0 (Polyline)-1657	MH-751	MH-2064	3.87	4	2.83	2.8	30.21	2.21	0.011	0.6	1.18	0.67	56.4	130.7	46,857.30	Box	Concrete	1.22	0.91
4026	0 (Polyline)-1662	MH-2341	MH-2342	5.2	4.27	4.49	3.56	50	0.89	0.011	2.59	1.32	0.22	16.6	52.2	11,060.30	Box	Concrete	0.61	0.61
4173	0 (Polyline)-1663	MH-2342	MH-2408	4.27	3.87	3.56	2.86	50	1.15	0.011	2.95	1.14	0.49	42.4	115.7	24,964.80	Box	Concrete	0.61	0.61
4445	0 (Polyline)-1664	MH-2408	MH-2516	3.87	4.32	2.86	2.83	50	2.47	0.011	0.64	0.92	0.71	76.6	136.4	36,797.50	Box	Concrete	1.22	0.91
4758	0 (Polyline)-1665	MH-2516	MH-2634	4.32	4.22	2.83	2.81	50	2.69	0.011	0.62	1.22	0.86	70.8	137.7	47,984.30	Box	Concrete	1.52	0.91
4824	0 (Polyline)-1666	MH-2634	MH-2426	4.22	4.06	2.81	2.78	50	2.79	0.011	0.7	1.22	0.97	79.6	138.9	58,047.20	Box	Concrete	1.52	0.91
5744	0 (Polyline)-1667(1)	MH-2426	MH-1209	4.06	4.24	2.78	2.71	48.38	2.39	0.011	0.72	2.14	1	46.7	142.6	64,195.30	Box	Concrete	1.52	0.91
1893	0 (Polyline)-1661	MH-1209	MH-1208	4.24	4.2	2.83	2.79	41.56	2.55	0.011	0.73	1.69	1	59.5	133.6	68,083.90	Box	Concrete	1.52	0.91
3865	0 (Polyline)-1660	MH-1208	MH-2099	4.2	4	2.79	2.77	49.88	3	0.011	0.77	1.09	1.06	97.6	135.1	74,687.10	Box	Concrete	1.52	0.91
3506	0 (Polyline)-1659	MH-2099	MH-1810	4	4.36	2.77	2.74	49.59	2.85	0.011	0.82	1.34	1.14	85	141.9	83,169.50	Box	Concrete	1.52	0.91
2923	0 (Polyline)-1658	MH-1810	MH-752	4.36	4.34	2.74	2.71	50	2.9	0.011	0.86	1.33	1.19	89.4	142.7	90,669.20	Box	Concrete	1.52	0.91
10173	CO-481	MH-752	MH-2064	4.34	4	2.71	2.69	21.45	2.76	0.011	0.93	1.66	1.28	77	143.5	1,01,362.20	Box	Concrete	1.52	0.91
3432	0 (Polyline)-2164	MH-2064	MH-1121	4	4.06	3.42	3.35	54.26	3.1	0.011	1.64	2.37	1.9	79.9	60.7	1,52,740.70	Box	Concrete	1.83	0.91
1754	0 (Polyline)-2165	MH-1121	MH-1122	4.06	3.95	3.35	3.24	50	2.86	0.011	2.11	3.33	1.98	59.5	55.8	1,62,352.40	Box	Concrete	1.83	0.91
4876	0 (Polyline)-2166	MH-1122	MH-1135	3.95	3.59	3.24	2.88	50	2.55	0.011	3.1	5.76	2.03	35.3	55.4	1,68,271.20	Box	Concrete	1.83	0.91
1777	0 (Polyline)-2167	MH-1135	MH-2329	3.59	3.92	2.88	2.07	41.15	2.34	0.011	4.38	9.61	2.06	21.5	78.3	1,72,130.50	Box	Concrete	1.83	0.91
686	0 (Polyline)-1286	MH-432	MH-431	4.61	4.59	3.9	3.88	18.7	1.25	0.011	0.83	0.3	0.16	53	65.2	8,171.20	Box	Concrete	0.61	0.61
3424	0 (Polyline)-1285	MH-431	MH-2060	4.59	4.49	3.88	3.78	50	1.3	0.011	1.2	0.43	0.25	58.8	70.4	12,993.20	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
4102	0 (Polyline)-1284	MH-2060	MH-1817	4.49	4.39	3.78	3.68	50	1.51	0.011	1.33	0.44	0.36	82.6	75.7	19,392.20	Box	Concrete	0.61	0.61
2934	0 (Polyline)-1283	MH-1817	MH-1816	4.39	4.24	3.68	3.53	50	1.55	0.011	1.62	0.53	0.47	87.9	73.8	25,659.50	Box	Concrete	0.61	0.61
3671	0 (Polyline)-1282	MH-1816	MH-2175	4.24	3.92	3.53	3.21	50	1.41	0.011	2.24	0.77	0.54	70.8	73.6	30,811.40	Box	Concrete	0.61	0.61
5743	0 (Polyline)-1281(2)	MH-2175	MH-1136	3.92	3.7	3.21	2.99	30.57	1.44	0.011	2.4	0.81	0.61	74.6	72	34,958.60	Box	Concrete	0.61	0.61
5742	0 (Polyline)-1281(1)	MH-1136	MH-2329	3.7	3.92	2.99	2.07	17.55	1.19	0.011	4.74	3.73	0.61	16.4	104.7	35,803.20	Box	Concrete	0.91	0.61
3325	0 (Polyline)-1287	MH-2017	MH-2005	4.33	4.09	3.62	3.38	50	0.83	0.011	1.17	0.66	0.08	11.8	31	3,970.70	Box	Concrete	0.61	0.61
3304	0 (Polyline)-1288	MH-2005	MH-619	4.09	3.93	3.38	3.22	50	1.12	0.011	1.36	0.54	0.21	39.5	49.4	11,159.70	Box	Concrete	0.61	0.61
972	0 (Polyline)-1289	MH-619	MH-620	3.93	4.08	3.22	3.21	27.82	1.77	0.011	0.74	0.36	0.29	79.6	54.7	15,621.90	Box	Concrete	0.91	0.61
2839	0 (Polyline)-1291	MH-1766	MH-1765	4.09	4	3.38	3.29	48.68	1.06	0.011	1.04	0.43	0.14	32.9	42	7,164.30	Box	Concrete	0.61	0.61
5739	0 (Polyline)-1290(2)	MH-1765	MH-620	4	4.08	3.29	3.21	45.83	1.39	0.011	1.1	0.67	0.24	36.1	49.2	12,745.30	Box	Concrete	0.91	0.61
5738	0 (Polyline)-1290(1)	MH-620	MH-1791	4.08	4.1	3.21	3.09	4.17	1.23	0.011	3.65	2.72	0.53	19.3	55.7	29,333.20	Box	Concrete	0.91	0.61
3744	0 (Polyline)-1292	MH-2212	MH-1996	4.43	4.11	3.72	3.4	50	0.75	0.011	1.08	0.77	0.05	6	20	2,333.60	Box	Concrete	0.61	0.61
3284	0 (Polyline)-1293	MH-1996	MH-1796	4.11	3.93	3.4	3.22	50	0.93	0.011	1.22	0.58	0.12	20.5	31.3	6,301.40	Box	Concrete	0.61	0.61
5736	0 (Polyline)-1294(1)	MH-1796	MH-1791	3.93	4.1	3.22	3.09	26.61	0.97	0.011	1.47	0.67	0.16	24.1	47.3	8,786.60	Box	Concrete	0.61	0.61
5737	0 (Polyline)-1294(2)	MH-1791	MH-1491	4.1	4.16	3.09	3.04	23.39	1.94	0.011	1.59	1.95	0.7	35.8	38.5	38,933.00	Box	Concrete	1.22	0.91
2353	0 (Polyline)-1295	MH-1491	MH-1492	4.16	3.5	3.04	2.49	50	1.66	0.011	2.84	4.32	0.77	17.8	50.9	43,588.90	Box	Concrete	1.22	0.91
2399	0 (Polyline)-1296	MH-1492	MH-1383	3.5	3.53	2.49	2.47	50	2.63	0.011	0.97	0.92	0.83	90.3	62.5	47,824.60	Box	Concrete	1.22	0.91
2178	0 (Polyline)-1297	MH-1383	MH-339	3.53	3.59	2.47	2.45	30.85	2.65	0.011	0.97	0.92	0.85	92	59.7	51,085.80	Box	Concrete	1.22	0.91
545	0 (Polyline)-1298	MH-339	MH-340	3.59	3.67	2.45	2.11	33.52	1.71	0.011	2.87	4.16	0.85	20.5	79.3	53,088.30	Box	Concrete	1.22	0.91
4393	0 (Polyline)-1305	MH-2495	MH-2493	4.4	4.29	3.69	3.58	50	1.46	0.011	1.37	0.46	0.36	77.6	63.3	18,098.80	Box	Concrete	0.61	0.61
4389	0 (Polyline)-1306	MH-2493	MH-2485	4.29	4.49	3.58	3.55	50	2.1	0.011	0.82	0.52	0.44	84.1	54.4	22,953.20	Box	Concrete	1.22	0.61
4369	0 (Polyline)-1307	MH-2485	MH-103	4.49	4.23	3.55	3.52	23.83	1.89	0.011	1.19	0.85	0.48	56.6	46.6	26,445.50	Box	Concrete	1.22	0.61
187	0 (Polyline)-1308	MH-103	MH-104	4.23	4.4	3.52	2.2	31.04	1.44	0.011	3.82	4.82	0.51	10.5	92.6	28,317.10	Box	Concrete	1.22	0.61
3875	0 (Polyline)-2171	MH-2274	MH-1047	4.21	4.03	3.5	3.32	50	0.96	0.011	1.28	0.58	0.14	23.5	68.6	6,955.30	Box	Concrete	0.61	0.61
1635	0 (Polyline)-2172	MH-1047	MH-588	4.03	4.24	3.32	3.3	50	1.63	0.011	0.7	0.36	0.23	63	84.5	11,961.60	Box	Concrete	0.91	0.61
924	0 (Polyline)-2173	MH-588	MH-589	4.24	4.39	3.3	3.28	26.75	1.69	0.011	0.72	0.36	0.25	69.9	86.5	14,098.10	Box	Concrete	0.91	0.61
5037	0 (Polyline)-1741	MH-2728	MH-2293	4.93	4.86	4.22	4.15	50	1.16	0.011	0.92	0.35	0.16	44	48.6	7,862.80	Box	Concrete	0.61	0.61
3916	0 (Polyline)-1742	MH-2293	MH-2294	4.86	4.41	4.15	3.7	50	1.08	0.011	2.24	0.92	0.32	34.8	54.3	16,907.40	Box	Concrete	0.61	0.61
5018	0 (Polyline)-1743	MH-2294	MH-1450	4.41	4.5	3.7	3.67	50	2.14	0.011	0.83	0.52	0.47	89.7	52	25,306.10	Box	Concrete	1.22	0.61
5570	0 (Polyline)-1744(1)	MH-1450	MH-589	4.5	4.39	3.67	3.28	43.85	1.6	0.011	2.37	2.21	0.55	24.9	66.1	31,275.40	Box	Concrete	1.22	0.61
5571	0 (Polyline)-1744(2)	MH-589	MH-1329	4.39	4.41	3.28	3.27	14.81	2.62	0.011	0.96	0.92	0.83	89.7	57.7	47,685.50	Box	Concrete	1.22	0.91
2092	0 (Polyline)-1745	MH-1329	MH-1330	4.41	4.4	3.27	3.25	41.35	2.64	0.011	0.97	0.92	0.84	91	53.5	49,098.20	Box	Concrete	1.22	0.91
4342	0 (Polyline)-1746	MH-1330	MH-1773	4.4	4.16	3.25	3.15	50	2.14	0.011	1.68	1.86	0.95	50.8	47.6	57,630.70	Box	Concrete	1.22	0.91
2854	0 (Polyline)-1747	MH-1773	MH-1580	4.16	3.8	3.15	2.79	50	1.83	0.011	2.69	3.52	1.01	28.6	46.2	63,118.40	Box	Concrete	1.22	0.91
2507	0 (Polyline)-1748	MH-1580	MH-1581	3.8	3.33	2.79	2.32	50	1.81	0.011	2.99	3.97	1.08	27.1	67.9	68,736.90	Box	Concrete	1.22	0.91
2512	0 (Polyline)-1749	MH-1581	MH-1583	3.33	3.76	2.32	2.3	50	2.96	0.011	1.05	1.22	1.15	94.4	89.1	74,691.20	Box	Concrete	1.52	0.91

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3422	0 (Polyline)-1750	MH-1583	MH-2059	3.76	4.01	2.3	2.27	50	3.06	0.011	1.04	1.53	1.17	76.5	90.3	79,030.60	Box	Concrete	1.83	0.91
4334	0 (Polyline)-1751	MH-2059	MH-1592	4.01	3.97	2.27	2.25	50	3.1	0.011	1.06	1.53	1.23	80.2	91.9	85,228.40	Box	Concrete	1.83	0.91
2527	0 (Polyline)-1752	MH-1592	MH-783	3.97	4.28	2.25	2.22	50	3.11	0.011	1.06	1.53	1.25	81.6	93.5	89,301.70	Box	Concrete	1.83	0.91
5732	0 (Polyline)-1753(1)	MH-783	MH-104	4.28	4.4	2.22	2.2	35.32	3.09	0.011	1.05	1.53	1.22	79.8	94.9	90,012.20	Box	Concrete	1.83	0.91
5733	0 (Polyline)-1753(2)	MH-104	MH-784	4.4	4.39	2.2	2.2	14.68	3.46	0.011	1.12	1.84	1.59	86.2	95.8	1,19,587.40	Box	Concrete	2.13	0.91
3839	0 (Polyline)-1754	MH-784	MH-1940	4.39	4.07	2.2	2.17	50	3.49	0.011	1.13	1.84	1.64	89	96.8	1,24,493.80	Box	Concrete	2.13	0.91
3175	0 (Polyline)-1755	MH-1940	MH-1941	4.07	3.8	2.17	2.15	50	3.5	0.011	1.13	1.84	1.65	89.8	98.3	1,29,428.40	Box	Concrete	2.13	0.91
3847	0 (Polyline)-1756	MH-1941	MH-2262	3.8	3.66	2.15	2.12	50	3.51	0.011	1.14	1.84	1.66	90.5	99.6	1,34,515.40	Box	Concrete	2.13	0.91
5734	0 (Polyline)-1757(1)	MH-2262	MH-340	3.66	3.67	2.12	2.11	23.92	3.51	0.011	0.86	1.84	1.67	91	100.2	1,37,938.60	Box	Concrete	2.13	0.91
5735	0 (Polyline)-1757(2)	MH-340	MH-2275	3.67	3.83	2.11	2.1	26.08	3.87	0.011	1.24	2.81	2.31	82.2	74.9	1,92,921.80	Box	Concrete	2.13	1.22
4263	0 (Polyline)-1758	MH-2275	MH-1667	3.83	3.64	2.1	2.08	31.57	3.87	0.011	1.25	2.81	2.31	82.3	75.1	1,95,197.20	Box	Concrete	2.13	1.22
5740	0 (Polyline)-1759(1)	MH-1667	MH-2329	3.64	3.92	2.08	2.07	20.9	3.87	0.011	1.24	2.81	2.3	81.9	75.2	1,96,747.20	Box	Concrete	2.13	1.22
5741	0 (Polyline)-1759(2)	MH-2329	MH-1668	3.92	4	2.07	2	51.04	4.23	0.011	2.15	5.46	4.71	86.2	75.7	4,05,521.60	Box	Concrete	2.44	1.22
4835	0 (Polyline)-1760	MH-1668	MH-2078	4	3.43	2	1.95	48.14	4.41	0.011	1.96	4.79	4.71	98.3	75.3	4,10,275.60	Box	Concrete	2.44	1.22
5730	0 (Polyline)-1761(1)	MH-2078	MH-672	3.43	3.86	1.95	1.9	29.01	4.08	0.011	2.35	6.17	4.7	76.1	75.6	4,14,485.40	Box	Concrete	2.44	1.22
5731	0 (Polyline)-1761(2)	MH-672	O-106	3.86	3.2	2	2	6.46	4.88	0.011	1.74	5.16	5.17	100.2	65.6	4,59,059.00	Box	Concrete	2.44	1.22
5016	0 (Polyline)-1841	MH-2721	MH-2103	4.35	4.07	3.64	3.36	50	0.84	0.011	1.32	0.73	0.09	13	39	4,766.20	Box	Concrete	0.61	0.61
3515	0 (Polyline)-1842	MH-2103	MH-2104	4.07	4.4	3.36	3.34	50	1.48	0.011	0.65	0.22	0.17	79.4	52.7	8,949.00	Box	Concrete	0.61	0.61
3924	0 (Polyline)-1843	MH-2104	MH-662	4.4	4.41	3.34	3.31	50	1.61	0.011	0.69	0.36	0.22	60.8	47.7	12,301.70	Box	Concrete	0.91	0.61
1038	0 (Polyline)-1844	MH-662	MH-48	4.41	4.1	3.31	3.3	29.66	1.67	0.011	0.71	0.36	0.24	67.2	40.7	14,533.80	Box	Concrete	0.91	0.61
3058	0 (Polyline)-719	MH-1880	MH-48	4.25	4.1	3.54	3.3	52.91	0.97	0.011	1.45	0.65	0.16	24.5	33.5	8,104.10	Box	Concrete	0.61	0.61
332	0 (Polyline)-721	MH-48	MH-199	4.1	4.01	3.3	2.55	8.37	1.36	0.011	4.39	7.01	0.39	5.5	79.6	23,943.70	Box	Concrete	1.22	0.61
4164	0 (Polyline)-1882	MH-2403	MH-2404	4.33	4.25	3.62	3.54	50	1	0.011	0.84	0.37	0.1	27.4	61.7	5,117.90	Box	Concrete	0.61	0.61
4611	0 (Polyline)-1883	MH-2404	MH-2210	4.25	4.21	3.54	3.5	50	1.58	0.011	0.9	0.29	0.27	91.6	61.3	14,247.20	Box	Concrete	0.61	0.61
3739	0 (Polyline)-1884	MH-2210	MH-1531	4.21	3.82	3.5	3.11	50	1.17	0.011	2.21	0.85	0.38	44.7	50.9	21,118.40	Box	Concrete	0.61	0.61
2422	0 (Polyline)-1885	MH-1531	MH-845	3.82	3.82	3.11	2.81	50	1.62	0.011	2.02	1.83	0.5	27.2	61.6	28,232.50	Box	Concrete	1.22	0.61
1316	0 (Polyline)-1886	MH-845	MH-846	3.82	4.16	2.81	2.57	36.56	1.64	0.011	2.11	3.32	0.54	16.2	68	31,169.40	Box	Concrete	1.22	0.91
3724	0 (Polyline)-1845	MH-2203	MH-366	3.63	3.54	2.92	2.83	35.57	1.03	0.011	1.13	0.48	0.15	30.3	75.9	7,365.70	Box	Concrete	0.61	0.61
586	0 (Polyline)-1846	MH-366	MH-367	3.54	3.37	2.83	2.66	29.82	1	0.011	1.65	0.73	0.19	26.6	96.1	10,075.90	Box	Concrete	0.61	0.61
3039	0 (Polyline)-1849	MH-1870	MH-367	3.83	3.37	3.12	2.66	49.97	0.76	0.011	1.34	0.93	0.06	6.6	71.5	3,095.90	Box	Concrete	0.61	0.61
2962	0 (Polyline)-1850	MH-367	MH-1831	3.37	3.61	2.66	2.6	50.03	1.74	0.011	0.43	0.8	0.32	39.9	113.5	16,788.30	Box	Concrete	1.22	0.61

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3279	0 (Polyline)-1851	MH-1831	MH-1617	3.61	3.95	2.6	2.57	50	2.02	0.011	0.79	0.92	0.38	41.5	79.9	22,276.50	Box	Concrete	1.22	0.91
5358	0 (Polyline)-1852(1)	MH-1617	MH-846	3.95	4.16	2.57	2.57	11.79	2.03	0.011	0.79	0.92	0.39	42.9	81.3	24,454.70	Box	Concrete	1.22	0.91
5359	0 (Polyline)-1852(2)	MH-846	MH-1321	4.16	4.26	2.57	2.56	26.93	2.72	0.011	0.98	1.22	0.9	73.8	82	56,415.70	Box	Concrete	1.52	0.91
5360	0 (Polyline)-1853(1)	MH-1321	MH-199	4.26	4.01	2.56	2.55	19.68	2.72	0.011	0.98	1.22	0.89	73.3	82.6	57,594.50	Box	Concrete	1.52	0.91
5361	0 (Polyline)-1853(2)	MH-199	MH-1322	4.01	4.1	2.55	2.52	41.6	3.11	0.011	1.06	1.53	1.24	81.3	83.3	82,048.10	Box	Concrete	1.83	0.91
3746	0 (Polyline)-1854	MH-1322	MH-2213	4.1	3.67	2.52	2.5	50	3.14	0.011	1.07	1.53	1.28	83.7	84.3	86,683.60	Box	Concrete	1.83	0.91
4420	0 (Polyline)-1855	MH-2213	MH-2506	3.67	3.84	2.5	2.47	50	3.2	0.011	1.09	1.53	1.36	88.8	85.4	94,646.70	Box	Concrete	1.83	0.91
4573	0 (Polyline)-1856	MH-2506	MH-790	3.84	3.49	2.47	2.45	50	3.37	0.011	1.09	1.84	1.44	78.1	86.6	1,02,982.40	Box	Concrete	2.13	0.91
10090	CO-460	MH-790	FO-102	3.49	3.23	2.47	2.46	13.35	3.52	0.011	1.21	2.25	1.43	63.7	33	1,05,934.20	Box	Concrete	0.91	2.13
4880	0 (Polyline)-2005	MH-2676	MH-2135	4.02	3.98	3.31	3.27	50	1.83	0.011	0.99	0.47	0.41	88.1	71.4	20,983.70	Box	Concrete	0.91	0.61
3584	0 (Polyline)-2006	MH-2135	MH-673	3.98	3.97	3.27	3.2	50	1.83	0.011	1.3	0.62	0.54	87.6	63.8	28,671.90	Box	Concrete	0.91	0.61
1055	0 (Polyline)-2007	MH-673	MH-674	3.97	3.68	3.2	2.5	29.94	1.27	0.011	3.56	2.49	0.58	23.4	70.4	31,786.00	Box	Concrete	0.91	0.61
3531	0 (Polyline)-1671	MH-2113	MH-2114	3.28	3.79	2.57	2.54	50	1.34	0.011	0.62	0.22	0.14	63.9	78.2	6,986.60	Box	Concrete	0.61	0.61
3648	0 (Polyline)-1672	MH-2114	MH-683	3.79	3.83	2.54	2.52	50	1.58	0.011	0.68	0.36	0.21	57.1	80.7	11,228.60	Box	Concrete	0.91	0.61
1070	0 (Polyline)-1673	MH-683	MH-684	3.83	3.73	2.52	2.5	30.38	1.63	0.011	0.7	0.36	0.23	62.7	82.8	13,138.70	Box	Concrete	0.91	0.61
5277	0 (Polyline)-740(1)	MH-684	MH-674	3.73	3.68	2.5	2.5	6.66	1.64	0.011	0.7	0.36	0.23	64.3	83.8	14,031.70	Box	Concrete	0.91	0.61
5278	0 (Polyline)-740(2)	MH-674	MH-811	3.68	3.6	2.5	2.48	43.34	2.55	0.011	0.95	0.92	0.77	83.6	54	46,663.90	Box	Concrete	1.22	0.91
1264	0 (Polyline)-741	MH-811	FO-101	3.6	3.5	2.48	2.46	33.1	2.57	0.011	0.95	0.92	0.78	85.2	44.9	49,751.40	Box	Concrete	1.22	0.91
2666	0 (Polyline)-800	MH-1670	MH-1671	3.24	3.05	2.53	2.34	50	0.82	0.011	1.02	0.6	0.06	10.7	54.1	3,244.40	Box	Concrete	0.61	0.61
2774	0 (Polyline)-801	MH-1671	MH-710	3.05	3.16	2.34	2.31	50	1.55	0.011	0.66	0.22	0.19	88.1	68.9	10,028.50	Box	Concrete	0.61	0.61
1111	0 (Polyline)-802	MH-710	MH-711	3.16	3.32	2.31	2.3	31.48	1.64	0.011	0.7	0.36	0.23	63.6	68.5	12,984.70	Box	Concrete	0.91	0.61
1921	0 (Polyline)-778	MH-1226	MH-1078	3.57	3.55	2.86	2.83	50	1.1	0.011	0.54	0.22	0.08	37.7	52.4	4,121.90	Box	Concrete	0.61	0.61
1684	0 (Polyline)-779	MH-1078	MH-1079	3.55	3.47	2.83	2.76	50	1.23	0.011	0.99	0.37	0.19	51	54.9	10,209.30	Box	Concrete	0.61	0.61
2350	0 (Polyline)-780	MH-1079	MH-1490	3.47	3.4	2.76	2.69	50	1.35	0.011	1.02	0.36	0.23	64.8	50.6	13,222.50	Box	Concrete	0.61	0.61
5386	0 (Polyline)-781(1)	MH-1490	MH-711	3.4	3.32	2.69	2.3	39.16	1.01	0.011	2.24	0.97	0.27	28.2	56.9	16,373.20	Box	Concrete	0.61	0.61
5387	0 (Polyline)-781(2)	MH-711	MH-2434	3.32	3.43	2.3	2.29	21.85	2.19	0.011	0.85	0.52	0.51	96.6	68.3	30,694.00	Box	Concrete	1.22	0.61
4807	0 (Polyline)-782	MH-2434	MH-2130	3.43	3.44	2.29	2.27	38.99	2.2	0.011	0.85	0.52	0.51	97.5	66.1	31,750.20	Box	Concrete	1.22	0.61
3570	0 (Polyline)-783	MH-2130	MH-2131	3.44	3.17	2.27	2.16	50	1.84	0.011	1.49	1.94	0.56	28.8	48.4	36,436.00	Box	Concrete	1.22	0.91
4033	0 (Polyline)-784	MH-2131	MH-2242	3.17	3.1	2.16	2.09	50	2.07	0.011	1.33	1.51	0.69	45.3	55.4	45,988.70	Box	Concrete	1.22	0.91
3806	0 (Polyline)-785	MH-2242	MH-2243	3.1	3.42	2.09	2.06	50	2.67	0.011	0.97	0.92	0.86	93.1	51.1	58,803.90	Box	Concrete	1.22	0.91
4609	0 (Polyline)-786	MH-2243	MH-737	3.42	2.7	2.06	1.69	50	1.83	0.011	2.7	3.55	1	28.2	50.9	70,735.80	Box	Concrete	1.22	0.91
1152	0 (Polyline)-787	MH-737	MH-738	2.7	2.77	1.69	1.67	37.58	2.92	0.011	1.04	1.22	1.1	90.4	53.6	78,772.30	Box	Concrete	1.52	0.91
805	0 (Polyline)-896	MH-510	MH-509	4.23	4.34	3.52	3.51	21.86	1.55	0.011	0.66	0.22	0.19	87.8	51.4	9,603.10	Box	Concrete	0.61	0.61
4977	0 (Polyline)-895	MH-509	MH-2584	4.34	3.57	3.51	2.86	50	1.01	0.011	2.54	1.1	0.31	28.3	49.6	16,181.60	Box	Concrete	0.61	0.61
4605	0 (Polyline)-805	MH-2584	MH-2238	3.57	3.62	2.86	2.83	50	1.98	0.011	0.77	0.52	0.36	69	44.6	19,086.70	Box	Concrete	1.22	0.61
3797	0 (Polyline)-806	MH-2238	MH-23	3.62	3.02	2.83	2.31	40.98	1.51	0.011	2.47	2.65	0.44	16.6	41.3	24,590.90	Box	Concrete	1.22	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
67	0 (Polyline)-807	MH-23	MH-24	3.02	3.02	2.31	2.01	10.3	1.47	0.011	3.41	3.94	0.53	13.4	45.9	29,847.80	Box	Concrete	1.22	0.61
5066	0 (Polyline)-2233	MH-24	MH-300	3.02	3	2.01	1.7	42.7	1.65	0.011	2.29	3.52	0.6	17.2	40.2	34,379.20	Box	Concrete	1.22	0.91
5384	0 (Polyline)-2234(1)	MH-300	MH-738	3	2.77	1.7	1.67	15.83	1.95	0.011	1.49	1.81	0.66	36.7	49.3	38,361.80	Box	Concrete	1.22	0.91
5385	0 (Polyline)-2234(2)	MH-738	FO-100	2.77	2.68	1.67	1.67	9.09	3.49	0.011	1.13	1.84	1.65	89.5	46.8	1,20,643.40	Box	Concrete	2.13	0.91
2012	0 (Polyline)-994	MH-1282	MH-1283	3.54	3.49	2.83	2.78	50	1.31	0.011	0.9	0.32	0.19	60.4	58.3	9,798.50	Box	Concrete	0.61	0.61
3590	0 (Polyline)-995	MH-1283	MH-1905	3.49	3.59	2.78	2.75	50	1.73	0.011	0.73	0.36	0.27	75.7	56.9	14,568.10	Box	Concrete	0.91	0.61
3104	0 (Polyline)-996	MH-1905	MH-1906	3.59	3.68	2.75	2.73	50	1.98	0.011	0.77	0.52	0.36	68.3	54	20,074.40	Box	Concrete	1.22	0.61
4343	0 (Polyline)-997	MH-1906	MH-239	3.68	3.56	2.73	2.7	40.39	2.05	0.011	0.8	0.52	0.41	78	45.7	24,287.90	Box	Concrete	1.22	0.61
394	0 (Polyline)-998	MH-239	MH-240	3.56	3.46	2.7	2.06	24.67	1.45	0.011	3.1	3.77	0.44	11.7	81.4	27,522.90	Box	Concrete	1.22	0.61
10038	CO-447	MH-3121	MH-1776	4	3.7	2.8	2.79	41.43	1.21	0.011	0.4	0.15	0.07	49.1	61.8	3,733.00	Box	Concrete	0.61	0.61
3577	0 (Polyline)-1718	MH-1776	MH-1793	3.7	3.38	2.79	2.76	50	1.44	0.011	0.7	0.24	0.18	75.3	61.2	9,830.60	Box	Concrete	0.61	0.61
2892	0 (Polyline)-1719	MH-1793	MH-1365	3.38	2.7	2.76	2.69	50	1.41	0.011	1.06	0.36	0.26	71.2	51.6	15,126.50	Box	Concrete	0.61	0.61
10044	CO-448	MH-1365	MH-3122	2.7	3.01	2.69	2.58	87.87	1.76	0.011	1.17	0.57	0.45	79.1	70.3	27,957.80	Box	Concrete	0.91	0.61
10045	CO-449	MH-3122	MH-3123	3.01	3.5	2.58	2.5	47.63	1.63	0.011	1.28	0.67	0.42	63.4	103.4	27,957.80	Box	Concrete	0.91	0.61
10046	CO-450	MH-3123	MH-3125	3.5	3.57	2.55	2.51	26.08	1.65	0.011	1.23	0.64	0.41	64.8	101.1	27,957.80	Box	Concrete	0.91	0.61
10047	CO-451	MH-3125	MH-2357	3.57	3.91	2.51	2.49	7.08	1.54	0.011	1.09	0.47	0.41	86.8	103.5	27,957.80	Box	Concrete	0.61	0.61
4011	0 (Polyline)-2168	MH-2333	MH-2334	4.23	3.73	3.52	3.02	50	0.81	0.011	1.62	0.96	0.1	10.2	38.8	4,968.70	Box	Concrete	0.61	0.61
4701	0 (Polyline)-2169	MH-2334	MH-302	3.73	3.82	3.02	2.99	50	1.53	0.011	0.66	0.22	0.19	85.8	44.8	9,621.70	Box	Concrete	0.61	0.61
489	0 (Polyline)-2170	MH-302	MH-303	3.82	3.74	2.99	2.72	12.92	1.1	0.011	2.43	2.35	0.21	9.1	51.6	11,835.00	Box	Concrete	0.91	0.61
1642	0 (Polyline)-983	MH-1051	MH-913	3.56	3.91	2.85	2.82	50	2.07	0.011	0.81	0.52	0.42	79.9	79.1	21,181.10	Box	Concrete	1.22	0.61
1424	0 (Polyline)-984	MH-913	MH-914	3.91	3.83	2.82	2.8	50	2.16	0.011	0.84	0.52	0.48	92.3	79.9	25,720.40	Box	Concrete	1.22	0.61
1726	0 (Polyline)-985	MH-914	MH-1104	3.83	3.86	2.8	2.77	50	2.22	0.011	0.86	0.92	0.52	56.8	53.6	29,302.40	Box	Concrete	1.22	0.91
2871	0 (Polyline)-986	MH-1104	MH-1188	3.86	3.9	2.77	2.75	50	2.34	0.011	0.89	0.92	0.61	66.1	52.6	35,947.80	Box	Concrete	1.22	0.91
5572	0 (Polyline)-987(1)	MH-1188	MH-303	3.9	3.74	2.75	2.72	41	2.33	0.011	0.89	0.92	0.61	65.9	50.6	37,784.00	Box	Concrete	1.22	0.91
5573	0 (Polyline)-987(2)	MH-303	MH-1189	3.74	3.65	2.72	2.64	9	1.7	0.011	2.65	3.89	0.77	19.9	55.3	50,368.40	Box	Concrete	1.22	0.91
4530	0 (Polyline)-988	MH-1189	MH-1218	3.65	3.77	2.64	2.62	50	2.6	0.011	0.96	0.92	0.8	87.3	59.3	52,593.20	Box	Concrete	1.22	0.91
1908	0 (Polyline)-989	MH-1218	MH-1219	3.77	3.51	2.62	2.5	46.42	2.01	0.011	1.81	2.12	0.87	41.2	63.6	59,282.10	Box	Concrete	1.22	0.91
5568	0 (Polyline)-990(1)	MH-1219	MH-2357	3.51	3.91	2.5	2.49	6.16	2.69	0.011	0.97	1.22	0.87	71.3	69.6	59,998.80	Box	Concrete	1.52	0.91
753	0 (Polyline)-980	MH-476	MH-475	3.61	3.73	2.9	2.89	20.34	1.07	0.011	0.53	0.22	0.07	34.3	55.5	3,749.90	Box	Concrete	0.61	0.61
4587	0 (Polyline)-979	MH-475	MH-1453	3.73	3.73	2.89	2.87	50	1.3	0.011	0.6	0.22	0.13	58.3	56	6,581.30	Box	Concrete	0.61	0.61
2290	0 (Polyline)-978	MH-1453	MH-1452	3.73	3.9	2.87	2.84	50	1.54	0.011	0.66	0.22	0.19	86	50.2	10,413.10	Box	Concrete	0.61	0.61

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4062	0 (Polyline)-977	MH-1452	MH-2357	3.9	3.91	2.84	2.49	50.03	1.17	0.011	1.67	1.36	0.2	14.7	74.1	11,998.80	Box	Concrete	0.91	0.61
5569	0 (Polyline)-990(2)	MH-2357	MH-1687	3.91	3.97	2.49	2.45	50.88	2.98	0.011	1.37	1.59	1.53	96.3	66.7	1,05,852.30	Box	Concrete	1.52	0.91
3442	0 (Polyline)-991	MH-1687	MH-1761	3.97	3.64	2.47	2.44	46.82	3.32	0.011	1.16	1.58	1.58	99.7	54.4	1,11,771.30	Box	Concrete	1.83	0.91
2832	0 (Polyline)-992	MH-1761	MH-58	3.64	3.43	2.44	2.11	53.41	2.47	0.011	2.75	5.42	1.6	29.6	65.3	1,16,487.00	Box	Concrete	1.83	0.91
1711	0 (Polyline)-981	MH-1095	MH-70	3.67	3.44	2.96	2.12	53.67	0.84	0.011	2.15	1.2	0.15	12.4	76.5	7,557.10	Box	Concrete	0.61	0.61
726	0 (Polyline)-914	MH-457	MH-458	3.24	3.27	2.53	2.48	19.95	0.73	0.011	0.63	0.48	0.02	4.9	65.5	1,187.20	Box	Concrete	0.61	0.61
2633	0 (Polyline)-918	MH-1652	MH-1651	4.16	3.75	3.45	3.04	47.47	0.7	0.011	0.96	0.89	0.03	2.9	18.3	1,326.50	Box	Concrete	0.61	0.61
3388	0 (Polyline)-917	MH-1651	MH-1386	3.75	3.67	3.04	2.96	50	0.94	0.011	0.83	0.39	0.08	21.4	27.7	4,418.10	Box	Concrete	0.61	0.61
2184	0 (Polyline)-916	MH-1386	MH-1382	3.67	3.21	2.96	2.5	50	0.86	0.011	1.75	0.93	0.14	14.7	49.6	7,558.30	Box	Concrete	0.61	0.61
5563	0 (Polyline)-915(2)	MH-1382	MH-458	3.21	3.27	2.5	2.48	43.31	1.57	0.011	0.66	0.22	0.19	90.3	70.2	11,083.40	Box	Concrete	0.61	0.61
5562	0 (Polyline)-915(1)	MH-458	MH-1381	3.27	3.35	2.48	2.18	6.69	1.06	0.011	3.08	3.43	0.21	6.1	94.6	12,671.60	Box	Concrete	0.91	0.61
181	0 (Polyline)-976	MH-100	MH-99	4.2	4.08	3.49	3.37	17.35	0.74	0.011	1.09	0.8	0.04	5.6	16.8	2,259.90	Box	Concrete	0.61	0.61
3411	0 (Polyline)-975	MH-99	MH-2003	4.08	3.52	3.37	2.81	37.44	0.77	0.011	1.74	1.18	0.08	7	28	4,240.20	Box	Concrete	0.61	0.61
3299	0 (Polyline)-974	MH-2003	MH-1261	3.52	3.45	2.81	2.74	50	1.06	0.011	0.91	0.38	0.12	32.7	33.1	6,493.10	Box	Concrete	0.61	0.61
1977	0 (Polyline)-973	MH-1261	MH-1260	3.45	2.9	2.74	2.19	50	0.87	0.011	1.92	1.01	0.15	15	73.3	8,284.30	Box	Concrete	0.61	0.61
5561	0 (Polyline)-972(2)	MH-1260	MH-1381	2.9	3.35	2.19	2.18	29.49	1.46	0.011	0.45	0.22	0.17	77.2	119.1	9,319.80	Box	Concrete	0.61	0.61
5560	0 (Polyline)-972(1)	MH-1381	MH-1916	3.35	3.16	2.18	2.17	20.51	2.02	0.011	0.51	0.52	0.38	73.1	120	23,124.20	Box	Concrete	1.22	0.61
3126	0 (Polyline)-971	MH-1916	MH-1274	3.16	3.37	2.17	2.14	50	2.05	0.011	0.55	0.52	0.41	78	121.1	25,642.60	Box	Concrete	1.22	0.61
5565	0 (Polyline)-970(2)	MH-1274	MH-70	3.37	3.44	2.14	2.12	38.92	2.07	0.011	0.56	0.52	0.42	79.9	122.5	28,392.60	Box	Concrete	1.22	0.61
5567	0 (Polyline)-969(2)	MH-70	MH-58	3.44	3.43	2.12	2.11	27.35	2.24	0.011	0.87	0.92	0.54	58.5	83	38,193.40	Box	Concrete	1.22	0.91
5566	0 (Polyline)-969(1)	MH-58	MH-1000	3.43	3.45	2.11	2.08	35.12	3.49	0.011	1.47	2.38	2.13	89.2	84.1	1,56,590.00	Box	Concrete	2.13	0.91
2870	0 (Polyline)-968	MH-1000	MH-1410	3.45	3.44	2.09	2.07	33.44	3.6	0.011	1.36	2.14	2.13	99.7	83.5	1,59,488.20	Box	Concrete	2.13	0.91
5628	0 (Polyline)-967(2)	MH-1410	MH-240	3.44	3.46	2.08	2.05	22.54	3.36	0.011	1.62	2.75	2.13	77.4	83.8	1,61,835.10	Box	Concrete	2.13	0.91
5627	0 (Polyline)-967(1)	MH-240	MH-1409	3.46	3.57	2.06	2.04	38.71	3.97	0.011	1.27	2.81	2.48	88.3	61.1	1,90,340.10	Box	Concrete	2.13	1.22
4039	0 (Polyline)-966	MH-1409	MH-1355	3.57	3.78	2.04	2.02	43.72	3.97	0.011	1.27	2.81	2.49	88.6	58.7	1,95,038.50	Box	Concrete	2.13	1.22
2132	0 (Polyline)-965	MH-1355	O-85	3.78	3.54	2.02	1.99	57.39	4.01	0.011	1.28	2.81	2.56	91	50.3	2,05,320.00	Box	Concrete	2.13	1.22
3919	0 (Polyline)-2113	MH-2295	MH-111	3.31	3.17	2.6	2.46	35.84	0.94	0.011	1.24	0.59	0.12	21.2	28.3	6,311.50	Box	Concrete	0.61	0.61
199	0 (Polyline)-2114	MH-111	MH-112	3.17	3.41	2.46	1.57	19.36	0.77	0.011	3.07	2.07	0.15	7.1	60.1	7,595.00	Box	Concrete	0.61	0.61
3446	0 (Polyline)-933	MH-2071	MH-537	3.62	3.4	2.91	2.69	50	1.06	0.011	1.53	0.64	0.21	32.8	37.1	10,587.50	Box	Concrete	0.61	0.61
847	0 (Polyline)-934	MH-537	MH-538	3.4	3.47	2.69	2.03	25.08	1.11	0.011	2.77	2.64	0.25	9.4	65.2	12,912.70	Box	Concrete	0.91	0.61
3756	0 (Polyline)-935	MH-2217	MH-2218	3.47	2.84	2.76	2.13	50	0.92	0.011	2.23	1.09	0.21	19.2	62.7	10,551.20	Box	Concrete	0.61	0.61
4942	0 (Polyline)-936	MH-2218	MH-1168	2.84	3.62	2.13	2.1	50	1.96	0.011	0.77	0.52	0.35	66.5	89.4	17,933.10	Box	Concrete	1.22	0.61
1829	0 (Polyline)-937	MH-1168	MH-1140	3.62	3.5	2.1	2.08	50	2.06	0.011	0.8	0.52	0.41	78.9	92	22,473.90	Box	Concrete	1.22	0.61
1785	0 (Polyline)-938	MH-1140	MH-1141	3.5	3.44	2.08	2.05	50	2.1	0.011	0.82	0.52	0.44	83.8	94.3	25,184.70	Box	Concrete	1.22	0.61
3261	0 (Polyline)-939	MH-1141	MH-538	3.44	3.47	2.05	2.03	55.29	2.1	0.011	0.82	0.52	0.44	83.7	96.8	26,633.70	Box	Concrete	1.22	0.61
5495	0 (Polyline)-940(2)	MH-538	MH-1926	3.47	3.46	2.03	2	44.71	2.35	0.011	0.9	0.92	0.62	66.8	66	39,996.90	Box	Concrete	1.22	0.91

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m^3/s)	System Rational Flow (m^3/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m^2)	Section Type	Material	Span (m)	Rise (m)
4416	0 (Polyline)-941	MH-1926	MH-2222	3.46	3.31	2	1.98	50	2.35	0.011	0.9	0.92	0.62	67	66.5	41,679.40	Box	Concrete	1.22	0.91
3764	0 (Polyline)-942	MH-2222	MH-1859	3.31	3.43	1.98	1.95	50	2.39	0.011	0.91	0.92	0.65	70.7	67	45,509.60	Box	Concrete	1.22	0.91
3019	0 (Polyline)-943	MH-1859	MH-319	3.43	3.32	1.95	1.93	50	2.39	0.011	0.91	0.92	0.65	70.5	67.3	46,999.80	Box	Concrete	1.22	0.91
515	0 (Polyline)-944	MH-319	MH-320	3.32	3.31	1.93	1.92	13.36	2.38	0.011	0.91	0.92	0.64	69.8	67.5	48,246.90	Box	Concrete	1.22	0.91
10024	0 (Polyline)-899(2)(1)	MH-3117	MH-549	3.59	3.63	2.35	2.33	29.12	0.76	0.011	0.33	0.23	0.01	6.4	34.2	742.9	Box	Concrete	0.61	0.61
865	0 (Polyline)-900	MH-549	MH-550	3.63	3.07	2.36	2.35	25.9	0.91	0.011	0.44	0.22	0.04	18.2	31.2	2,144.90	Box	Concrete	0.61	0.61
10022	CO-442	MH-550	MH-372	3.07	2.86	2.36	2.15	15.96	0.74	0.011	1.55	1.06	0.07	6.2	48.4	3,779.10	Box	Concrete	0.6	0.6
595	0 (Polyline)-901	MH-372	MH-373	2.86	3.14	2.15	2.15	15.68	1.1	0.011	0.54	0.22	0.08	37.1	66	4,639.10	Box	Concrete	0.61	0.61
2616	0 (Polyline)-902	MH-1642	MH-1304	3.42	2.97	2.71	2.26	50	0.97	0.011	2	0.91	0.22	24	43.6	11,060.40	Box	Concrete	0.61	0.61
5502	0 (Polyline)-903(1)	MH-1304	MH-373	2.97	3.14	2.26	2.15	38.09	1.36	0.011	1.42	0.9	0.29	32.1	57.5	14,915.10	Box	Concrete	0.91	0.61
5503	0 (Polyline)-903(2)	MH-373	MH-1305	3.14	3.46	2.15	2.14	19.45	1.88	0.011	0.77	0.36	0.34	94.4	65.8	20,399.50	Box	Concrete	0.91	0.61
3657	0 (Polyline)-904	MH-1305	MH-2170	3.46	3.18	2.14	2.12	42.47	2	0.011	0.78	0.52	0.37	71.5	65.2	22,802.90	Box	Concrete	1.22	0.61
3830	0 (Polyline)-905	MH-2170	MH-1220	3.18	3.2	2.12	2.09	50	2.1	0.011	0.82	0.52	0.44	83.9	64.2	28,217.20	Box	Concrete	1.22	0.61
1911	0 (Polyline)-906	MH-1220	MH-1221	3.2	3.26	2.09	2.07	41.67	2.13	0.011	0.85	0.54	0.48	88.6	61.3	32,227.90	Box	Concrete	1.22	0.61
2232	0 (Polyline)-931	MH-1417	MH-639	3.29	3.3	2.58	2.55	50	1.33	0.011	0.61	0.22	0.13	61.9	38.8	6,767.80	Box	Concrete	0.61	0.61
1003	0 (Polyline)-932	MH-639	MH-640	3.3	3.27	2.55	2.11	29.76	0.86	0.011	2.2	1.18	0.17	14.4	55.8	9,162.50	Box	Concrete	0.61	0.61
3371	0 (Polyline)-907	MH-2037	MH-1703	3.07	3.41	2.36	2.33	50	1.6	0.011	0.68	0.36	0.21	58.8	62.5	10,815.10	Box	Concrete	0.91	0.61
2723	0 (Polyline)-908	MH-1703	MH-1387	3.41	2.93	2.33	2.22	50	1.41	0.011	1.29	0.78	0.29	37.4	71.6	15,674.70	Box	Concrete	0.91	0.61
2186	0 (Polyline)-909	MH-1387	MH-644	2.93	3.42	2.22	2.19	50	1.88	0.011	0.77	0.36	0.34	94.1	80.1	18,997.00	Box	Concrete	0.91	0.61
1011	0 (Polyline)-910	MH-644	MH-645	3.42	3.48	2.19	2.18	28.93	2	0.011	0.78	0.52	0.37	71.6	80.7	22,058.50	Box	Concrete	1.22	0.61
3118	0 (Polyline)-919	MH-1912	MH-807	3.54	3.7	2.83	2.81	50	1.08	0.011	0.53	0.22	0.08	35.1	49.9	3,838.80	Box	Concrete	0.61	0.61
1258	0 (Polyline)-920	MH-807	MH-808	3.7	3.55	2.81	2.78	50	1.45	0.011	0.64	0.22	0.16	76.2	42.5	9,008.30	Box	Concrete	0.61	0.61
5492	0 (Polyline)-921(1)	MH-808	MH-645	3.55	3.48	2.78	2.18	38.2	0.87	0.011	2.3	1.21	0.18	14.8	57.6	10,575.60	Box	Concrete	0.61	0.61
5493	0 (Polyline)-921(2)	MH-645	MH-1680	3.48	3.24	2.18	2.16	30.18	2.25	0.011	0.87	0.92	0.55	59.4	54.4	33,348.00	Box	Concrete	1.22	0.91
4547	0 (Polyline)-922	MH-1680	MH-2508	3.24	3.34	2.16	2.15	31.62	2.25	0.011	0.87	0.92	0.55	59.3	54.1	34,420.60	Box	Concrete	1.22	0.91
4424	0 (Polyline)-923	MH-2508	MH-2233	3.34	3.25	2.15	2.12	50	2.26	0.011	0.87	0.92	0.56	60.3	53.7	36,340.30	Box	Concrete	1.22	0.91
5498	0 (Polyline)-924(1)	MH-2233	MH-640	3.25	3.27	2.12	2.11	22.34	2.25	0.011	0.87	0.92	0.55	59.6	53.2	37,383.10	Box	Concrete	1.22	0.91
5499	0 (Polyline)-924(2)	MH-640	MH-1860	3.27	3.81	2.11	2.1	27.67	2.44	0.011	0.92	0.92	0.69	74.6	51.9	47,522.80	Box	Concrete	1.22	0.91
3021	0 (Polyline)-925	MH-1860	MH-1221	3.81	3.26	2.1	2.07	54.44	2.45	0.011	0.92	0.92	0.69	75.4	45.3	48,946.30	Box	Concrete	1.22	0.91
598	0 (Polyline)-913	MH-375	MH-374	3.13	2.99	2.42	2.28	18.41	0.72	0.011	1.04	0.85	0.04	4.1	24.2	1,777.20	Box	Concrete	0.61	0.61
2039	0 (Polyline)-912	MH-374	MH-1299	2.99	3.15	2.28	2.25	50	1.13	0.011	0.55	0.22	0.09	40.1	35.4	4,453.20	Box	Concrete	0.61	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
4364	0 (Polyline)-911	MH-1299	MH-1221	3.15	3.26	2.25	2.07	50	1.02	0.011	1.36	0.59	0.17	28.9	46.6	9,383.20	Box	Concrete	0.61	0.61
5501	0 (Polyline)-926(1)(2)	MH-1221	MH-320	3.26	3.31	2.07	1.92	4.95	2.16	0.011	4.19	11.79	1.25	10.6	53.7	91,428.60	Box	Concrete	1.83	0.91
5497	0 (Polyline)-926(2)	MH-320	MH-1465	3.31	3.32	1.92	1.9	40.61	3.55	0.011	1.18	2.32	1.85	79.9	44.6	1,40,484.00	Box	Concrete	1.83	1.22
3565	0 (Polyline)-927	MH-1465	MH-2128	3.32	2.95	1.9	1.63	50	2.57	0.011	2.75	7.66	1.86	24.3	48.5	1,44,351.50	Box	Concrete	1.83	1.22
3600	0 (Polyline)-928	MH-2128	MH-2143	2.95	3.26	1.63	1.6	50	3.6	0.011	1.19	2.32	1.93	83.2	56.8	1,51,743.80	Box	Concrete	1.83	1.22
4746	0 (Polyline)-929	MH-2143	MH-496	3.26	3.16	1.6	1.58	50	3.62	0.011	1.2	2.32	1.97	84.7	52.5	1,58,960.90	Box	Concrete	1.83	1.22
5574	0 (Polyline)-930(1)	MH-496	MH-112	3.16	3.41	1.58	1.57	17.96	3.62	0.011	1.2	2.32	1.97	84.6	47.5	1,61,902.40	Box	Concrete	1.83	1.22
5575	0 (Polyline)-930(2)	MH-112	O-84	3.41	3.41	1.57	1.57	3.14	3.69	0.011	1.21	2.32	2.06	88.8	43.4	1,71,156.10	Box	Concrete	1.83	1.22
2450	0 (Polyline)-961	MH-1548	MH-1549	3.68	3.85	2.97	2.94	46.28	0.95	0.011	0.46	0.22	0.05	21.8	49.7	2,387.70	Box	Concrete	0.61	0.61
4740	0 (Polyline)-954	MH-2631	MH-2111	3.83	3.89	3.12	3.09	50	1.45	0.011	0.64	0.22	0.16	75.5	41.3	8,258.20	Box	Concrete	0.61	0.61
5578	0 (Polyline)-955(1)	MH-2111	MH-1549	3.89	3.85	3.09	2.94	30.01	0.95	0.011	1.47	0.68	0.15	22.5	40.9	8,258.20	Box	Concrete	0.61	0.61
5579	0 (Polyline)-955(2)	MH-1549	MH-2112	3.85	3.72	2.94	2.93	24.08	1.65	0.011	0.7	0.36	0.24	64.9	50.5	12,967.20	Box	Concrete	0.91	0.61
3741	0 (Polyline)-956	MH-2112	MH-1100	3.72	3.82	2.93	2.91	45.91	1.7	0.011	0.72	0.36	0.26	71	41.3	14,626.10	Box	Concrete	0.91	0.61
1719	0 (Polyline)-957	MH-1100	MH-36	3.82	3.27	2.91	2.56	44.01	1.21	0.011	1.88	1.45	0.25	17.6	39.3	15,262.40	Box	Concrete	0.91	0.61
1665	0 (Polyline)-962	MH-1066	MH-1067	3.44	3.68	2.73	2.71	50	1.35	0.011	0.62	0.22	0.14	64.3	41.6	7,030.60	Box	Concrete	0.61	0.61
3137	0 (Polyline)-963	MH-1067	MH-36	3.68	3.27	2.71	2.56	52.33	1.06	0.011	1.24	0.52	0.17	32.7	41.2	9,165.50	Box	Concrete	0.61	0.61
4310	0 (Polyline)-958	MH-36	MH-1879	3.27	3.06	2.56	2.35	50	1.43	0.011	1.79	1.06	0.42	39.8	46.9	25,949.20	Box	Concrete	0.91	0.61
3056	0 (Polyline)-959	MH-1879	MH-106	3.06	2.99	2.35	1.98	55.01	1.37	0.011	2.13	1.33	0.45	33.9	54	28,399.40	Box	Concrete	0.91	0.61
4454	0 (Polyline)-945	MH-2521	MH-492	3.77	3.26	3.06	2.55	50	0.77	0.011	1.45	0.97	0.07	7.4	21.2	3,627.10	Box	Concrete	0.61	0.61
779	0 (Polyline)-946	MH-492	MH-493	3.26	3.36	2.55	2.29	20.97	0.81	0.011	1.79	1.08	0.11	9.9	34.5	5,554.60	Box	Concrete	0.61	0.61
2968	0 (Polyline)-947	MH-1833	MH-1834	3.25	3.82	2.54	2.51	50	1.65	0.011	0.71	0.36	0.24	65.7	59.1	12,093.70	Box	Concrete	0.91	0.61
3793	0 (Polyline)-948	MH-1834	MH-1896	3.82	3.79	2.51	2.49	50	1.68	0.011	0.71	0.36	0.25	69	58.2	13,441.30	Box	Concrete	0.91	0.61
3088	0 (Polyline)-949	MH-1896	MH-832	3.79	3.62	2.49	2.46	50	1.74	0.011	0.74	0.36	0.28	76.8	55.6	15,909.80	Box	Concrete	0.91	0.61
1296	0 (Polyline)-950	MH-832	MH-833	3.62	3.2	2.46	2.44	50	1.75	0.011	0.74	0.36	0.28	78.1	47.5	17,215.70	Box	Concrete	0.91	0.61
4495	0 (Polyline)-951	MH-833	MH-2301	3.2	3.02	2.44	2.31	50	1.4	0.011	1.35	0.82	0.3	36.6	48	19,463.80	Box	Concrete	0.91	0.61
5576	0 (Polyline)-952(1)	MH-2301	MH-493	3.02	3.36	2.31	2.29	31.43	1.83	0.011	0.76	0.36	0.32	87.2	49.8	21,212.60	Box	Concrete	0.91	0.61
5577	0 (Polyline)-952(2)	MH-493	MH-106	3.36	2.99	2.29	1.98	19.08	1.23	0.011	2.82	2.08	0.41	19.7	52.7	28,264.20	Box	Concrete	0.91	0.61
797	0 (Polyline)-953	MH-106	O-83	2.99	3.33	1.98	1.57	20.94	1.61	0.011	3.56	5.76	0.85	14.7	42.1	58,616.10	Box	Concrete	1.22	0.91
3130	0 (Polyline)-1618	MH-1919	MH-1918	4.57	4.32	3.86	3.61	49.29	0.77	0.011	1.04	0.7	0.05	7	32	2,499.30	Box	Concrete	0.61	0.61
3461	0 (Polyline)-1617	MH-1918	MH-1433	4.32	4.41	3.61	3.58	50	1.41	0.011	0.6	0.36	0.14	37.3	50.6	7,134.50	Box	Concrete	0.91	0.61
2257	0 (Polyline)-1616	MH-1433	MH-1432	4.41	4.37	3.58	3.56	50	1.66	0.011	0.71	0.36	0.24	67.1	49.2	13,768.80	Box	Concrete	0.91	0.61
4468	0 (Polyline)-1615	MH-1432	MH-2449	4.37	4.27	3.56	3.53	50	1.86	0.011	0.72	0.52	0.28	53	45.4	16,709.10	Box	Concrete	1.22	0.61
4281	0 (Polyline)-1614	MH-2449	MH-2110	4.27	4.43	3.53	3.42	50	1.67	0.011	1.28	1.09	0.35	32.1	51.5	22,643.30	Box	Concrete	1.22	0.61
3526	0 (Polyline)-1613	MH-2110	MH-1970	4.43	4.46	3.42	3.36	50	1.85	0.011	1.1	1.42	0.42	29.9	41.2	28,336.60	Box	Concrete	1.22	0.91
3228	0 (Polyline)-1612	MH-1970	MH-1437	4.46	4.41	3.36	3.34	50	2.17	0.011	0.84	0.92	0.49	52.7	41	33,350.90	Box	Concrete	1.22	0.91
2263	0 (Polyline)-1611	MH-1437	MH-1436	4.41	4.24	3.34	3.23	50	1.91	0.011	1.52	1.88	0.64	34	41.5	45,582.60	Box	Concrete	1.22	0.91

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2876	0 (Polyline)-1610	MH-1436	O-66	4.24	4.05	3.23	3.08	50	2.02	0.011	1.91	2.23	0.93	41.7	43.4	67,851.30	Box	Concrete	1.22	0.91
4106	0 (Polyline)-393	MH-2374	MH-533	2.28	2.58	1.57	1.55	50	1.06	0.011	0.52	0.22	0.07	33.4	53	3,651.00	Box	Concrete	0.61	0.61
841	0 (Polyline)-394	MH-533	MH-534	2.58	2.79	1.55	1.54	23.7	1.22	0.011	0.58	0.22	0.11	49.8	54.6	5,889.60	Box	Concrete	0.61	0.61
4719	0 (Polyline)-1924	MH-2625	MH-2626	2.63	2.99	1.92	1.89	50	1.19	0.011	0.57	0.22	0.1	47	33	5,137.00	Box	Concrete	0.61	0.61
5532	0 (Polyline)-1925(1)	MH-2626	MH-534	2.99	2.79	1.89	1.54	32.75	1.14	0.011	1.93	1.7	0.2	11.9	41.4	10,954.10	Box	Concrete	0.91	0.61
5533	0 (Polyline)-1925(2)	MH-534	MH-2305	2.79	2.89	1.54	1.53	17.25	1.97	0.011	0.77	0.52	0.35	66.6	54.5	19,787.10	Box	Concrete	1.22	0.61
3942	0 (Polyline)-1926	MH-2305	MH-853	2.89	3	1.53	1.51	45.41	2.07	0.011	0.81	0.52	0.42	79.8	46.9	24,209.80	Box	Concrete	1.22	0.61
1328	0 (Polyline)-1927	MH-853	FO-34	3	1.61	1.51	0.9	58.89	1.54	0.011	2.33	2.38	0.45	19.1	32.9	27,769.20	Box	Concrete	1.22	0.61
1791	0 (Polyline)-1920	MH-1144	MH-1145	3.73	3.55	3.02	2.84	50	0.75	0.011	0.8	0.58	0.03	5.9	15.1	1,724.70	Box	Concrete	0.61	0.61
2632	0 (Polyline)-1921	MH-1145	MH-1316	3.55	3.36	2.84	2.65	50	0.84	0.011	1.05	0.58	0.07	12.5	19.8	3,893.70	Box	Concrete	0.61	0.61
2068	0 (Polyline)-1922	MH-1316	O-33	3.36	2.28	2.65	1.57	64.64	0.76	0.011	1.83	1.25	0.09	6.9	16.7	4,794.00	Box	Concrete	0.61	0.61
121	0 (Polyline)-432	MH-60	MH-59	3.33	3.13	2.62	2.42	8.08	0.64	0.011	0.93	1.53	0.01	0.6	8.9	497.1	Box	Concrete	0.61	0.61
2378	0 (Polyline)-431	MH-59	MH-1507	3.13	2.96	2.42	2.25	45.35	0.77	0.011	0.88	0.59	0.04	7.2	18.1	2,171.80	Box	Concrete	0.61	0.61
3650	0 (Polyline)-1918	MH-1507	MH-75	2.96	2.84	2.25	2.13	41.92	0.89	0.011	1.03	0.52	0.09	17.2	23.2	4,753.20	Box	Concrete	0.61	0.61
145	0 (Polyline)-1919	MH-75	FO-31	2.84	2.64	2.13	1.93	12.05	0.78	0.011	1.94	1.25	0.1	8.1	18.7	5,564.00	Box	Concrete	0.61	0.61
3265	0 (Polyline)-566	MH-1987	MH-1921	3.44	3.22	2.73	2.51	50	0.69	0.011	0.67	0.64	0.02	2.6	11.8	860.6	Box	Concrete	0.61	0.61
3135	0 (Polyline)-567	MH-1921	MH-1713	3.22	3.21	2.51	2.48	50	0.82	0.011	0.38	0.22	0.02	11.4	15.5	1,322.40	Box	Concrete	0.61	0.61
2742	0 (Polyline)-568	MH-1713	MH-929	3.21	2.92	2.48	2.21	50	0.76	0.011	1.05	0.72	0.05	6.9	20.9	3,013.20	Box	Concrete	0.61	0.61
1448	0 (Polyline)-569	MH-929	MH-930	2.92	2.83	2.21	2.12	43.78	0.89	0.011	0.84	0.43	0.07	16.5	32.8	4,469.50	Box	Concrete	0.61	0.61
1049	0 (Polyline)-570	MH-669	MH-670	3.14	3.23	2.43	2.42	29.66	0.78	0.011	0.34	0.22	0.02	8.3	51.2	911.7	Box	Concrete	0.61	0.61
9154	EX	MH-2973	MH-2975	3.5	3.41	2.79	2.6	38.08	0.76	0.019	0.58	0.4	0.03	6.3	31.5	1,298.10	Box	Concrete	0.61	0.61
838	0 (Polyline)-441	MH-532	MH-531	3.91	3.88	3.2	3.09	23.63	0.72	0.011	0.81	0.65	0.03	4.3	21.6	1,432.30	Box	Concrete	0.61	0.61
4951	0 (Polyline)-553	MH-2699	MH-905	3.84	3.96	3.13	3.1	50	0.93	0.011	0.45	0.22	0.04	20.6	31.7	2,247.60	Box	Concrete	0.61	0.61
5331	0 (Polyline)-554(1)	MH-905	MH-531	3.96	3.88	3.1	3.09	19.5	1.1	0.011	0.54	0.22	0.08	36.9	31.6	4,423.60	Box	Concrete	0.61	0.61
5332	0 (Polyline)-554(2)	MH-531	MH-906	3.88	3.79	3.09	3.08	30.51	1.38	0.011	0.59	0.36	0.12	34.3	26.9	7,141.60	Box	Concrete	0.91	0.61
4973	0 (Polyline)-555	MH-906	MH-1448	3.79	3.45	3.08	2.74	50	1.13	0.011	1.49	1.33	0.15	11.4	35.5	9,099.40	Box	Concrete	0.91	0.61
2282	EXI-556	MH-1448	MH-1449	3.45	3.39	2.74	2.68	50	1.4	0.011	0.92	0.55	0.21	37.2	50.4	12,817.80	Box	Concrete	0.91	0.61
4654	EXI-557	MH-1449	MH-2433	3.39	3.63	2.68	2.66	50	1.62	0.011	0.69	0.36	0.23	62.1	52.1	14,782.90	Box	Concrete	0.91	0.61
4242	0 (Polyline)-558	MH-2433	MH-1894	3.63	3.63	2.66	2.63	50	1.84	0.011	0.71	0.52	0.27	50.7	51.3	18,247.50	Box	Concrete	1.22	0.61
3084	0 (Polyline)-559	MH-1894	MH-961	3.63	3.42	2.63	2.61	50	1.91	0.011	0.74	0.52	0.31	60.1	50.3	22,628.80	Box	Concrete	1.22	0.61
9152	0 (Polyline)-560(1)	MH-961	MH-2975	3.42	3.41	2.61	2.6	20.66	1.96	0.011	0.76	0.52	0.34	65.8	48	25,869.20	Box	Concrete	1.22	0.61

ID	Label	Start Node	Stop Node	Elevation Ground (Start) (m)	Elevation Ground (Stop) (m)	Invert (Start) (m)	Invert (Stop) (m)	Length (Scaled) (m)	Wetted Perimeter (m)	Manning's n	Velocity (m/s)	Capacity (Full Flow) (m³/s)	System Rational Flow (m³/s)	Flow / Capacity (Design) (%)	Depth/Rise (%)	System Drainage Area (m²)	Section Type	Material	Span (m)	Rise (m)
9153	0 (Polyline)-560(2)	MH-2975	MH-962	3.41	3.4	2.6	2.58	29.34	1.98	0.011	0.77	0.52	0.35	67.9	40.2	27,167.30	Box	Concrete	1.22	0.61
5321	0 (Polyline)-561(1)	MH-962	MH-670	3.4	3.23	2.58	2.42	36.6	1.58	0.011	1.63	1.57	0.36	22.7	43.1	28,014.90	Box	Concrete	1.22	0.61
5322	0 (Polyline)-561(2)	MH-670	MH-968	3.23	3.19	2.42	2.41	13.4	1.99	0.011	0.78	0.52	0.37	70.2	51.8	29,322.60	Box	Concrete	1.22	0.61
2886	0 (Polyline)-562	MH-968	MH-980	3.19	3.11	2.41	2.38	50	2	0.011	0.78	0.52	0.37	71.4	43	30,151.10	Box	Concrete	1.22	0.61
1530	0 (Polyline)-563	MH-980	MH-981	3.11	2.94	2.38	2.23	50	1.64	0.011	1.45	1.29	0.37	28.8	34.7	30,856.40	Box	Concrete	1.22	0.61
5323	0 (Polyline)-564(1)	MH-981	MH-930	2.94	2.83	2.23	2.12	13.89	1.53	0.011	1.99	2.08	0.37	17.9	36.4	31,496.20	Box	Concrete	1.22	0.61
5324	0 (Polyline)-564(2)	MH-930	FO-29	2.83	0.99	2.12	0.28	84.24	1.46	0.011	2.91	3.46	0.43	12.4	29	36,389.50	Box	Concrete	1.22	0.61
474	0 (Polyline)-1899	MH-293	MH-292	3.67	3.54	2.96	2.83	13.03	0.76	0.011	1.44	0.99	0.07	6.7	24.2	3,367.40	Box	Concrete	0.61	0.61
1724	0 (Polyline)-1898	MH-292	MH-1103	3.54	2.98	2.83	2.27	50	0.87	0.011	1.95	1.01	0.16	15.4	37.3	7,982.20	Box	Concrete	0.61	0.61
3329	0 (Polyline)-1897	MH-1103	MH-2019	2.98	3.11	2.27	2.25	50	1.56	0.011	0.67	0.36	0.2	55.1	39.5	10,430.00	Box	Concrete	0.91	0.61
4208	0 (Polyline)-1896	MH-2019	MH-1663	3.11	2.61	2.25	1.9	50	1.24	0.011	1.87	1.35	0.28	21	41.3	15,779.60	Box	Concrete	0.91	0.61
2653	0 (Polyline)-1895	MH-1663	MH-1587	2.61	2.48	1.9	1.77	50	1.48	0.011	1.47	0.84	0.38	45	53.6	21,424.10	Box	Concrete	0.91	0.61
2517	0 (Polyline)-1894	MH-1587	O-9	2.48	2.72	1.77	1.65	50	1.64	0.011	1.53	0.79	0.51	64.2	55.9	29,746.00	Box	Concrete	0.91	0.61
2881	0 (Polyline)-687	MH-1788	MH-1789	3.37	2.77	2.66	2.06	50	0.75	0.011	1.45	1.05	0.06	5.8	37.1	3,071.30	Box	Concrete	0.61	0.61
2997	0 (Polyline)-688	MH-1789	MH-1474	2.77	3.11	2.06	2.04	50	1.24	0.011	0.59	0.22	0.11	52.7	58.4	5,928.70	Box	Concrete	0.61	0.61
2324	0 (Polyline)-689	MH-1474	MH-1475	3.11	3.29	2.04	2.01	50	1.34	0.011	0.61	0.22	0.14	63.6	58.8	7,679.60	Box	Concrete	0.61	0.61
4184	0 (Polyline)-690	MH-1475	MH-2411	3.29	2.8	2.01	1.99	50	1.46	0.011	0.64	0.22	0.17	77.6	56.9	10,090.50	Box	Concrete	0.61	0.61
4262	0 (Polyline)-691	MH-2411	MH-2248	2.8	2.67	1.99	1.96	50	1.57	0.011	0.69	0.37	0.21	55.4	55.3	13,397.50	Box	Concrete	0.91	0.61
3816	0 (Polyline)-692	MH-2248	MH-2249	2.67	2.72	1.96	1.94	50	1.69	0.011	0.72	0.36	0.25	69.9	54	17,398.70	Box	Concrete	0.91	0.61
4288	0 (Polyline)-693	MH-2249	MH-380	2.72	2.85	1.94	1.91	50	1.74	0.011	0.73	0.36	0.28	76.5	43.6	19,878.20	Box	Concrete	0.91	0.61
607	0 (Polyline)-694	MH-380	MH-79	2.85	2.63	1.91	1.31	17.18	1.1	0.011	3.16	3.05	0.28	9.1	51.9	20,838.50	Box	Concrete	0.91	0.61
2805	0 (Polyline)-2208	MH-1746	MH-1690	3.17	3.18	2.46	2.43	50	0.91	0.011	0.44	0.22	0.04	18.4	22.6	2,013.20	Box	Concrete	0.61	0.61
2701	0 (Polyline)-2209	MH-1690	MH-1691	3.18	2.9	2.43	2.19	50	0.86	0.011	1.24	0.67	0.09	14.1	39.8	5,221.30	Box	Concrete	0.61	0.61
4005	0 (Polyline)-2210	MH-1691	MH-2330	2.9	2.88	2.19	2.17	50	1.35	0.011	0.63	0.22	0.14	64.9	57.3	8,266.30	Box	Concrete	0.61	0.61
4320	0 (Polyline)-2211	MH-2330	MH-1545	2.88	3.22	2.17	2.14	50	1.57	0.011	0.66	0.22	0.2	90.5	46.3	12,154.40	Box	Concrete	0.61	0.61
2445	0 (Polyline)-2212	MH-1545	MH-1546	3.22	2.98	2.14	1.66	46.01	1.49	0.011	2.15	2.39	0.36	15	71.3	23,940.60	Box	Concrete	1.22	0.61
3293	0 (Polyline)-695	MH-2000	MH-2001	2.9	3.08	2.19	2.16	50	1.2	0.011	0.57	0.22	0.1	47.6	52.6	5,209.80	Box	Concrete	0.61	0.61
3412	0 (Polyline)-696	MH-2001	MH-513	3.08	3.03	2.16	2.14	50	1.61	0.011	0.69	0.36	0.22	61.1	52.3	12,076.30	Box	Concrete	0.91	0.61
811	0 (Polyline)-697	MH-513	MH-514	3.03	3.33	2.14	2.12	22.24	1.71	0.011	0.73	0.36	0.27	73	50	15,382.40	Box	Concrete	0.91	0.61
4408	0 (Polyline)-659	MH-2501	MH-921	3.89	4.01	3.18	3.16	50	1.48	0.011	0.65	0.22	0.17	79.5	55.7	8,690.80	Box	Concrete	0.61	0.61
1436	0 (Polyline)-660	MH-921	MH-922	4.01	4.03	3.16	3.13	50	1.5	0.011	0.65	0.22	0.18	81.9	45.1	9,541.90	Box	Concrete	0.61	0.61
4773	0 (Polyline)-661	MH-922	MH-1146	4.03	3.13	3.13	2.42	50	0.9	0.011	2.3	1.15	0.2	17.6	46.2	11,688.30	Box	Concrete	0.61	0.61
1794	0 (Polyline)-662	MH-1146	MH-1147	3.13	3.49	2.42	2.4	50	1.75	0.011	0.74	0.36	0.28	77.2	52.5	16,512.50	Box	Concrete	0.91	0.61
2793	0 (Polyline)-663	MH-1147	MH-1300	3.49	3.38	2.4	2.37	50	1.97	0.011	0.77	0.52	0.35	67.3	42.1	22,116.80	Box	Concrete	1.22	0.61
5243	0 (Polyline)-664(1)	MH-1300	MH-514	3.38	3.33	2.37	2.12	19.81	1.49	0.011	2.32	2.62	0.38	14.3	41.7	25,073.80	Box	Concrete	1.22	0.61
5244	0 (Polyline)-664(2)	MH-514	MH-1301	3.33	2.83	2.12	1.82	30.19	1.61	0.011	2.56	2.35	0.61	26.1	78.9	41,217.50	Box	Concrete	1.22	0.61

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2255	0 (Polyline)-665	MH-1301	MH-1431	2.83	3.21	1.82	1.79	50	2.42	0.011	0.92	0.92	0.67	72.5	73.8	45,160.10	Box	Concrete	1.22	0.91
3935	0 (Polyline)-666	MH-1431	MH-1035	3.21	3.01	1.79	1.77	50	2.51	0.011	0.94	0.92	0.73	79.8	74.4	51,374.80	Box	Concrete	1.22	0.91
1616	0 (Polyline)-667	MH-1035	MH-1036	3.01	3.28	1.77	1.75	39.15	2.54	0.011	0.95	0.92	0.76	82.7	74.6	55,018.10	Box	Concrete	1.22	0.91
2036	0 (Polyline)-2213	MH-1297	MH-1298	3.72	3.52	3.01	2.81	42.55	0.93	0.011	1.38	0.66	0.13	20.1	39.3	6,755.00	Box	Concrete	0.61	0.61
4031	0 (Polyline)-668	MH-2344	MH-1327	3.82	3.74	3.11	3.03	50	0.91	0.011	0.79	0.39	0.07	19	36.5	3,717.90	Box	Concrete	0.61	0.61
2089	0 (Polyline)-669	MH-1327	MH-1328	3.74	3.92	3.03	3.01	50	1.22	0.011	0.58	0.22	0.11	50.4	38.6	5,802.90	Box	Concrete	0.61	0.61
3960	0 (Polyline)-670	MH-1328	MH-1953	3.92	3.57	3.01	2.86	50	1.01	0.011	1.21	0.53	0.15	28.1	45	8,486.20	Box	Concrete	0.61	0.61
5241	0 (Polyline)-671(1)(1)	MH-1953	MH-1298	3.57	3.52	2.86	2.81	37.11	1.32	0.011	0.97	0.34	0.21	61	52.6	12,517.40	Box	Concrete	0.61	0.61
5242	0 (Polyline)-671(1)(2)	MH-1298	MH-67	3.52	3.49	2.81	2.6	5.02	0.89	0.011	3.89	1.98	0.33	16.6	52.8	20,394.50	Box	Concrete	0.61	0.61
4818	0 (Polyline)-1887	MH-2659	MH-2654	3.65	3.79	2.94	2.92	50	1.54	0.011	0.66	0.22	0.19	87	54.8	9,512.20	Box	Concrete	0.61	0.61
4808	0 (Polyline)-1888	MH-2654	MH-2655	3.79	3.7	2.92	2.89	50	1.59	0.011	0.68	0.36	0.21	58.3	50.1	11,416.60	Box	Concrete	0.91	0.61
5053	0 (Polyline)-1889	MH-2655	MH-1744	3.7	3.64	2.89	2.87	50	1.68	0.011	0.71	0.36	0.25	68.6	43	14,303.10	Box	Concrete	0.91	0.61
2802	0 (Polyline)-1890	MH-1744	MH-1745	3.64	3.36	2.87	2.65	50	1.32	0.011	1.63	1.07	0.3	28.3	50.3	18,562.70	Box	Concrete	0.91	0.61
3452	0 (Polyline)-1891	MH-1745	MH-2074	3.36	3.62	2.65	2.63	50	2.11	0.011	0.82	0.52	0.45	85.6	62.3	28,280.50	Box	Concrete	1.22	0.61
3670	0 (Polyline)-1892	MH-2074	MH-67	3.62	3.49	2.63	2.6	53.76	2.11	0.011	0.82	0.52	0.45	85.7	57.7	29,973.00	Box	Concrete	1.22	0.61
5240	EXI-671(2)	MH-67	MH-1954	3.49	3.5	2.6	2.5	12.13	1.7	0.011	2.53	2.11	0.74	34.9	63	51,266.50	Box	Concrete	1.22	0.61
3921	EX	MH-1954	MH-2208	3.5	3.2	2.59	2.19	45.75	1.9	0.019	1.79	1.27	0.75	58.9	55.7	52,180.10	Box	Concrete	1.22	0.61
5237	EXI-673(1)	MH-2208	MH-1036	3.2	3.28	2.19	1.75	42.6	2.3	0.019	1.76	4.03	0.76	18.9	51.7	54,072.50	Box	Concrete	1.83	0.91
5238	EXI-673(2)	MH-1036	MH-2209	3.28	3.15	1.75	1.74	26.97	4.01	0.019	0.74	1.63	1.48	91.1	54.7	1,09,963.40	Box	Concrete	2.13	1.22
4744	EX (Polyline)-674	MH-2209	MH-2198	3.15	3	1.74	1.68	30.22	3.29	0.019	1.18	3.14	1.46	46.4	54.5	1,10,865.80	Box	Concrete	2.13	1.22
5235	EXI-675(1)	MH-2198	MH-1546	3	2.98	1.68	1.66	22.06	3.75	0.019	0.84	1.96	1.45	74.3	54.9	1,12,361.20	Box	Concrete	2.13	1.22
5236	EXI-675(2)	MH-1546	MH-2199	2.98	3.09	1.66	1.65	27.94	4.31	0.019	0.77	1.92	1.76	91.4	53.1	1,38,540.90	Box	Concrete	2.44	1.22
3787	EXI-676	MH-2199	MH-2234	3.09	2.87	1.65	1.55	50	3.58	0.019	1.26	3.87	1.76	45.5	53.4	1,42,079.70	Box	Concrete	2.44	1.22
3884	EXI-677	MH-2234	MH-2278	2.87	3.38	1.55	1.52	50	4.32	0.019	0.77	1.92	1.77	92.1	52.4	1,45,696.10	Box	Concrete	2.44	1.22
4070	EXI-678	MH-2278	MH-2009	3.38	3.39	1.52	1.5	50	4.3	0.019	0.77	1.92	1.75	91	43.5	1,48,570.80	Box	Concrete	2.44	1.22
3311	EXI-679	MH-2009	MH-79	3.39	2.63	1.5	1.31	50	3.35	0.019	1.56	5.33	1.74	32.6	35.9	1,52,494.20	Box	Concrete	2.44	1.22
151	0 (Polyline)-680	MH-79	FO-7	2.63	2.62	1.31	1.3	4.11	3.31	0.011	1.84	6.42	1.96	30.5	33.8	1,74,317.10	Box	Concrete	2.44	1.22
4737	0 (Polyline)-650	MH-2630	MH-53	2.84	2.73	2.13	1.91	53.21	0.92	0.011	1.27	0.62	0.12	19.4	31.2	6,060.30	Box	Concrete	0.61	0.61
3694	0 (Polyline)-643	MH-2186	MH-1895	3.05	3.19	2.34	2.32	50	1.23	0.011	0.58	0.22	0.11	50.8	54.7	5,554.20	Box	Concrete	0.61	0.61
3086	0 (Polyline)-644	MH-1895	MH-1609	3.19	3.28	2.32	2.29	50	1.53	0.011	0.66	0.22	0.18	85.6	47.4	10,047.00	Box	Concrete	0.61	0.61
2556	0 (Polyline)-645	MH-1609	MH-1610	3.28	2.83	2.29	2.12	50	1.08	0.011	1.37	0.56	0.2	34.8	50.2	11,373.60	Box	Concrete	0.61	0.61

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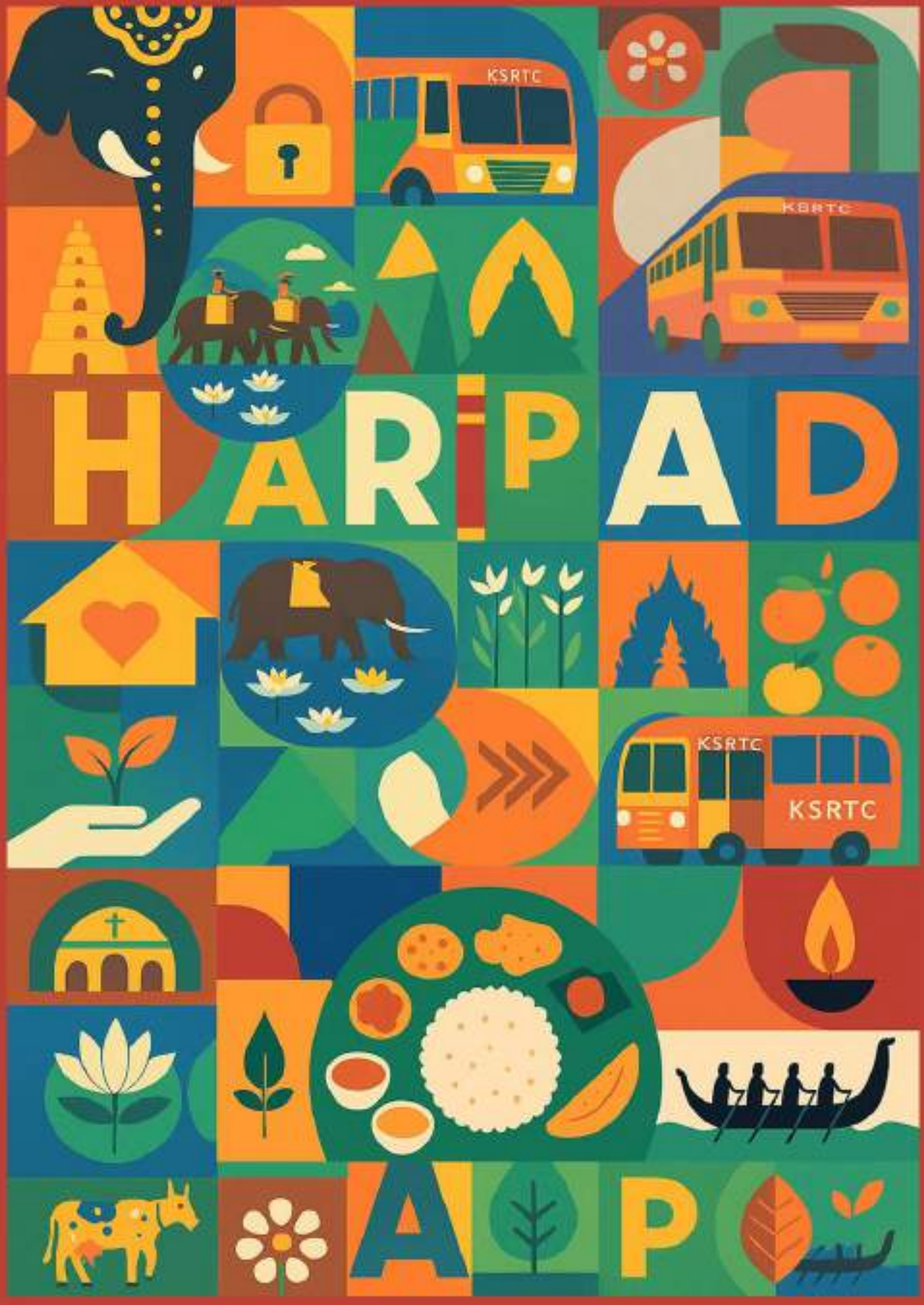
4212	0 (Polyline)-646	MH-1610	MH-2076	2.83	2.79	2.12	2.08	50	1.49	0.011	0.83	0.28	0.22	81	55.9	13,493.90	Box	Concrete	0.61	0.61
3457	0 (Polyline)-647	MH-2076	MH-2077	2.79	2.64	2.08	1.93	50	1.23	0.011	1.41	0.52	0.27	51.3	53	17,000.60	Box	Concrete	0.61	0.61
3547	0 (Polyline)-648	MH-2077	MH-53	2.64	2.73	1.93	1.91	47.24	1.8	0.011	0.75	0.36	0.3	83.3	45.8	19,975.20	Box	Concrete	0.91	0.61
1622	0 (Polyline)-649	MH-53	MH-1040	2.73	2.61	1.91	1.6	43.16	1.55	0.011	1.98	1.98	0.4	20.3	49.4	27,562.10	Box	Concrete	1.22	0.61
4837	0 (Polyline)-652	MH-2663	MH-2457	3.22	2.9	2.51	2.19	50	0.72	0.011	0.96	0.78	0.03	4.3	34.5	1,674.80	Box	Concrete	0.61	0.61
4300	0 (Polyline)-653	MH-2457	MH-2353	2.9	2.89	2.19	2.16	50	1.18	0.011	0.57	0.22	0.1	45.3	59.1	5,166.90	Box	Concrete	0.61	0.61
4054	0 (Polyline)-654	MH-2353	MH-1182	2.89	3.1	2.16	2.14	50	1.34	0.011	0.61	0.22	0.14	63.4	60.2	7,798.90	Box	Concrete	0.61	0.61
1852	0 (Polyline)-655	MH-1182	MH-1183	3.1	3.28	2.14	2.11	50	1.43	0.011	0.64	0.22	0.16	73.6	59.3	9,769.30	Box	Concrete	0.61	0.61
3220	0 (Polyline)-656	MH-1183	MH-1239	3.28	3.13	2.11	2.09	50	1.47	0.011	0.64	0.22	0.17	78.1	56.4	11,209.40	Box	Concrete	0.61	0.61
1942	EXI-657	MH-1239	MH-467	3.13	3.01	2.09	2.06	50	1.52	0.011	0.66	0.22	0.18	84.6	44.8	12,718.70	Box	Concrete	0.61	0.61
741	0 (Polyline)-658	MH-467	MH-468	3.01	2.77	2.06	1.72	23.79	0.88	0.011	2.27	1.16	0.19	16.3	40.4	13,892.30	Box	Concrete	0.61	0.61
883	0 (Polyline)-2024	MH-561	MH-555	3.5	3.36	2.79	2.65	25.69	0.76	0.011	1.02	0.7	0.05	6.7	18.2	2,367.00	Box	Concrete	0.61	0.61
874	0 (Polyline)-642	MH-555	MH-556	3.36	3.32	2.65	1.79	25.22	0.74	0.011	2.41	1.79	0.1	5.5	41.1	5,037.30	Box	Concrete	0.61	0.61
1102	0 (Polyline)-641	MH-704	MH-705	3.02	2.76	2.31	1.83	31.17	0.76	0.011	1.76	1.2	0.08	6.9	41.9	4,205.00	Box	Concrete	0.61	0.61
4842	0 (Polyline)-639	MH-2664	MH-830	3.15	2.87	2.44	2.16	50	0.78	0.011	1.13	0.73	0.06	8.3	25.7	3,036.30	Box	Concrete	0.61	0.61
1293	0 (Polyline)-640	MH-830	MH-831	2.87	2.82	2.16	2.11	34.89	1.03	0.011	0.85	0.36	0.11	30	35.5	5,680.90	Box	Concrete	0.61	0.61
4873	0 (Polyline)-628	MH-2675	MH-2529	3.12	2.93	2.41	2.22	50	0.73	0.011	0.76	0.61	0.03	4.5	22.6	1,376.40	Box	Concrete	0.61	0.61
4476	0 (Polyline)-629	MH-2529	MH-1212	2.93	3.23	2.22	2.19	50	1.04	0.011	0.51	0.22	0.07	30.6	35.7	3,532.90	Box	Concrete	0.61	0.61
1899	0 (Polyline)-630	MH-1212	MH-1213	3.23	3.24	2.19	2.17	50	1.12	0.011	0.54	0.22	0.08	39.1	33.8	4,912.20	Box	Concrete	0.61	0.61
5226	0 (Polyline)-631(1)	MH-1213	MH-831	3.24	2.82	2.17	2.11	30.47	0.97	0.011	0.9	0.41	0.1	23.8	33.8	6,220.30	Box	Concrete	0.61	0.61
5227	0 (Polyline)-631(2)	MH-831	MH-2168	2.82	2.57	2.11	1.86	19.54	0.9	0.011	2.19	1.09	0.2	18	48.9	12,904.10	Box	Concrete	0.61	0.61
4335	0 (Polyline)-632	MH-2168	MH-2470	2.57	3.02	1.86	1.84	50	1.58	0.011	0.68	0.36	0.21	57	62.5	13,735.00	Box	Concrete	0.91	0.61
5228	0 (Polyline)-633(1)	MH-2470	MH-705	3.02	2.76	1.84	1.83	15.05	1.6	0.011	0.69	0.36	0.22	59.8	63.3	15,079.50	Box	Concrete	0.91	0.61
5229	0 (Polyline)-633(2)	MH-705	MH-1878	2.76	3.12	1.83	1.81	34.96	1.75	0.011	0.74	0.36	0.28	77.8	63	19,881.00	Box	Concrete	0.91	0.61
3053	0 (Polyline)-634	MH-1878	MH-556	3.12	3.32	1.81	1.79	49.11	1.78	0.011	0.75	0.36	0.3	81.9	61.1	21,560.50	Box	Concrete	0.91	0.61
3555	0 (Polyline)-635	MH-556	MH-1768	3.32	3.06	1.79	1.76	50.89	2.03	0.011	0.79	0.52	0.39	74.6	58.6	29,514.90	Box	Concrete	1.22	0.61
2845	0 (Polyline)-636	MH-1768	MH-1637	3.06	2.76	1.76	1.74	50	2.04	0.011	0.8	0.52	0.4	76	55.5	31,440.80	Box	Concrete	1.22	0.61
5230	EXI-637(1)	MH-1637	MH-468	2.76	2.77	1.74	1.72	44.2	2.04	0.011	0.8	0.52	0.4	75.7	49.6	32,475.10	Box	Concrete	1.22	0.61
5234	CO-6	MH-468	MH-1040	2.77	2.61	1.72	1.6	13.58	1.61	0.011	2.33	2.14	0.56	26.3	53.9	47,248.20	Box	Concrete	1.22	0.61
5233	0 (Polyline)-638(2)	MH-1040	FO-6	2.61	2.62	1.6	1.5	3.95	1.59	0.011	3.92	6.5	0.89	13.7	35.8	75,427.40	Box	Concrete	1.22	0.91





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