CHAPTER 3 Policies and Strategies of the Government of Madagascar of Transport and Urban Development Sector

3.1 Policies and Strategies of Transportation and Urban Development Sector

This section presents the policy and planning system for national land development in Madagascar. In Madagascar, the National Spatial Planning Policy (PNAT : Politique Nationale de l'Aménagement du Territoire) is the upper-most basic policy, and the system is used to develop national land development plans for the nation, regional areas, and urban areas.

The Transport Sector Policy (Politique Sectorielle des Transports) is the upper-most policy on transport development and the MTP (Ministry of Public Works) has already formulated a five-year (5) national road development plan.

Table 3-1 Policy/strategy system for national land development and transportation in Madagascar

Level	Sector	Policy/Strategy documents
National Policy	National Land Development	**National Spatial Planning Policy (PNAT : Politique Nationale de l'Aménagement du Territoire)** *Basic policies and systems for national land development and urban planning are presented. Under PNAT, SNAT (National Spatial Planning Scheme), SRAT (Regional Spatial Planning Scheme), and PUDi (Urban Development Plans) are systematically planned.
	Transportation	**Transport Sector Policy: Politique Sectorielle des Transports** *The national transport policy and plan is currently under consideration with EU technical support.
National Area	National Land Development	**National Spatial Planning Scheme: SNAT (Schéma National d'Aménagement du Territoire)** *A policy document that introduces strategies for national land development.
	Transportation (Traffic)	The national transport policy and plan is currently under consideration with EU technical support.
	Transportation (Road)	**Five-year National Road Development Plan : Strategies and Programme of Activities 2020-2024** **National Road Emergency Response Plan : Plan Emergence Madagascar 2022**
Regional Area	National Land Development	**Analamanga Regional Spatial Planning Scheme: Analamanga SRAT (Schémas Regionaux d'Aménagement du Territoire)** *The SRAT for Analamanga Region (region), which includes the Antananarivo metropolitan area, will be formulated in early 2023.
	Transportation (Traffic)	*There is no regional transportation plan. The basic maintenance concept is described in the SRAT. However, in the TaToM Master Plan, a draft plan for the development of the TaToM corridor connecting the

Level	Sector	Policy/Strategy documents
		Antananarivo metropolitan area and the Toamasina metropolitan area is presented.
Metropolitan area	Urban Planning	**Antananarivo Urban Development Plan : Plan d'Urbanisme Directeur (PUDi) Antananarivo** * A policy document that presents a medium-term urban area development policy. The TaToM master plan is being utilized.
		Detailed Urban Planning: Plan d'Urbanisme de Détails (PUDé) *In Antananarivo, 3 regions have already formulated plans, and 5 regions are currently developing them.
	Transportation/ Traffic (including roads)	**Urban Transport Master Plan: SDT (Antananarivo Schéma Directeur du Transport)** * Formulated in 2021 to present road, public transportation, etc. development policies for the next 20 years

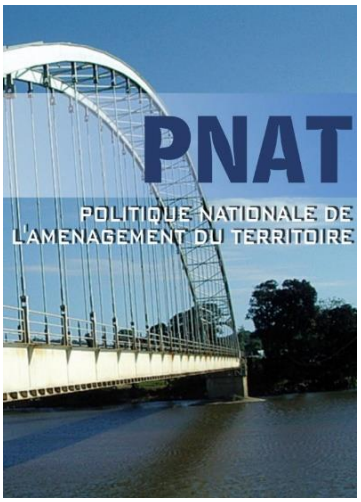
Source: JICA Study Team

3.2 Policies in the Field of Transport and Urban Development

3.2.1. Policies of Urban Development Sector

The National Spatial Planning Policy (PNAT) is the planning reference for the terrestrial and maritime dimension of the territory. Adopted by the Government's Council, the PNAT provides a framework for sectoral and territorial actions to remedy the country's disorganization and the resulting economic, social and environmental difficulties, at both spatial and institutional and financial levels. The aim of this policy is to make the country more competitive and efficient.

It is accompanied by the application of the "Loi d'Orientation de l'Aménagement du Territoire" (LOAT law). The Ministry in charge of Spatial Planning (MATSF) supports the Decentralized Territorial Entities in the strategic planning of their respective territories.



Source: PNAT Document, 2006

Figure 3-1 PNAT Document

The PNAT prioritizes the preparation of the National Spatial Planning Scheme (SNAT); the institutional strengthening of the department responsible for spatial planning; and the establishment of the National Spatial Planning Committee (CNAT). Sustainable management of natural resources and urban development focuses on several strategic areas of intervention:

(1) Protection and enhancement of natural areas
(2) Consistency of sectoral visions on the use and consumption of space, taking into account the vulnerability of the environment;
(3) Land use planning (land policy, land value creation, land reserves);
(4) Sectoral restructuration (elimination of slum areas, regulation of all urban areas, land tenure security, access to basic services);
(5) Renovating town centres, safeguarding and enhancing heritage, upgrading the commercial, cultural and tourist functions;
(6) Urban development policies for Antananarivo, consisting in upgrading infrastructure (roads, transport, sanitation); Restructuring and sanitizing impoverished urban areas; Upgrading the city centre's livability and protecting its heritage.

The PNAT is the reference document that sets out the development of all the planning tools (SNAT, SRAT, PUDi, PUDe) and the overall coherence between them. The procedures for implementing the PNAT and LOAT are set out by the Decree n. 2017-646.

3.2.2. Transport Sector Policy: Politique Sectorielle des Transports (2014)

3.2.2.1. Brief Background, Challenges, Vision and Objectives

The Transport Sector Policy (TSP) (Politique Sectorielle des Transports: 2014) was prepared jointly by the Ministry of Public Works (MTP) and the Ministry of Transport and Meteorology (MTM), two ministries working for transport sector. The policy document serves as reference for government and development partners as far as transport is concern in rebuilding the country and re-launching its economy after the five-year political crisis (2009-2014). Although this document is a bit old, the latest version is not yet ready and is under preparation as of this writing.

Challenges of Transport Sector

- To make up for the infrastructure deficits that have deteriorated either as a result of poor management or cyclical socio-political crises.
- To modernize these infrastructures in order to optimize the sector's contribution to development and accelerated growth.

Vision

"A safe and secure transport system and network, efficient, environmentally friendly and in line with a sustainable development policy"

Main Objectives of Transport Sector Policy

- Consolidate the positive achievements of institutional reform
- Develop and maintain transport infrastructure on a sustainable basis
- Optimise funding for the development of the sector
- Ensure coherent, efficient and effective management and regulation of operations
- Promote capacity-building initiatives and job creation

3.2.2.2. Strategies by Sector

The TSP has prepared a comprehensive strategies and action plans in matrix form divided into transport modes (i.e. road infrastructure and transport, rail transport, maritime and inland water transport, air transport, other transport related subjects like intermodal, non-motorized transport and urban mobility).

At the same time, the TSP recognizes the challenges of coming up with appropriate amount of fund to execute the target projects. For this reason, its strategic option is to give priority to the rehabilitation needs of the road network in general and the RN (National roads) network in particular. Thus, the MTP (Ministry of Public Works) must ensure the permanent viability of the national road network (approximately 12,000 km) according to a programming approach that is generally as follows:

- Rehabilitation of road section in poor condition,
- Periodic maintenance of road section in medium condition,
- Routine maintenance of rad section in good condition.

Although maintenance of existing infrastructure is the priority as discussed above, exception is made to the following new strategic infrastructure currently identified. This means that these projects will also be equally pursued by the government as priority.

- Antananarivo-Toamasina Expressway
- Deep-water ports on the east and west coasts
- Extension of the port of Toamasina
- Extension of Ivato Airport
- Antananarivo peripheral/outer roads and developments

3.2.2.3. Investment Requirements

The investment needs for the Road Programme (2015-2019) in the TSP is shown in Table 3-2 and Table 3-3 showing (i) road investment for new projects and (ii) maintenance of existing roads respectively. In both programmes, the role of international development partners is important due to the limited budget of the government.

Table 3-2 Road Investment (in billions of ariary)

Financing	2015	2016	2017	2018	2019	Total
External	251,4	802,2	1 449,8	1 934,4	1 195,5	5 633,3
Internal	251,1	455,1	558,6	548,5	268,4	2 081,9
Total in Billion Ar	502,5	1 257,3	2 008,4	2 483,0	1 464,0	7 715,2*
Linear Km	290,0	552,4	1209,4	1609,6	1591,9	5253,3

**Note 1: 95% of the budget for trunk roads; 5% for rural roads*

**Note 2: 98% of the budget is road projects; 2% is for institutional and other projects*

Table 3-3 Road Maintenance (in billions of ariary)

Financing	2015	2016	2017	2018	2019	Total
External	0,00	15,15	18,18	21 ,82	26,18	81,33
Internal	50,50	60,60	72,72	87,26	104,2	403,30
Total in Billion Ar	50,50	75,75	90,90	109,08	130,90	484,63*
Linear Km	11890,0	11890,0	11890,0	11890,0	11890,0	

**Note 1: 94% of the budget for maintenance national roads; maintenance of rural roads: 6%*

3.3 Development Strategies and Plans at the National Level

3.3.1. Integrated Urban Development Sector

The National Spatial Planning Scheme (SNAT) is the planning framework document on which all planning and development initiatives at different scales must be based, and the drafting of the Analamanga Region's SRAT, which is a planning tool intended to serve as a reference for all players and decision-making authorities at regional level, meets the need to have this reference framework for the major present and future directions of its development, and also for the development and enhancement of the economic and environmental potential of its territory. In this context, a participatory approach is essential, right down to the municipal level.

The SNAT defines the development guidelines and priority projects for the 12 identified "Growth Areas". There are 3 types of growth areas:

- Areas linked to heavy foreign investment (mining, etc.)
- Regional growth areas
- Endogenous growth areas at national level

The 12 priority growth areas are:

(1) **Taolagnaro Area**: a priority area for mining exploration and for the development of a second deep-water port (Ehoala) and a Special Economic Zone (SEZ),

(2) **Area of Vakinankaratra et Analamanga**: Development of Antsirabe as the 2nd national metropolis with strong agricultural and industrial potential,

(3) **Nosy Bé, Diana and Sava Area**: Tourism development,

(4) **Toamasina Cluster**: Development of the first deep-water port, the TaToM axis and Madagascar's third largest city (1 million inhabitants by 2035),

(5) **Alaotra lake agriculture development**: Development of Rice production,

(6) **Fianarantsoa Cluster**: Boosting the local economy,

(7) **Area along the RN7 Road**: Antananarivo-Tulear: tourism development,

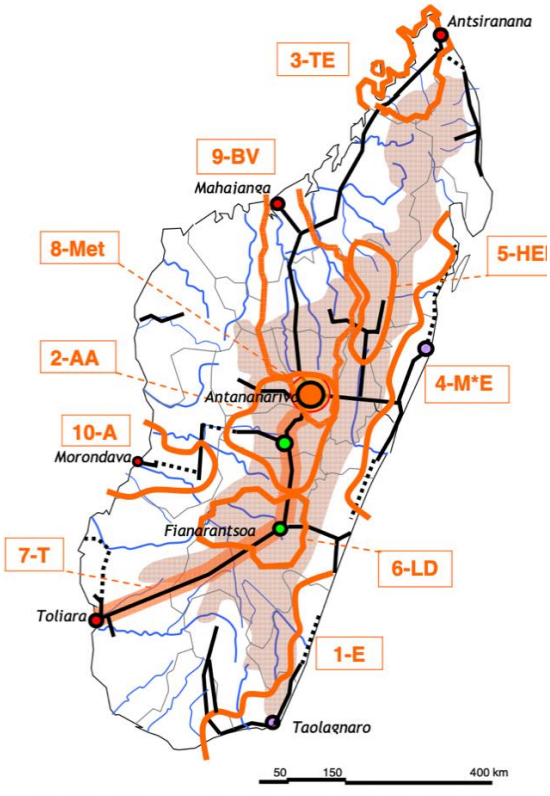
(8) **Antananarivo metropolitan region**: Urban expansion programs and new towns, electricity capacity),

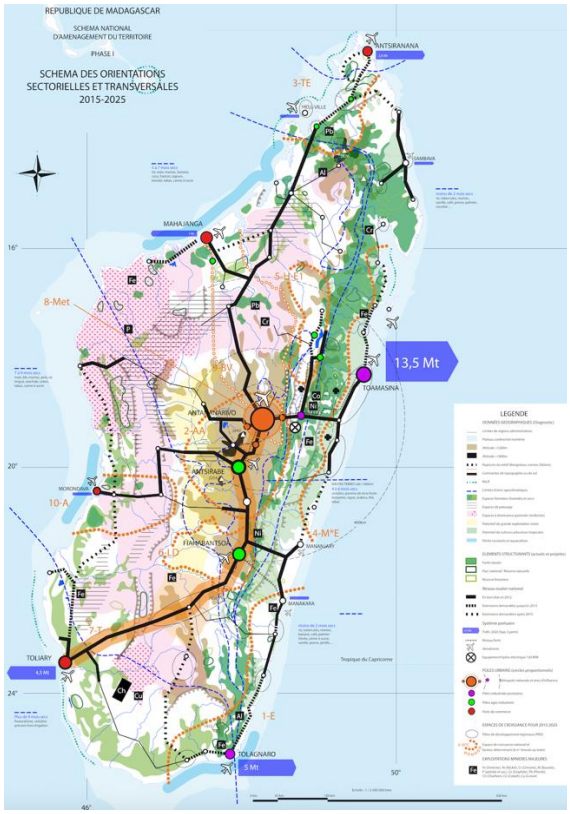
(9) **Betsiboka watershed :** Connecting the north-west of the country,

(10) **Menabe regional hub**: Rehabilitation of roads and opening up the region, development of the port of Morondava,

(11) **Atsimo Andrefana Cluster**: Tourism, agriculture and mining, development of the port of Toliary,

(12) **Maritime area around Madagascar**: fishing, maritime transport, energy,





Source: National Scheme of Sectoral and Transversal Orientations, 2015 - 2025

Figure 3-2 Targeted Growth Space (Espaces de Croissance)

Figure 3-3 Sectoral and Cross-sectoral Development Schemes

3.3.2. Transport Sector

By looking at the SNAT which identified the 12 “Growth Area” and the National Development Plan (PND), the national development policy of the country on the transportation sector is equally revealed. This is because transportation sector is a major component of these growth areas.

The growth areas designated in the National Development Plan (PND) are elaborated into the growth poles in the Vision 2030. Four growth poles are expected to emerge by 2030 based on the available opportunities and distinctive characteristics of the regions: Grand-Central, Grand-North, Grand-South, and Grand-West. Five key projects to transform the growth pole have already been formulated, namely:

(1) Antananarivo-Toamasina Highway to link Antananarivo to the port of Toamasina in 3 hours (this calls for construction of a new highway),

(2) Rehabilitation of the Antsirabe-Antananarivo-Tamatave North Railway,

(3) Dredging of the Pangalanes Canal for 24- hour operation,

(4) Antsirabe-Mahanoro Road, and

(5) Expansion of Toamasina Port. In addition, a new modern cargo airport is proposed in Toamasina for the export of the agro-processing industrial products.

3.3.3. Strategies and Program of Activities 2020-2024

3.3.3.1. Brief Background

In general, the transport infrastructure and road network are in poor condition. Of the entire network, only 11% is in good condition with a Rural Access Index (RAI) estimated at 11.4%. Accordingly, complementation among the various transport mode (road, rail, air) is still low where the road transport still dominates in carrying passenger traffic (90%) and freight traffic (95%).

In terms of financing, it was noted that after experiencing a sharp decline since 2007, road investment spending picked up again in 2017 reaching 14.3% of the general budget in 2020. This change reflects the government's determination to promote the extension of the new sectoral policy focused on the development of infrastructure and equipment (PNDIE: National Infrastructure and Equipment Policy).

3.3.3.2. Indicators and Strategies for Developing the Road Network

This medium-term program (Strategies and Program of Activities 2020-2024) is formulated in order to identify priority roads based on consolidated data and in terms of socio-economic performance according to available studies. In terms of indicators, it wants to achieve the

following:

- Rate of opening up communes: From 50% in 2020 to 70% in 2024
- Rural Access Index: From 11.4% in 2020 to 16.6% in 2024

In targeting to achieve the above, the level of investment to infrastructure development is expected to rose from 16.7% of the general budget to 34.7% in 2023. Similarly, it was stated that given the condition of the road network, the overall cost of road programs should be in the range of 4% to 6% of the GDP.

3.3.3.3. Program of Activities

(1) Road Investment (Construction and Rehabilitation)

Among the roads, the largest investment is allocated to the national roads placing significant resources to this primary link of the country. However, the report noted that for all road investment projects, the financial gap is 79%. This means that available resources by the government is just 21% of the total amount in the programme.

Table 3-4 Road Investment, 2021-2024 (U$ Million)

Road Classification	Investment (U$ Million)				
	2021	2022	2023	2024	Total
National Road	1,032.68	1,717.96	1,138.45	885.63	4,774.72
Freeways	375.00	375.00	375.00	375.00	1,500.00
Rural Roads	269.16	405.73	419.76	365.82	1,460.47

Among the priority national roads identified since 2020 are:

Table 3-5 Priority Roads Identified since 2020

Road Name	Justification
RN12a : Taolagno/Vangaindrano	Development of the deep southeast and southwest corridors
RN10 : Andronanovoy/ Ambovombe	
RN9 : Manja/ Morondava	Rice-growing basins
RN31 : Ankazobatsiahy/ Bealalana	
RN32 :Antsohihy/ Mandristsara	Northeast corridors
RN44 – RN3 : Moramanga- Ambatondrazaka-Vohitraivo- Andilamena + RN 32 connection	
RN1bis : Tsiroanomandidy/ Maintirano	• Area with economic potential to be opened up • Mid-West Corridor
RN11-RN11A : Mananjar – Nosy Varika-Mahanoro-Vatomandry- Antsampanana	• East Corridor
RNP : 2, 4, 6,7	• Maintening service levels on the core network

Specific projects included in the 2020-2024 programming are the following :

- Highway : Antananarivo – Toamasina (757.6 billion Ar)
- Highway : Art malagasy– Ivato airport (579.6 billion Ar)
- Flyover : Maki – Antananarivo (17.8 billion Ar)
- West Tana Expressway (VROT) : Maki - Imeritsiatosika

(2) Road Maintenance (Routine and Periodic)

In essence, routine maintenance prioritizes the national road (RN routes). The basic principle of intervention are generally as follows :

- Network in good condition : Routine Maintenance
- Network in average condition : Periodic Maintenance
- Network in poor condition : Rehabilitation

From 2021 to 224, the total for maintenance programme are as follows :

- Periodic maintenance for national roads (RN): 1,155.56 U$ Mil (Total from 2021-2024)
- Routine maintenance for national roads (RN): 608.8 U$ Mil (Total from 2021-2024)
- Routine maintenance for Rural Roads (RR): 47.98 U$ Mil (Total from 2021-2024)

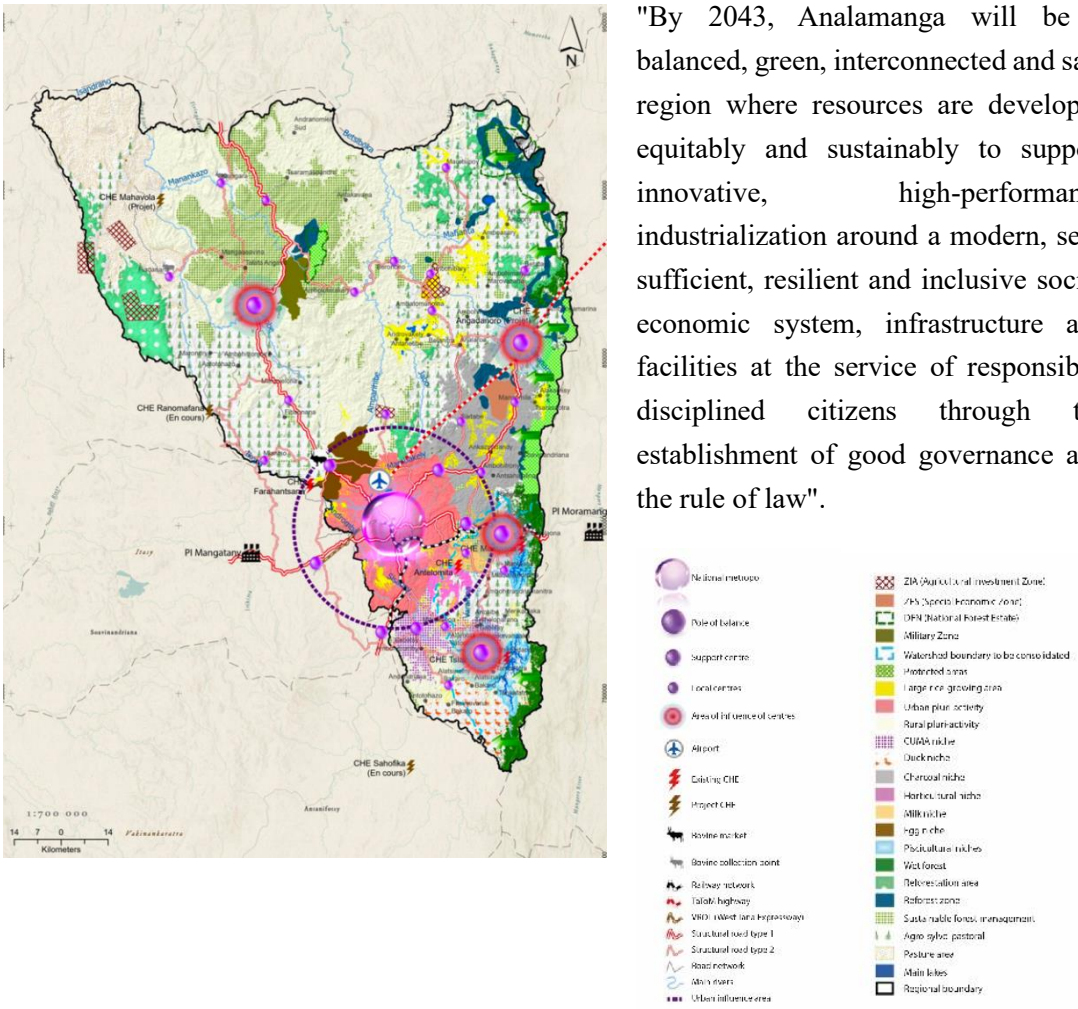
3.4 Development Strategies and Plans at the Regional Level

3.4.1. Integrated Urban Development Sector

The Regional Spatial Planning Scheme (SRAT) is one of the territorial planning tools recommended by law (LOAT) no. 2015-051 of 03 February 2016 on the orientation of regional planning. It is a guidance document for the long-term and sustainable development of the regional territory, and is an integral part of the preparation of the SNAT. Since the National Spatial Planning Policy (PNAT) was drawn up in 2006, 15 years later, 13 of the 22 regions now have SRATs. Analamanga SRAT was updated in 2023, with the support of the World Bank and its PRODUIR Programme.

The SRAT is a guidance document at regional level, setting out planning and development guidelines for a 20-year period, and providing a coherent framework for all sectoral policies and programmes, including the PRDs, which must be based on it. The region is home to the country's largest population (more than 3,600,000 inhabitants, or 14% of the national population) working in a wide range of sectors, from typically rural occupations to urban jobs (secondary and tertiary).

With its multimodal hub, the country's largest industrial fabric, facilities and infrastructure, the Analamanga region has attracted, and continues to attract, a large number of both local and foreign investors.



"By 2043, Analamanga will be a balanced, green, interconnected and safe region where resources are developed equitably and sustainably to support innovative, high-performance industrialization around a modern, self-sufficient, resilient and inclusive socio-economic system, infrastructure and facilities at the service of responsible, disciplined citizens through the establishment of good governance and the rule of law".

Source: National Scheme of Sectoral and Transversal Orientations, 2015

Figure 3-4 Analamanga Regional Development Vision

Table 3-6 Development Proposal from Regional Spatial Planning Scheme (SRAT)

Proposal 1: "By 2043, Analamanga will be a balanced, interconnected, accessible, green, healthy, secure and harmonious region, benefiting from a strong and efficient industry, supported by a transparent and accountable administration at the service of responsible and disciplined citizens".
Proposal 2: "By 2043, Analamanga will be a well-balanced, well-planned, green region, making the most of its resources and taking advantage of its modern socio-economic system and infrastructures to create added value for a responsible population through efficient, transparent and rigorous governance".
Proposal 3: "By 2043, Analamanga will be a balanced, green, interconnected and secure region where resources are developed equitably and sustainably to support innovative, high-performance industrialization around a modern, self-sufficient, resilient and inclusive socio-economic system, infrastructure and facilities for the benefit of a responsible and disciplined population through the establishment of good governance and the rule of law".

Source: SRAT of Analamanga, 2023-2043 (WB funded)

In line with PUDi elaborated in 2019, the SRAT of Anamalanga supports most of its orientations in terms of infrastructure and urban development. Table 3-7 outlined a selection of strategic orientations and objectives that will impact the infrastructure programming and prioritization in the Greater Tana Area.

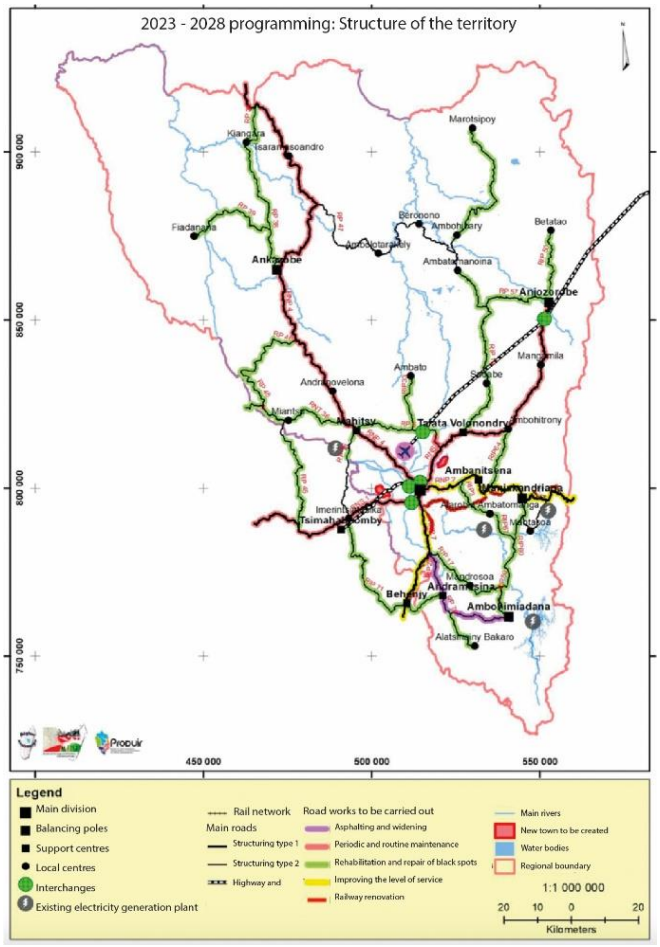
Table 3-7 Development Orientation from SRAT Analamanga

Strategic orientation	**Redistribute population and activities in the regional area**	
Strategic objective	**Specific objective**	**Consistent Activities**
Create and build attractive, safe, competitive and sustainable cities	Build compact, low-carbon and mobility-efficient towns	- Coordinate SRAT with PUDi, SAC, SDT, PUDe - Implement a 'Green City Concept' and develop green infrastructure - Promote energy transition with renewable energies
	Develop new urban central hubs	- Build decentralized social facilities for each town and regional subcenter - Build new municipal markets for Ankazobe, Anjozorobe, Manjakandriana, Ambohimiadana - Build new Road Stations for passengers and Parking Areas for trucks, taxi-brousse
	Promote economy-friendly urban environment	- Reorganise wholesale markets of Anosibe, Namontana, Andravoahangy - Develop logistic hubs in Ankazobe, Ambohimiadana, Manjakandriana, Mahitsy, Alarobia, Ambatomanga - Develop new industrial parks in Merimandroso and Ambohijanaka (cfr PUDi 2019)
	Provide access to decent housing for each household	- Develop residential new towns in Ampangabe, Betsizaraina, Alakamisy (PUDi 2019)

Strategic orientation	Redistribute population and activities in the regional area	
Strategic objective	**Specific objective**	**Consistent Activities**
	Reinforce international visibility and competitivity of Antananarivo	- Create a Special Economic Zone (SEZ) around the metropolitan area of Antananarivo - Implement Green Health Center in Tana
Develop, densify and hierarchise the transport network with a multimodal capacity	Connect rural areas and the metro area with multimodal infrastructure	- Rehabilitate, raise the level of service and extend type 2 trunk roads (RN36, RN51, RIP3, RIP6, etc.) - Rehabilitate, improve the level of service and extend local and feeder roads (RIP1, RIP4, RIP7, RIP8, RIP9, etc.). - Develop a new road linking Ankazobe - Ambatomanoina - Anjozorobe and build engineering structures and crossings. - Deploy modern communication and information infrastructures (NTIC) with high-performance services
	Mitigate the isolation of rural area and territorial discontinuity	- Construction of interchanges at RIP6 - RN51 and the new Tana - Toamasina freeway - Construction of engineering structures and crossings (RNT36 on Ikopa, RIP38 at Kiangara on Manankazo, RIP39 at Andakana on Ikopa, ...) - Construction of crossings and connect Mahitsy to Imerintsiatosika and Arivonimamo to Miantso
	Ensure connectivity between Analamanga and outer regions	- Upgrade and build the freeway linking Antananarivo Ivato to Toamasina - Construction of the Tana western expressway (VROT: road and rail axes) between the commune of Antananarivo and the new Tana-Masoandro town at Imerintsiatosika - Improve the level of service on type 1 trunk roads (RN1, RN2, RN3, RN4 and RN7) - Renovate existing rail lines and relaunch activities (TCE, TA)
Diversify economic and industrial development in secondary regional areas	Ensure sufficient, affordable and sustainable access to energy	- Development of the new 64 MW hydroelectric power plant at Ranomafana (MEH project), and 192 MW - extendable to 300 MW at Sahofika (MEH project) - Construction of a new 20 MW solar power plant and a 30 MW waste-to-energy plant at Ambohidratrimo (MEH project). - Develop a new 30 MW hydroelectric plant - expandable to 320 MW - at Mahavola (SRAT Project) and a 2.4 MW plant at Angadanoro Anjozorobe (SRAT Project).
	Support the development of business niches and sectors through economic infrastructures and	- Build infrastructure to support the CUMA sector - Build and equip processing centers for agricultural products - Redevelop and expand the Ampanotokana zebu market - Set up zebu collection and marketing points in

Strategic orientation	Redistribute population and activities in the regional area	
Strategic objective	**Specific objective**	**Consistent Activities**
	facilities.	Kiangara, Fiadanana and Ambatomanoina
	Promote Economic Zoning	- Operationalize agricultural emergence zones (ZEA) in Ankazobe, Anjozorobe, Ambohidratrimo and Manjakandriana - Create and operationalize the agricultural investment zones (ZIA) of Fiadanana, Ambohibary and Ambato - Create a special economic zone (ZES) with an industrial park between the RN3 and the Antananarivo - Toamasina highway
	Proving the sustainable use and development of tourist areas	- Create, develop and equip a tourism land reserve at Mantasoa - Upgrade, equip and promote Ambohitantely and Angavo - Upgrade, equip and promote Angavokely as a forestry resort

Source: SRAT of Analamanga, 2023-2043 (WB funded)



Source: SRAT of Analamanga, 2023-2043 (WB funded)

Figure 3-5 Programming 2023-2028 of Infrastructure Development

The output of the SRAT of Analamanga recommends a list of priority actions and investments for the period 2023-2028, which are mostly in line with the PUDi and take in account the new location of TanaMasoandro and the new potential itinerary of the Antananarivo - Toamasina highway passing across Anjozorobe.

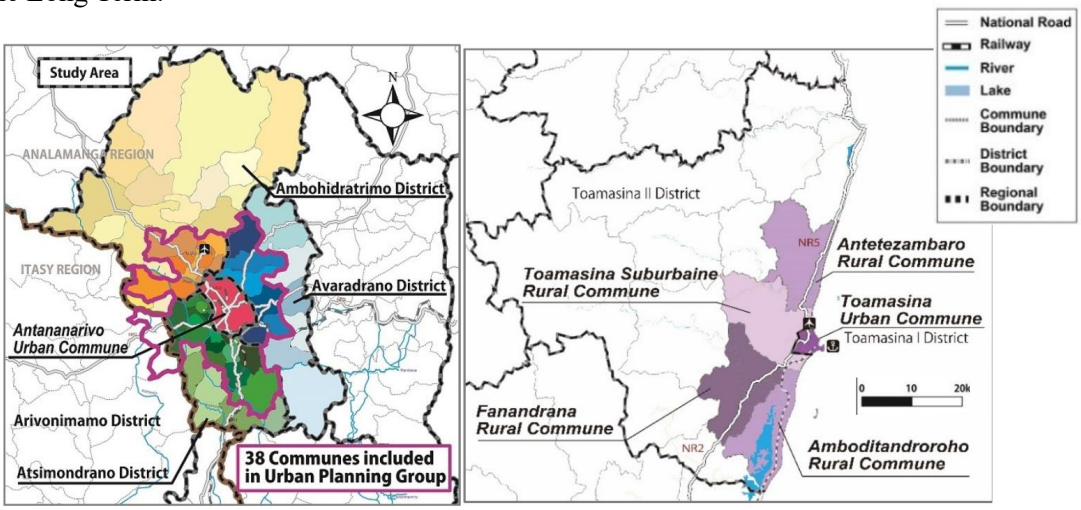
- Improving the level of service and upgrading type 1 trunk roads:
  - RNP2 (widening of 4 m x 2 lanes): Ambohimangakely - Toamasina
  - RNP7 (widening of 4 m x 2 lanes): Bongatsara – Toliara;
- Upgrading, asphalting and raising the level of service of the RR-ALG20 and RR-ALG79 (asphalting and track widening): Ambatofotsy (RN7) - Andramasina - Anepoka - Ambohimiadana - Tsiazompaniry (60 km);
- Asphalting of regional roads: 250 km, i.e. ~ 50 km / year;
- Partial rehabilitation, repair of black spots and periodic maintenance of regional roads : 900 km, i.e. ~ 200 km / year;
- Partial rehabilitation, repair of black spots and periodic maintenance of regional roads, inter-municipal and communal roads (local roads): ~ 200 km / year;
- Construction of the Tana Western expressway (VROT) between the municipality of Antananarivo and the new town of Tana-Masoandro to Imerintsiatosika: 20 km;
- Motorway development linking Antananarivo Ivato to Toamasina with an interchange on the RN3. (Anjozorobe) - Phase I: 60 km;
- Construction work on Fly Over Ankorondrano (interchange) at the junction of the Marais Masay bypass and the hydrocarbons road;
- Construction work on Fly Over Andohatapenaka (interchange) at the junction of the extension of the Marais Masay bypass and the RN58A road;
- Construction work on Fly over Anosizato (interchange) at the junction of the RN1 road and the RN58A road (embankment road) in Anosizato;
- Construction work on the Ambohidratimo bypass road linking the RN58A (embankment road) and the RN4 road at the Ambohidratimo exit (completed);
- Renovation work on the TA railway line: Antananarivo - Antsirabe: 170 km;
- Renovation work on the railway line between Soarano station and Amoronakona station over a distance of around 12 km, to allow the 1st stage of the urban train to start operating: 12 km;
- Rehabilitation work ex-RIP73: Behenjy - Andramasina: 20 km

3.4.2. Transport Sector (TaToM)

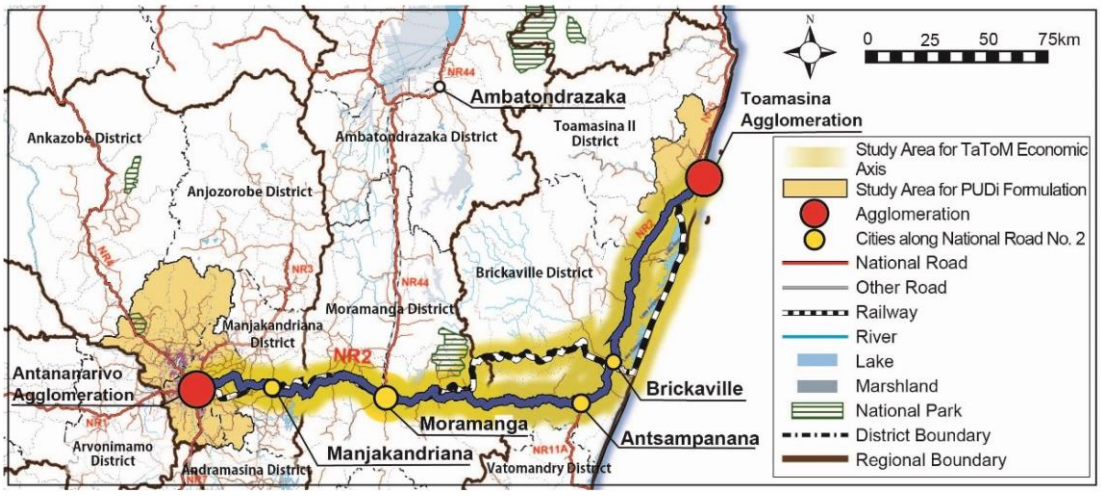
3.4.2.1. Introduction

The study titled “The Project on Master Plan Formulation for Economic Axis of TaToM (Antananarivo-Toamasina, Madagasikara)" (TaToM Project) was completed in October 2019 with technical support from JICA. The study covers Antananarivo Agglomeration (Antananarivo

Urban Commune (CUA: Commune Urbaine d'Antananarivo) and its surrounding 37 communes), Toamasina Agglomeration (Toamasina Urban Commune (CUT: Commune Urbaine de Toamasina) and its surrounding four communes) and TaToM Economic Axis (connecting the two agglomerations). The whole area of TaToM (the Overall TaToM Area) is composed of three areas, namely, Antananarivo Agglomeration, Toamasina Agglomeration and the TaToM Economic Axis. It has the following target years: 2023 for the Short Term, 2028 for the Mid-term, and 2033 for the Long Term.



Study Area for Atananarivo Agglomeration (left) and Toamasina Agglomeration (right)



Study Area for Antananarivo - Toamasina Economic Axis

Source: The Project on Master Plan Formulation for Economic Axis of TaToM (Antananarivo-Toamasina, Madagasikara), 2019, JICA

Figure 3-6 Three (3) Study Areas

3.4.2.2. Output of the TaToM Project

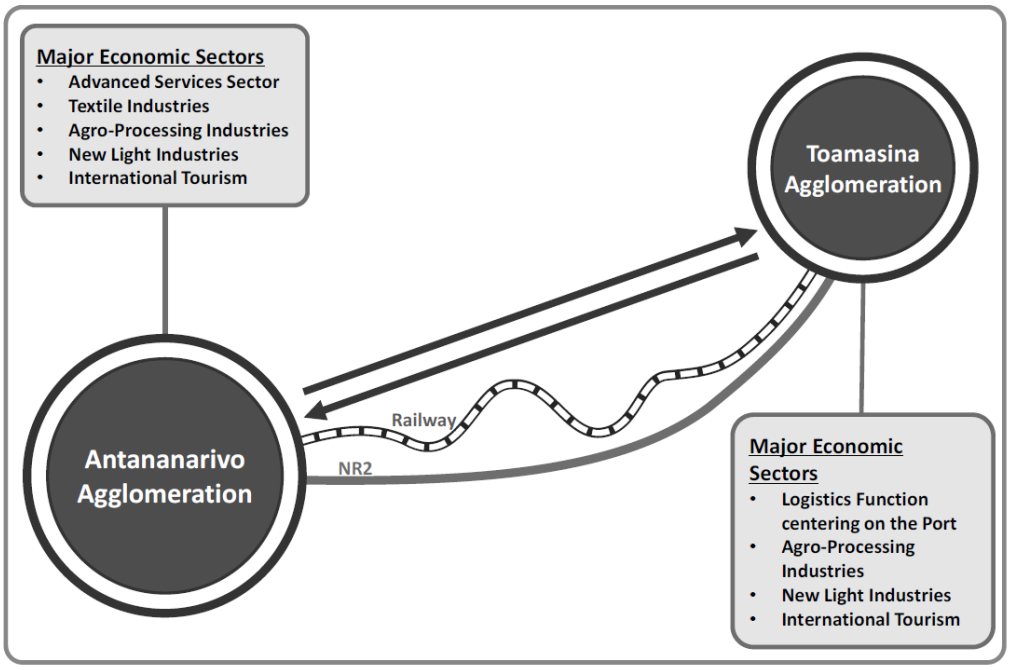
The study was tasked to prepare (revise or formulate) the following three development master plans and to establish a mechanism for coordination, monitoring and management of the implementation of the formulated plans.

- Revision of PUDi for Antananarivo Agglomeration (Revision of 2004 version)
- Revision of PUDi for Toamasina Agglomeration (Revision of 2004 version)
- Formulation of Transport and Territorial Development Plan for TaToM Economic Axis (New)

3.4.2.3. Growth Scenario for Overall TaToM Area

The TaToM Project had selected a growth scenario which envisioned the establishment of Antananarivo Service-Industrial Metropolis in connection with a strong economic axis with Toamasina Industrial City as illustrated in Figure 3-7. This calls for strong effort to the development of economic sector both for Antananarivo Agglomeration and Toamasina Agglomeration with particular emphasis in attracting investments to textile industries, agro-processing industries and other light industries. Equally important under this growth scenario is the strengthening of the connectivity between the two agglomerations (Antananarivo and Toamasina). In particular, it promotes the:

- Upgrading of Passenger Transport Speed by Constructing a Climbing Lane in Selected Sections of RN2
- Upgrading of Cargo Transport Volume by Widening in Selected Sections of RN2



Source: The Project on Master Plan Formulation for Economic Axis of TaToM (Antananarivo-Toamasina, Madagasikara), 2019, JICA

Figure 3-7 Selected Growth Scenario: Growth Scenario C for the Overall TaToM Area (Antananarivo Service-Industrial Metropolis and Toamasina Industrial City)

3.4.2.4. High Priority Projects and Necessary Budget for Transport Sector

The total cost necessary for implementing the high priority projects in Antananarivo Agglomeration is estimated to be US$ 1,875 million. High priority projects in Toamasina Agglomeration accounts for US$ 420 million and for TaToM Economic Axis accounts for US$ 443.5 million. The total amount for the Overall TaToM Area is US$ 2,748 million, which is estimated to account for, at largest, 30% of the total national development budgets of the next 10 years. The list of projects under the US$ 443.5 million for TaToM Economic Axis are presented in Table 3-8.

Table 3-8 High Priority Projects of TaToM Economic Axis

No.	Project Name	Cost (US M)	Organization in Charge
1	Capacity Development for Commune Officers along TaToM Economic Axis for Promoting TaToM Development Strategies	1.5	MAHTP, MID
2	Project on Replacement of Two Bridges along National Road No. 2	30.0	MAHTP
3	Project for Improvement of Traffic Safety on National Road No. 2	20.0	MAHTP
4	Project for Construction of Climbing Lane in Steep Slope Sections between Moramanga and Brickaville on National Road No. 2	200.0	MAHTP
5	Project for Construction of Climbing Lane in Steep Slope Sections between Antananarivo and Moramanga on National Road No. 2	75.0	MAHTP
6	Project for Construction of Moromanga Bypass Road	20.0	MAHTP, PPP
7	Project for Rehabilitation of Antananarivo – Toamasina Railway	105.0	MAHTP, PPP
	Total	443.5	

Note: MAHTP=Ministry of Regional Development, Building, Housing and Public Works
Source: The Project on Master Plan Formulation for Economic Axis of TaToM (Antananarivo-Toamasina, Madagasikara), 2019, JICA

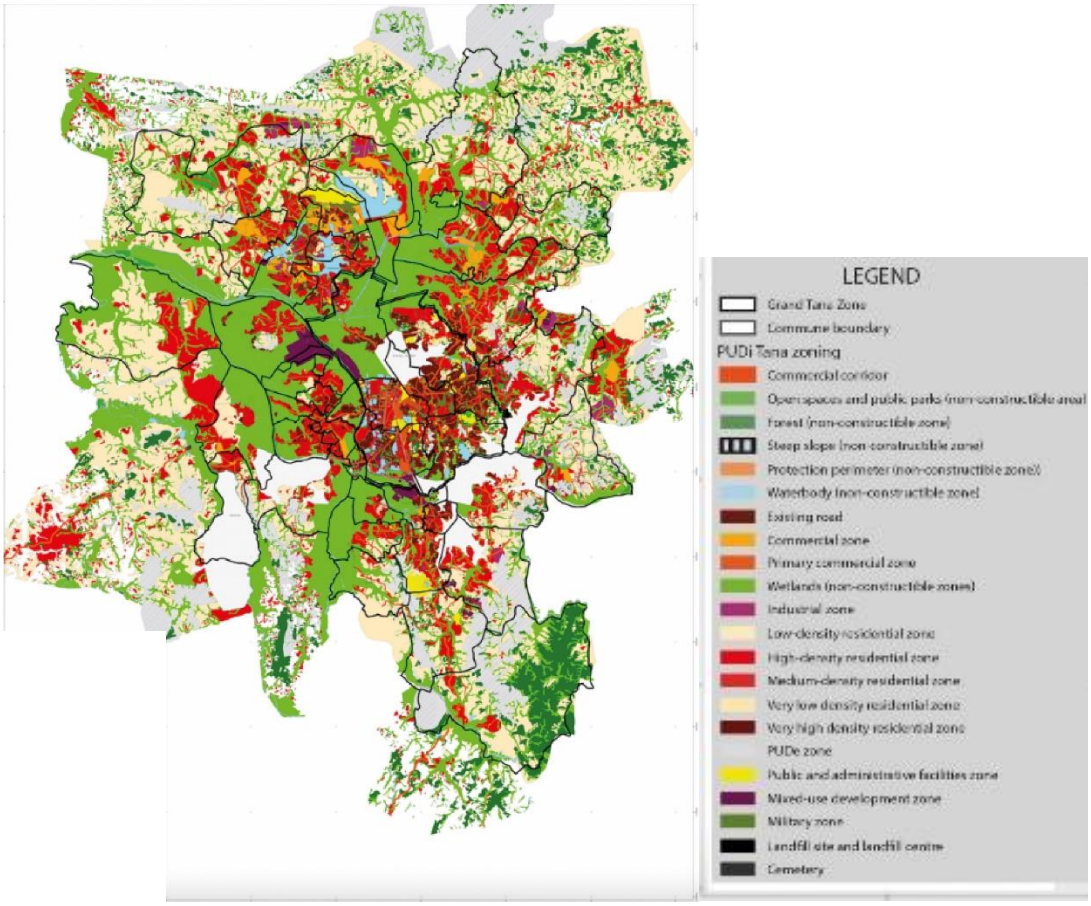
3.5 Development Strategies and Plans at the Municipal Level

3.5.1. Integrated Urban Development Sector

3.5.1.1. Urban Planning Tools and Laws at Greater Tana Area and CUA Levels

The **Urban Planning and Housing Law 2015-052 (LUH)** stipulates that the Urban Master Plan (PUDi) sets out the strategic guidelines for a conurbation, the development of which must be the subject of an overall study due to the interdependence of its various spatial components on an economic, social and environmental level.

The **Urban Master Plan (PUDi)** determines the general land use and, where necessary, the nature and layout of facilities and infrastructure, particularly transport, and the location of important services and activities. Based on forecasts of population growth and requirements in terms of housing, jobs and facilities, it sets the general guidelines for the extension of urban development and the restructuring of urbanised areas. The PUDi was finalised in 2019 in line with the TaToM project and remains the reference document for urban planning, although it needs updating in light of the major urban and infrastructure projects that are redefining urban development trends in the south-west (Tana-Masoandro new town, VROT) and north-east (Talata-Volonondry new town, motorway to Toamasina).



Source: PUDi TaToM, 2019 (JICA funded)

Figure 3-8 Land Use Orientations of the PUDi

The **Detailed Urban Development Plan (PUDé)** provides detailed urban development plan studies for particular areas of the Municipality's master plan or urban development plan according to specific sectors or districts. It is intended for local use and the preparation of a detailed urban plan is preceded by the establishment of the Local Occupancy Plan for the sector or district concerned. The PUDé of the By-Pass Zone, Ampitatafika and Ankorondrano are in force, although they are drawn up as land use plans and do not provide quantified demographic and economic projections.

The PUDés for the PRODUIR and PADARNE zones are being drawn up in 2023 and their provisional versions are used as a reference in this report.

Urban planning within the CUA is the responsibility of the Urban Planning Department, which manages all parks and gardens, as well as roads, building permits and urban plan management.

The IPAM Unit (Ivom- Panajariana ny tanànan'Antananarivo sy ny Manodidina) is a new Urban Planning Agency implemented in 2020 with the objective to coordinate and implement urban planning orientations at the level of the Greater Tana Area. IPAM plays a role of coordination, communication and capacity building for the 38 municipalities, especially those outside of CUA

area, as they need technical and financial support to operationalize and apply planning tools and laws in their territorial areas.

3.5.1.2. Urban Development Strategies, Urban Structure and Land Use Policies for the Antananarivo Metropolitan Area

The PUDi's overall strategies for the Antananarivo metropolitan area aim to reorganise the urban structure as follows:

- Strengthening the national and international administrative functions of the urban centre within the CUA. This requires coordination with the development of the new administrative city of Tana-Masoandro, located 30 km from the city centre;
- Develop new urban centres outside the CUA and provide basic infrastructure, such as electricity and water supplies and access roads outside the CUA, in order to structure peripheral urbanisation;
- Strengthen the capacity of radial roads linking the interior and exterior of the CUA in order to organise population densities and urban functions towards the exterior of the CUA;
- Building an outer ring road to strengthen connectivity with the Port of Toamasina and to attract industries and logistics hubs along the outer ring roads near the RN2;
- Improve the high-density residential environment within the CUA, by integrating sanitised local roads and supplying neighbourhoods with water;
- Strengthen the water retention capacity of the urban areas of the CUA by preserving and building water retention basins and reinforcing land-use regulations;
- Preserve part of the rice fields in flood-prone areas by rehabilitating irrigation infrastructure for agricultural land. This measure applies to the PUDé of the PADARNE zone and must be a priority in the development of the Ankorondrano urban centre.

The projected urban structure has the following general orientations:

- Four primary urban centres in the CUA will form the urban core for the Antananarivo conurbation. The link between Ivato Airport, the Ivato business centre (secondary urban centre) and the primary urban centres will be strengthened with a view to accentuating the service and trade industries.
- Urban sub-centres and sub-urban centres outside the CUA will be developed to make Antananarivo a polycentric city. The construction of high-capacity radial roads will help to achieve this objective.
- An outer ring road will link the sub-urban centres. The outer ring road will incorporate new industrial sites on the outskirts of the city, in the area north of Ivato Airport, and in the area to the north-east between the RN3. Large industrial parks will be developed along this bypass from the RN2 to the RN7. This route will strengthen connectivity between Antananarivo, Toamasina and Antsirabe. At present, the final route of the motorway linking

Greater Tana to Toamasina will start at Talata-Volonondry, but its exact route has not yet been decided.

- New towns to the east and west of the Antananarivo conurbation are linked by east-west roads providing access to the urban core.
- The New Town / Smart City of Tana-Masoandro will be located 35 km south-west of Tana, and involves the construction of a connecting motorway (VROT) and a public transport line that will influence the spatial structuring of urban development, in favour of the new towns planned to the south-west of the agglomeration.

Land use policies for the Antananarivo agglomeration include the following guidelines:

- Very high and medium density residential areas will involve an increase in the height of residential buildings;
- Outside the CUA, the development of high and medium density residential areas will be prioritised along radial roads and around urban sub-centres;
- Beyond the Outer Ring Road, the development of low-density residential areas is promoted. In certain areas, the development of new towns accommodating high-density and medium-density residential areas is promoted in order to accommodate growing low- and middle-income populations.
- Within the CUA, commercial zones including administrative zones will grow along newly built main roads, as well as in existing commercial zones, such as Analakely and Ankorondrano. More commercial building heights will be permitted in commercial zones.
- Outside the CUA, the commercial function of the exurban areas will increase, turning them into "Urban Sub-Centres";
- Around the Outer Ring Road, sub-urban centres will be developed to accommodate commercial and administrative areas;
- Industrial zones will be developed in the sub-urban areas along the planned Outer Ring Road;
- Flood-prone areas will be preserved in order to maintain the water retention capacity of 15 million m3 within the CUA;
- It will be necessary to strictly control the volume of flood-risk land to be filled in through the application of land-use zoning regulations and the construction of water retention basins;
- Potential sites for urban parks and sports fields are designated in the revised PUDi.

Recent developments in planning have had a direct impact on the spatial and demographic structuring of Antananarivo's urban growth:

- The planned administrative Smart City of Tana-Masoandro, 30 km to the south-west, includes a daytime population of 200,000 to 300,000 people (population + employment) and a resident population of 100,000. The strategic importance of this project from

political and economic point of view means that there will be significant commuter traffic with the Greater Tana conurbation. We can therefore anticipate the eventual urbanization of Tana's south-western sub-urban ring, with strong potential for urban development for the middle classes near the new towns (PUDi) of Nord Fenoarivo, Sud Fenoarivo and Ampangabe. This trend implies more residential and commercial urbanization in the south-west, while urbanization in the south-east and north-east will be much more affected by industrial development.

- In the north-east of the agglomeration, the route of the future motorway to Toamasina will influence inter-urban logistics and urbanization trends. SENVH is currently giving priority to the development of a new town at Talata-Volonondry (along the RN3), which is the starting point for the Antananarivo - Toamasina highway project. In addition, a number of housing projects and new neighborhoods in Ambodifasina are making it a fast-growing urban sub-centre. The PADARNE PUDé has also suggested the development of an option B for the creation of a Madarail logistics hub in Ambodifasina, which could complement the first one planned for Amoronakona (located at the intersection between East Rocade and By Pass).
- The urban, commercial and administrative hub of Ankorondrano is best placed to emerge as a first-tier urban sub-centre, but its development is highly dependent on land control, the creation of retention basins and the construction of the western Rocade. It is directly affected by the VROT project.

3.5.2. Transport Sector

The Transport Master Plan (Schéma Directeur du Transport, SDT) for Antananarivo Agglomeration was completed in December 2021 with financial support of the Arab Bank for Economic Development in Africa (BADEA). The main objective of this master plan is to define an overall policy for transport facilities in Antananarivo Agglomeration, and to set up an implementation schedule by prioritizing investments for the next 20 years consisting of four phases.

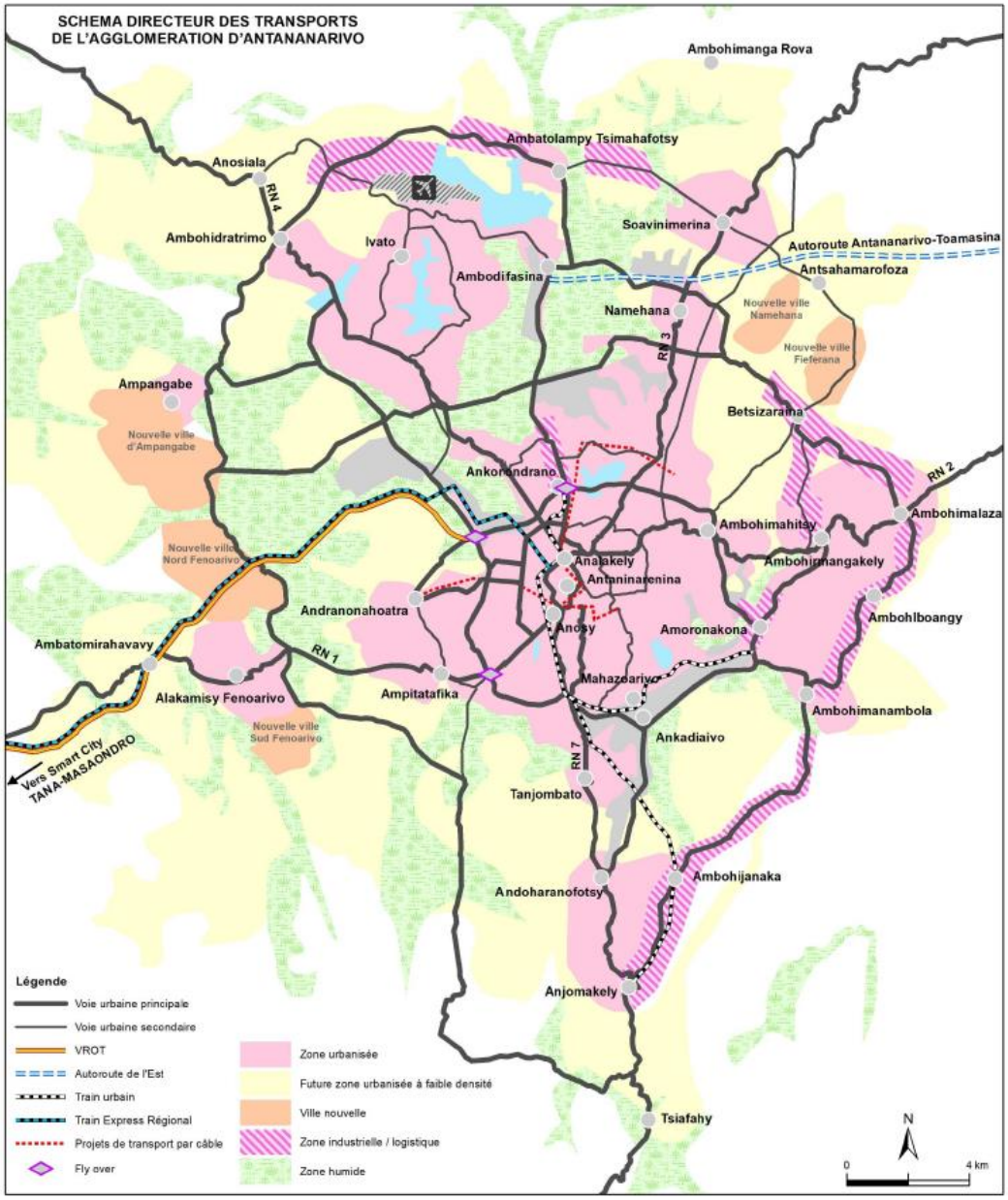
3.5.2.1. Transport Master Plan

The Transport Master Plan shown in Figure 3-9 addresses four specific objectives:

- Accessibility: To develop a transport network that ensures accessibility to the entire urban structure of the future Antananarivo Agglomeration, which should accompany and support the development of the future urban structures (residential and business).
- Reduced transit through the city center: To relieve the central area of the city from motorized transit traffic, while maintaining its attractiveness and economic dynamism.
- Quality of service: To improve transportation and travel conditions for all users, particularly during peak periods of the day, and continually to meet the growth in travel demand and

motorized traffic in the Agglomeration.

- Multimodality: To provide an integrated, equitable and efficient transportation system that promotes multimodality and interoperability between various ways of transport.



Source: Study of the Transport Master Plan in the City of Antananarivo, Arab Bank for Economic Development in Africa (BADEA), 2021

Figure 3-9 Transport Master Plan of Antananarivo 2021-2040

3.5.2.2. Phasing of the Master Plan

Implementation of the twenty-year (2021-2040) Transport Master Plan is divided into four phases, each phase composing a five-year program. The estimated total cost of the projects in the Master Plan is Euro 1495.0 Million.

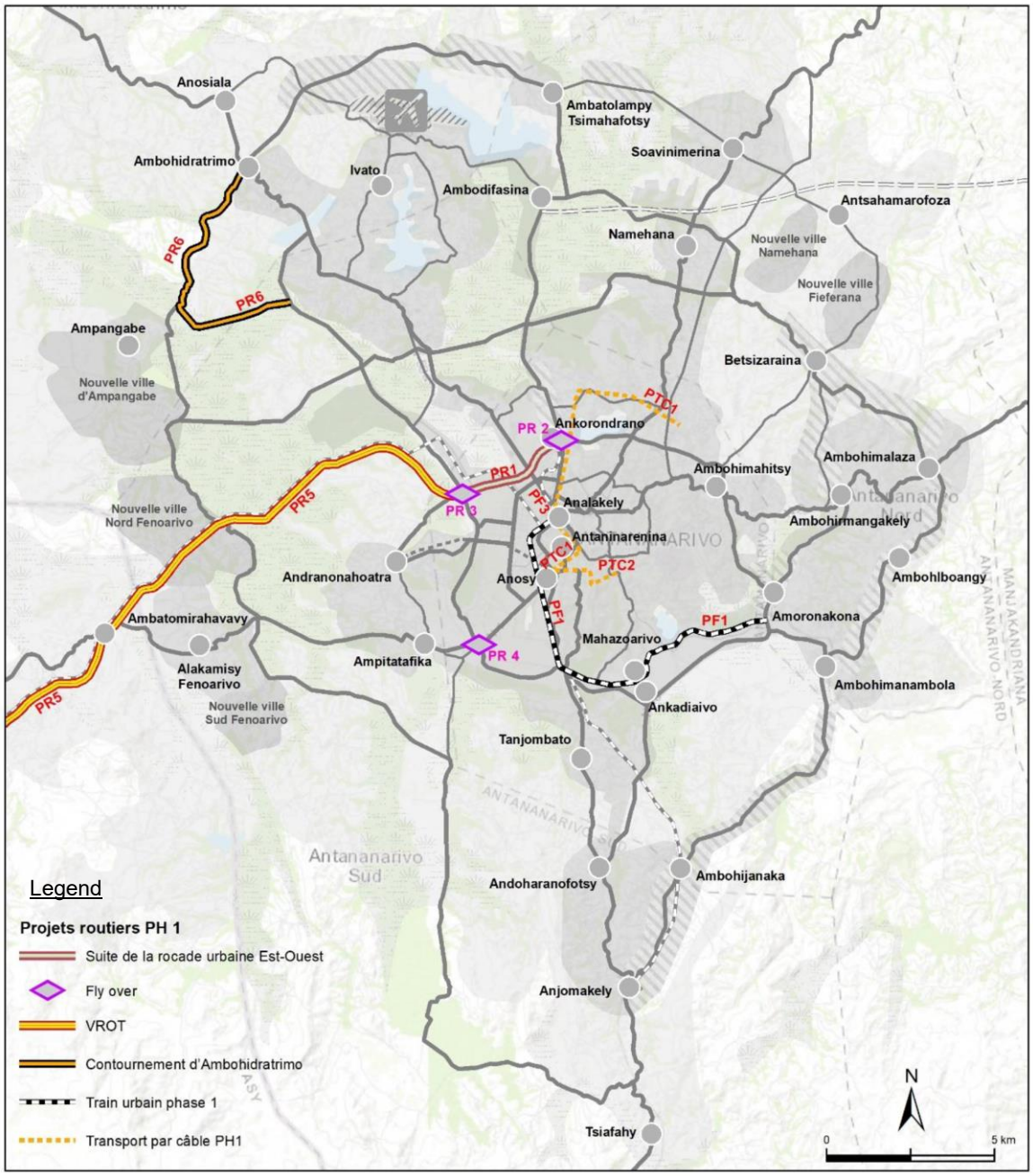
Phase I (2021-2025)

Phase 1 (2021-2025) projects are for the most part already registered projects in Short-term Investment Plans of the country. West Tana expressway (VROT) (PR 5) which link Antananarivo and the new town Tana-Masoandro in Imerintsiatosika is under the Phase 1. Phase 1 projects aim to:

- Improve travel conditions in the center of Antananarivo and particularly on the Anosy – Ankorondrano axis (PR1 to PR3, PF1 and PTC1 as shown in Table 3-9)
- Ensure a direct and fast link between Antananarivo and the future smart city Tana-Masoandro
- Relieve the RN3 road of the intensity of traffic by creating a relief route towards the road of the airport.

Table 3-9 Transport Projects in Phase I (2021-2025)

Project Name	Detail	Cost (M Euro)
Road project 1 (PR 1)	Extension of the Marais Masay ring road between the Flyover in Ankorondrano and the dyke road (at the Maki Stadium)	36.0
Road project 2 (PR 2)	Fly Over Ankorondrano (interchange)	12.5
Road project 3 (PR 3)	Fly Over Andohatapenaka (interchange) at the crossing of extension of the Marais Masay bypass and the RN58A road	12.5
Road project 4 (PR 4)	Fly over Anosizato (interchange) at the crossing of the RN1 road and from the RN58A road (dike road) to Anosizato	17.5
Road project 5 (PR 5)	West Tana expressway (VROT) between the municipality of Antananarivo and the new town Tana-Masoandro in Imerintsiatosika, located about 22 km west of Antananarivo	198.0
Road project 6 (PR 6)	Ambohidratimo bypass road which allows the junction between the RN58A road (dike road) and the RN4 road at the exit of Ambohidratimo	46.5
Railway project 1 (PF 1)	Renovation of the railway line between Soarano station and Amoronakona station for about 12 km, to allow the start of the 1st stage of the urban train	60.0
Cable Transport Project 1 (PTC 1)	Construction of a cable transmission line (TPC) which serves all the primary centers of the city between Anosy, Soarano station, Ankorondrano, Vandry and Ambatobe	100.0
Cable Transport Project 2 (PTC 2)	Construction of a 2nd TPC line between Anosy, Andohalo and Ambanidja	35.0
	Total	518.0



Source: Study of the Transport Master Plan in the City of Antananarivo, Arab Bank for Economic Development in Africa (BADEA), 2021

Figure 3-10 Location Map of Projects in Phase I (2021-2025)

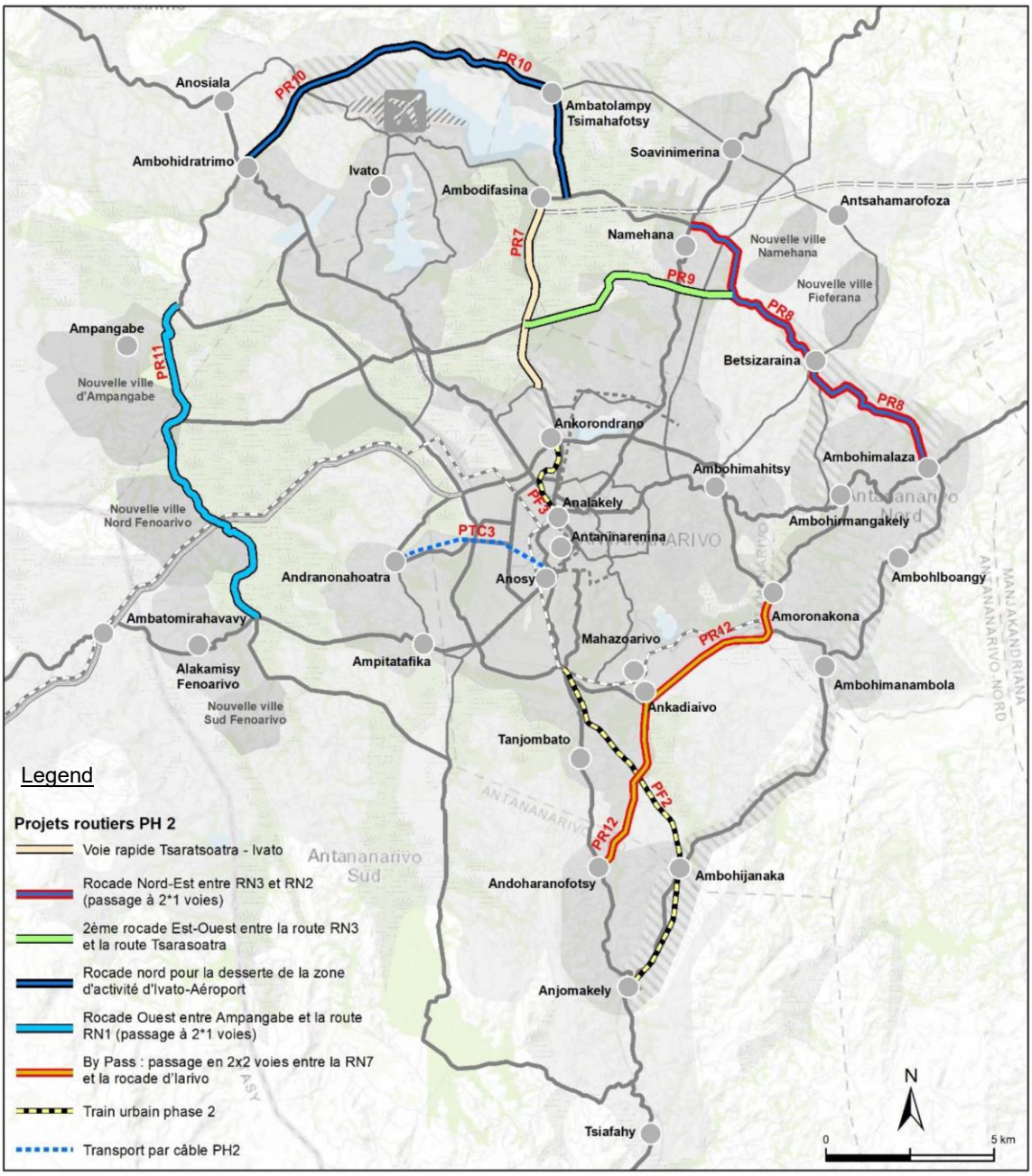
Phase II (2026-2030)

The projects that correspond to the phase development of the PUDi are related to the construction of the section of the Outer Ring Road connecting RN2 and RN3 (PR 8), the section linking RN3 and RN4 (PR 10) and the project for doubling Tokyo Bypass (PR 12). The construction of the western outer ring road connecting Ampangabe to RN1 is also proposed in this phase (PR 11).

The second phase of the project for urban rail is the section between Soarano and Ankorondrano (PF 3), as well as the renovation of the railway line to the south of Antananarivo Agglomeration (Anjomakely) (PF 2). However, this Transport Master Plan does not have any plan to extend the urban rail to Ivato. Moreover, this master plan proposes in this phase the implementation of the cable car transport between Anosy and Andranonahoatra.

Table 3-10 Transport Projects in Phase II (2026-2030)

Project Name	Detail	Cost (M Euro)
Road project 7 (PR 7)	Doubling of the Tsaratsoatra – Ivato Airport road	24.0
Road project 8 (PR 8)	Construction project for the North-East outer ring road between the RN2 road and the RN3 road	36.3
Road project 9 (PR 9)	Construction of a second East-West ring road between the RN3 road and the airport road (Tsaratsoatra – Ivato)	40.0
Road project 10 (PR 10)	Outer bypass project north of Ivato, which is being deployed between the airport road and the RN4 road (Ambodifasina - Ambatolampy Tsimahafotsy – Ambohidratrimo)	42.7
Road project 11 (PR 11)	Western outer ring road between the town of Ampangabe and the road RN1	36
Road project 12 (PR 12)	Project to double the By Pass (passage to 2x2 lanes) between the RN7 road and the Iarivo ring road for about 11 km	33
Railway project 2 (PF 2)	Project to renovate the railway line between the station of travelers from Soanierana (Ankadimbahoaka) and the terminus station of Anjomakely (about 11km)	44.0
Railway project 3 (PF 3)	Project to renovate the railway line between the station central Soarano and Ankorondrano (about 3 km)	14.0
Cable Transmission Project 3 (PTC 3)	Construction of a cable transmission line (TPC) which serves important sub-sectors in the center-west of the city between Anosy and Andranonahoatra	70.0
	Total	340.0



Source: Study of the Transport Master Plan in the City of Antananarivo, Arab Bank for Economic Development in Africa (BADEA), 2021

Figure 3-11 Location Map of Transport Projects in Phase II (2026-2030)

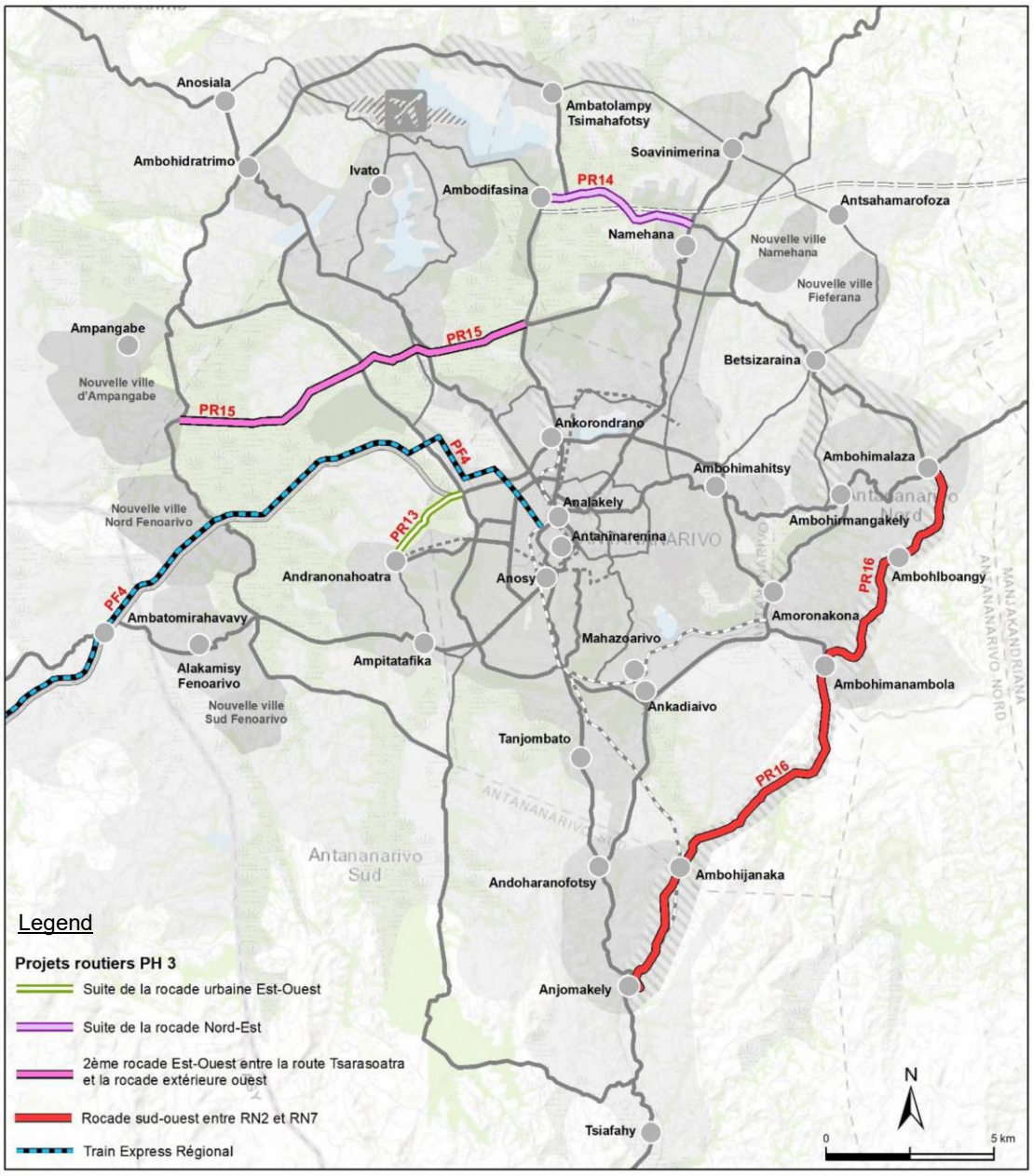
Phase III (2031-2035)

There four (4) road projects projected under Phase III. The proposed south-east section of Outer Ring Road connecting RN2 and RN7 (PR 16) is similar to the phase proposed in the PUDi. There is a single railway project which is the construction of a railway line for the interurban train between Antananarivo and Imerintsiatosika to commute to the new city of Tana-Masoandro (PF 4).

Table 3-11 Transport Projects in Phase III (2031-2035)

Project Name	Detail	Cost (M Euro)
Road project 13 (PR 13)	Project to extend the East-West ring road from the Maki stadium (Andohatapenaka) to Andranonahoatra	15.0
Road project 14 (PR 14)	Project to extend the North-East ring road between the RN3 road and the airport road (Ambodifasina)	30.0
Road project 15 (PR 15)	Project to extend the 2nd East-West ring road between the airport road (Tsaratsoatra) and the western outer ring road at the level of the new town of Ampangabe	45.2
Road project 16 (PR 16)	South-West outer ring road between the RN7 road and the RN2 road	84.8
Railway project 4 (PF 4)	Construction project of the railway line for the intercity train between Antananarivo and Imerintsiatosika to serve the smart city Tana-Masoandro	250.0
	Total	425.0

Source: Study of the Transport Master Plan in the City of Antananarivo, Arab Bank for Economic Development in Africa (BADEA), 2021



Source: Study of the Transport Master Plan in the City of Antananarivo, Arab Bank for Economic Development in Africa (BADEA), 2021

Figure 3-12 Location Map of Transport Projects in Phase III (2031-2035)

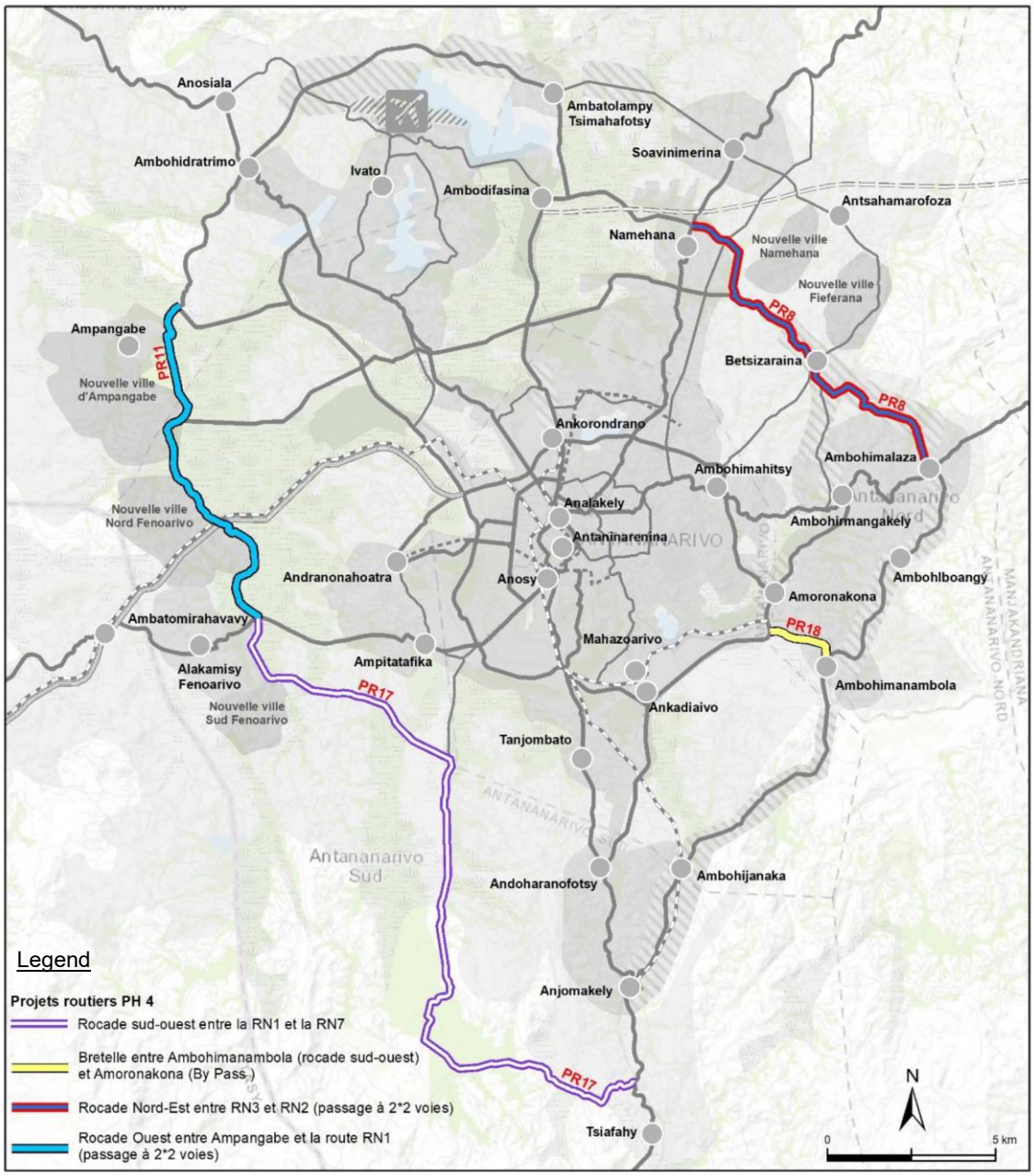
Phase IV (2036-2040)

Completion of the various missing sections of the outer ring roads are under this phase as shown in Table 3-12 and succeeding figure.

Table 3-12 Transport Projects in Phase IV (2036-2040)

Project Name	Detail	Cost (Euro M)
Road project 17 (PR 17)	South-West ring road between the RN1 road and the RN7 road	99.0
Road project 18 (PR 18)	Slip road between the South-West ring road (Ambohimanambola) and the By Pass (Amoronakona)	12.0
Road project 8 (PR 8)	North-East ring road between the RN3 and RN2 roads (Phase 2: transition to 2x2 lanes)	36.3
Road project 10 (PR 10)	North ring road for the airport activity zone (Phase 2: transition to 2x2 lanes)	28.7
Road project 11 (PR 11)	West ring road between Ampangabe and the RN1 road (Phase 2: transition to 2x2 lanes)	36.0
	Total	212.0

Source: Study of the Transport Master Plan in the City of Antananarivo, Arab Bank for Economic Development in Africa (BADEA), 2021



Source: Study of the Transport Master Plan in the City of Antananarivo, Arab Bank for Economic Development in Africa (BADEA), 2021

Figure 3-13 Location Map of Transport Projects in Phase Ⅳ (2036-2040)

CHAPTER 4 Implementation System and Project Trends in Transport and Urban Development in Antananarivo Metropolitan Area

4.1 Government Agencies responsible for Transportation and Urban Development

The main projects related to transport and urban development in Antananarivo metropolitan area are presented in Table 4-1. Also shown in the same table is the role and structure of the ministries and agencies responsible for each project.

Table 4-1 Transportation and Urban Development Projects by Various Agencies

Government Agency	Mandate/Function	Major Projects in the Antananarivo Metropolitan Area
MDAT: Ministry of Decentralization and Land development Former MATSF *Reorganization of ministries in 2024	- Policy making related to land development, land development and improvement, and urban planning, implementation and monitoring in the metropolitan area - Land Valuation and Expropriation (Service foncier), Land Use and Development Permit	- Promotion of PUDi - Formulation and promotion of PUDé - Implementation of the PRODUIR(WB) project - Land use permit for LP's oil tank relocation site
MTP (implementing agency) AR	- Mainly, implementation of policy, planning, implementation, monitoring, etc. related to national road development and maintenance - MTP is in charge of implementation of new road construction projects as the client, and the road agency is in charge of implementation as the representative of the client	- Intermediate Ring Road (Rocade) project - Anosizato flyover project - Maki flyover project - VROT project - TaTom expressway project - Expressway Maintenance
MTM (implementing agency) ATT Madarail	- Policy and planning, implementation, and monitoring related to land transportation, shipping, aviation, etc - ATT is responsible for the licensing and management of Taxi Be (minibus) - The maintenance and management of railroads is carried out by Madarail	- Promotion of SDT - Urban rail project - Logistics terminal project
SENVH *After the reorganization of ministries in 2024, it will be abolished.	- Planning and implementation of new city and residential developments and related projects	- Implementation of the new city construction project (Tana Masaondro) - Planning of residential development for Talata-Volonondry new town project - Implementation of cable car project

Government Agency	Mandate/Function	Major Projects in the Antananarivo Metropolitan Area
CUA	- City road development and maintenance - Community development	- Intersection improvement project - Community road development project - Local coordination of detailed urban planning projects promoted by MATSF

Source: JICA Study Team

4.2 Ministry of Decentralization and Land Development (MDAT)

4.2.1. Mandate

With the inauguration of the new Cabinet in 2024, MATSF was changed to MDAT (Ministry of Decentralization and Land Development). Since the new responsibilities are currently being updated, the roles of the former MATSF are presented here.

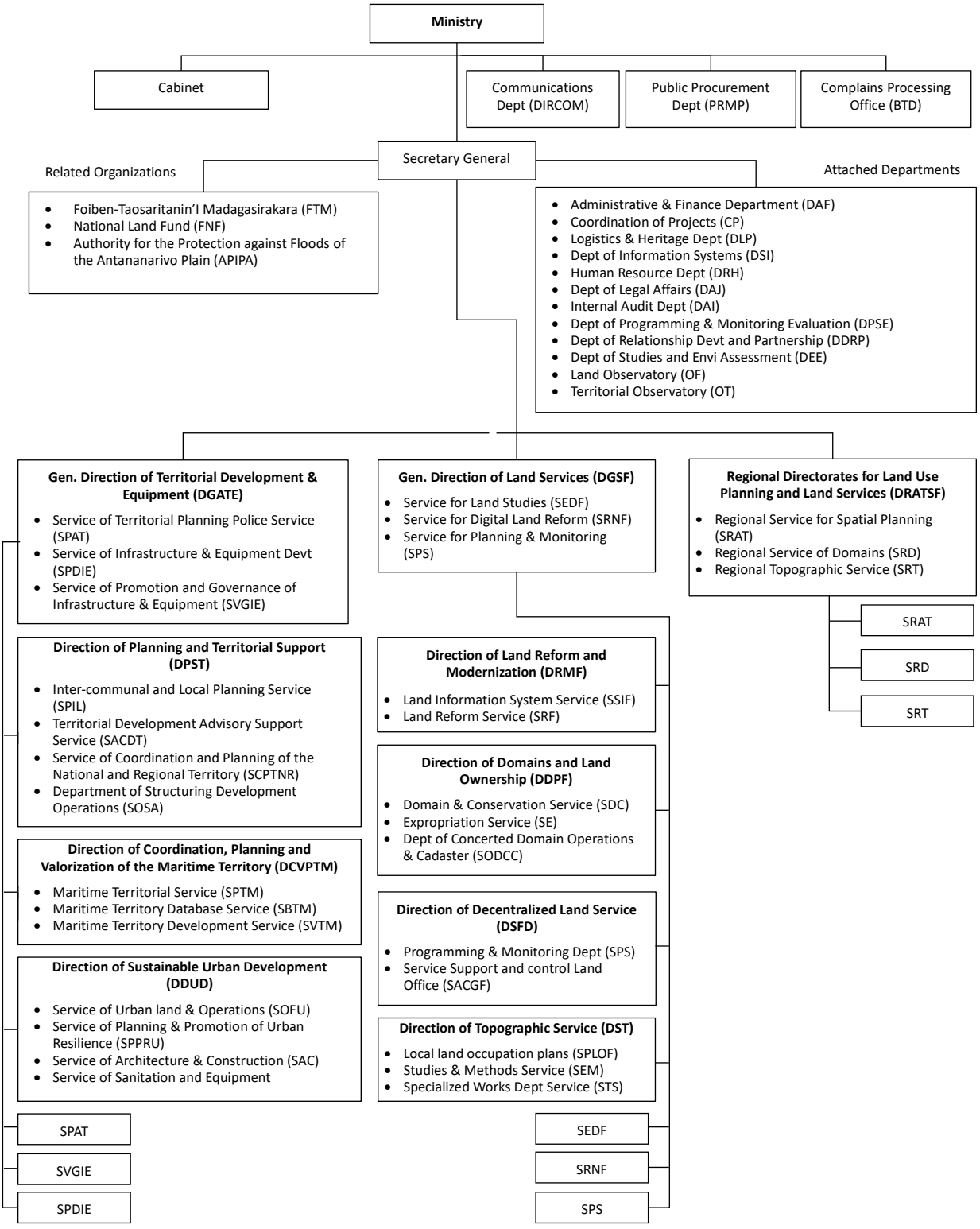
As part of the achievement of the strategic objectives set out in the Initiative Emergence Madagascar (IEM), the Ministry of Territorial Planning and Land Services is responsible for the design, implementation and monitoring of the government's policy on territorial development and land services. In this respect, MATSF's mandate covers the following:

- Territorial forecasting and planning, the synergy of the various public and private, sectoral and transversal development and planning programmes for a better territorial and social anchoring of the IEM's actions;
- Project management for the construction, rehabilitation and maintenance of roads within the national road network in accordance with the Road Charter as well as public infrastructure
- Land reform and its implementation, as well as the improvement of land security and rational land management as a whole;
- Promotion and development of cities in line with the IEM's orientations;
- Coordination of the coherence of the interventions of all the actors and departments concerned with land use planning (territorial planning) and land tenure; and
- In general, the development and implementation of sectoral policies related to the Ministry's areas of competence.

Source: Official website of the MATSF (http://www.matsf.gov.mg/les-missions-du-ministere)

4.2.2. Organizational Chart of MATSF

The organizational chart of MATSF is illustrated in the Figure 4-1:



Source: Decree n°2021-052

Figure 4-1 Organization Chart of the Ministry of Territorial Planning and Land Services (MATSF)

Table 4-2 Organizational Chart of MATSF

Abbreviation	French	English
Attached to the Minister		
SG	Le Secrétariat Général	General Secretariat
Cabinet	Cabinet du Ministre	Cabinet of the Minister
DIRCOM	Direction de la Communication	Direction in charge of Communications
PRMP	Personne Responsable des Marchés Publics	Person Responsible for Public Procurement
BTD	Le Bureau de Traitement des Doléances.	Complaints Processing Office
Attached to the Secrétariat Général		
DGATE	Direction Générale de l'Aménagement du Territoire et de l'Equipement	General Direction of Territorial Development and Equipment
DGSF	Direction Générale des Services Fonciers	General Direction of Land Services
DAF	Direction Administrative et Financière	Administrative and Financial Direction
CP	Coordination des Projets	Coordination of Projects
DLP	Direction de la Logistique et du Patrimoine	Logistics and Heritage Direction
DSI	Direction des Systèmes d'Informations	Direction of Information Systems
DRH	Direction des Ressources Humaines	Human Resources Department
DAJ	Direction des Affaires Juridiques	Department of Legal Affairs
DAI	Direction de l'Audit Interne	Internal Audit Department
DPSE	Direction de la Programmation et du Suivi-Evaluation	Department of Programming and Monitoring Evaluation
DDRP	Direction du Développement Relationnel et de Partenariat	Department of Relationship Development and Partnership
DEE	Direction des Etudes et de l'Evaluation Environnemental	Department of Studies and Environmental Assessment
OF	Observatoire du Foncier	Land Observatory
OT	Observatoire du Territoire	Territorial observatory
DRATSF	Directions Régionales de l'Aménagement du Territoire et des Services Fonciers, incluant :	Regional Directions for Land Use Planning and Land Services, which include
- SRAT	Le Service Régional de l'Aménagement du Territoire	Regional Service for Spatial Planning
- SRD	Le Service Régional des Domaines	Regional Service of Domains
- SRT	Le Service Régional Topographique.	Regional Topographic Service
DGSF	Attached to the General Direction of Land Services	
DRMF	Direction de la Réforme et de la Modernisation Foncières	Direction of Land Reform and Modernization
DSFD	Direction des Services Fonciers Décentralisés	Direction of Decentralized Land Services
DDPF	Direction des Domaines et de la Propriété Foncière	Direction of Domains and Land Ownership
DST	Direction des Services Topographiques	Direction of Topographical Services
SEDF	Service des Etudes Domaniales et Foncières	Section in charge of Land Studies
SRNF	Service pour la Réforme Numérique Foncière	Section in charge of Digital Land Reform
SPS	Service de Planification et Suivi	Section of Planning and Monitoring
DGATE	Attached to the General Direction of Territorial Development and Equipment	

Abbreviation	French	English
DDUD	Direction du Développement Urbain Durable	Direction of Sustainable Urban Development
DCPVTM	Direction de la Coordination, de la Planification et de la Valorisation du Territoire Maritime	Direction of Coordination, Planning and Valorization of the Maritime Territory
DPST	Direction de la Planification et du Soutien au Territoire	Direction of Planning and Territorial Support
SPAT	Service de la Police de l'Aménagement du Territoire	Section of Territorial Planning Police Service
SPDIE	Service de la Promotion du Développement des Infrastructures et Equipements	Section of Infrastructure and Equipment Development
SVGIE	Service de la Valorisation et de Gouvernance des Infrastructures et Equipements.	Section of Promotion and Governance of Infrastructures and Equipment
Attached Organisations / Institutions of the MATSF		
FTM	Foibe-taosarintanin'i Madagasikara	Map Center of Madagascar
FNF	Fonds National Foncier	National Land Fund
APIPA	Autorité pour la Protection contre l'Inondation de la Plaine d'Antananarivo	Authority for the Protection against the Flood of the Antananarivo Plain

Source: Decree n°2021-052

4.2.3. Number of Employees at the MATSF Headquarters

The total number of MATSF employees at their Headquarters is 27 as shown in Table 4-3.

Table 4-3 Total Number of MATSF Employees at Headquarters

Direction	No. of employees
General Direction of Territorial Development and Equipment	5
Direction of Sustainable Urban Development	7
Direction of Planning and Territorial Support	7
Direction of Coordination, Planning and Valorization of the Maritime Territory	5
Territory Observatory	3
Total	**27**

Source: MATSF, 2023

4.2.4. Budget of MATSF

The budget of MATSF is provided in Table 4-4:

Table 4-4 Budget of MATSF

Unit: (in thousands of Ariary)

		LFR 2022	*LFI 2023*	*Forecast 2024*	*Forecast 2025*
REVENUE FORECAST	**A.ESTATE AND LAND SECURITY**	7,056,203	4,970,010	3	3
	-Administration and Coordination	3.00	2,970,000	3	3
	-Estate and Land Security	7,056,200	2,000,010	-	-
	B.TERRITORY PLANNING	20,270,000	21,510,010	12,132,000	4,165,000
	-Town Planning and Equipment	20,270,000	21,510,010	12,132,000	4,165,000
TOTAL		**27,326,203**	**26,480,020**	**12,132,003**	**4,165,003**
EXPENDITURE FORECAST	**A.ESTATE AND LAND SECURITY**	11,856,195	35,548,907	4,223,508	4,634,726
	-Administration and Coordination	574,715	578,215	723,508	834,726
	-Estate and Land Security	11,281,480	34,970,692	3,500,000	3,800,000
	B.TERRITORY PLANNING	241,637,165	218,706,921	208,108,435	123,555,530
	-Administration and Coordination	25,885,459	28,051,328	31,231,794	38,390,875
	-Town Planning and Equipment	215,751,706	190,655,593	176,876,641	85,164,655
TOTAL		**253,493,360**	**254,255,828**	**212,331,943**	**128,190,256**

Note: LFI= Loi de Finances Initiale (Initial Budget Law); LFR= Loi de Finances Rectificative (Revised Budget Law)
Source: "Document Budgétaire annexe à la Loi N° 2022 - 015 portant Loi de Finances pour 2023" (Budgetary document annexed to Law N° 2022 - 015 on the Finance Law for 2023)

4.3 Ministry of Public Works (MTP)

4.3.1. Mandate

As part of the achievement of strategic objectives set out in the Initiative Emergence Madagascar (IEM), the Ministry of Public Works (MTP) is responsible for the design, implementation and monitoring of government policies on public works. As such, MTP's jurisdiction mainly covers the following matters:

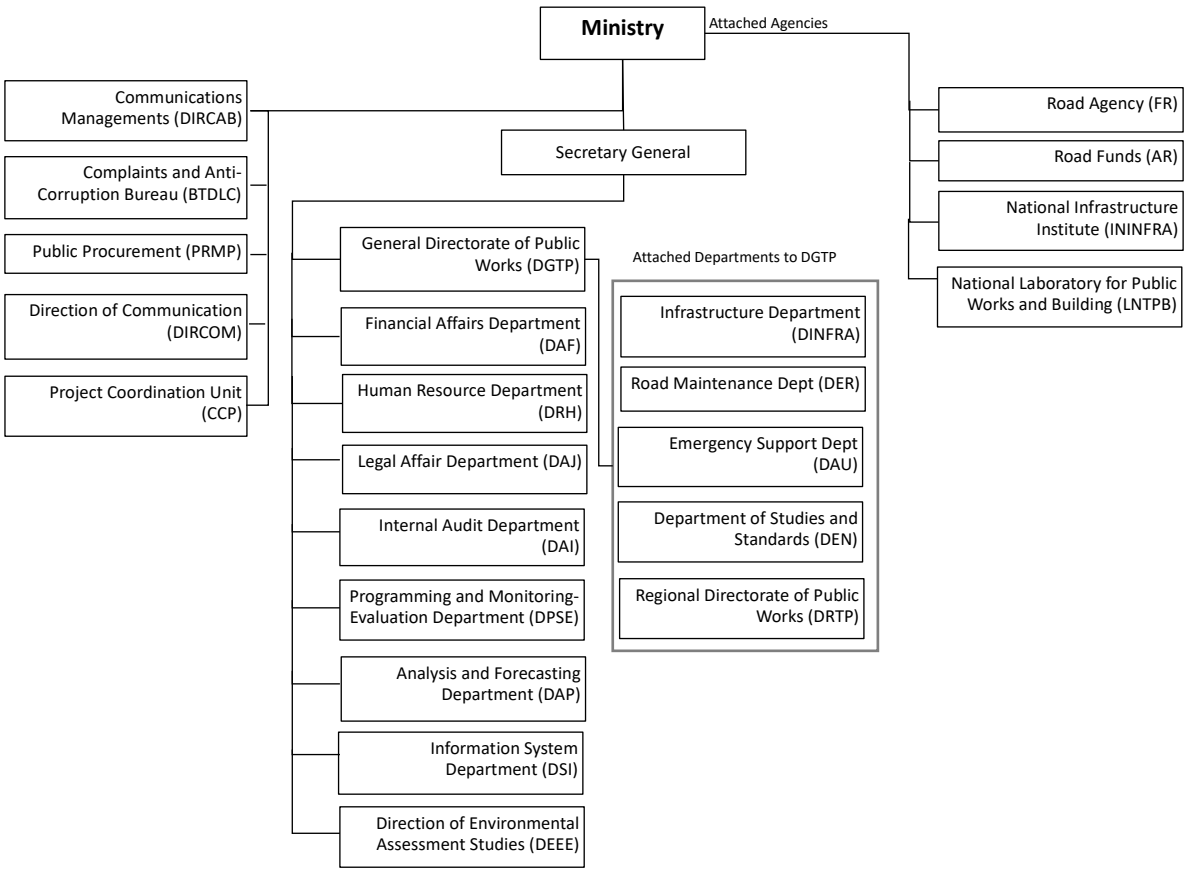
- Prospective and territorial planning, the synergy of the various public and private, sectoral and transversal development and planning programmes for a better territorial and social anchoring of the actions of the IEM;
- Project management for the construction, rehabilitation and maintenance of roads within the national road network in accordance with the Road Charter, as well as public infrastructure
- Land reform and its implementation as well as the improvement of land security and rational land management as a whole;
- Promotion and development of cities in line with IEM's guidelines;
- Coordination of the coherence of the interventions of all the actors and departments concerned with public works; and

- In general, the development and implementation of sectoral policies related to the Ministry's areas of competence.

Source: The Advisory Work for Urban Development and Logistics in TaToM Region, JICA, 2023

4.3.2. Organizational Chart of MTP

The organizational chart of MTP is illustrated in Figure 4-2.



Source: Decree n°2021-0854

Figure 4-2 Organizational Chart of the Ministry of Public Works (MTP)

Table 4-5 Organizational Chart of MTP

Abbreviation	French	English
Attached to the Minister		
SG	Secrétariat Général	General Secretariat
DIRCAB	Directeur de Cabinet	Director of Cabinet
BTDLC	Bureau de Traitement des Doléances et de la Lutte contre la Corruption	Office for the Handling of Grievances and the Fight against Corruption
PRMP	Personne Responsable des Marchés Publics	Person Responsible for Public Procurement
DIRCOM	Direction de la Communication	Communication Department
CCP	Cellule de Coordination des Projets	Project Coordination Unit

Abbreviation	French	English
Attached to Secretariat Général		
DGTP	Direction Générale des Travaux Publics	General Direction of Public Works
DAF	Direction des Affaires Financières	Direction of Financial Affairs
DRH	Direction des Ressources Humaines	Direction of Human Resources
DAJ	Direction des Affaires Juridiques	Direction of Legal Affairs
DAI	Direction de l'Audit Interne	Direction of Internal Audit
DPSE	Direction de la Programmation et de Suivi Evaluation	Direction of Programming and Monitoring Evaluation
DAP	Direction des Analyses Prospectives	Direction of Prospective Analysis
DSI	Direction des Systèmes d'Informations	Direction of Information Systems
DEEE	Direction des Etudes et de l'Evaluation Environnementale	Direction of Environmental Assessment Studies
DGTP	Attached to the General Direction of Public Works	
- DINFRA	Direction des Infrastructures	Direction of Infrastructure Directorate
- DER	Direction de l'Entretien Routier	Direction of Road Maintenance Department
- DAU	Direction d'Appui aux Urgences	Direction in charge of Emergency Support
- DEN	Direction des Etudes et Normes	Direction of Studies and Standards
- DRTP	Directions Régionales des Travaux Publics	Regional Directons of Public Works
Attached Organisations / Institutions of the MTP		
FR	- Fonds Routiers	- Road Funds
AR	- Agence Routière	- Road Agency
ININFRA	- Institut National de l'Infrastructure	- National Institute of Infrastructure
LNTPB	- Laboratoire National des Travaux Publics et Bâtiment	- National Laboratory of Public Works and Building

Source: Décret n°2021-0854

4.3.3. Number of Employees at MTP Headquarters

The total number of MTP employees at their Headquarters is 55 as shown in the Table 4-6.

Table 4-6 The Total Number of MTP Employees

Direction	No. of employees
Project Coordination Unit	4
General Direction of Public Works	13
Direction of Internal Audit	1
Direction in charge of Emergency Support	6
Direction of Studies and Standards	8
Direction of Road Maintenance Department	3
Direction of Infrastructure	20
Total	**55**

Source: MTP, 2023

4.3.4. Budget of MTP

The budget of MTP is provided in Table 4-7.

Table 4-7 Budget of MTP

Unit: (in thousands of Ariary)

		LFR 2022	*LFI 2023*	*Forecast 2024*	*Forecast 2025*
REVENUE FORECAST	**A.PUBLIC WORKS**	137,703,200	231,752,420	159,882,778	176,459,570
	Road Infrastructure Development	137,703,200	231,752,420	159,882,778	176,459,570
TOTAL		**137,703,200**	**231,752,420**	**159,882,778**	**176,459,570**
EXPENDITURE FORECAST	**A.PUBLIC WORKS**	1,193,139,561	1,523,948,509	2,068,165,859	2,832,512,441
	Administration and Coordination	16,086,477	15,824,684	18,444,027	22,004,141
	Road Infrastructure Development	1,175,924,084	1,506,344,825	2,047,487,750	2,807,945,538
	Road Asset Management	1,129,000	1,779,000	2,234,082	2,562,762
	B.MAJOR INFRASTRUCTURE AND EQUIPMENT PROJECTS	197,971,538	197,450,485	314,344,152	418,644,073
	Infrastructure Development	197,971,538	197,450,485	314,344,152	418,644,073
TOTAL		**1,391,111,099**	**1,721,398,994**	**2,382,510,011**	**3,251,156,514**

Note: LFI= Loi de Finances Initiale (Initial Budget Law); LFR= Loi de Finances Rectificative (Revised Budget Law)
Source: "Document Budgétaire annexe à la Loi N° 2022 - 015 portant Loi de Finances pour 2023" (Budgetary document annexed to Law N° 2022 - 015 on the Finance Law for 2023)

4.4 Road Agency (AR)

4.4.1. Mandate

The Road Agency (AR), the successor of "Autorité Routière de Madagascar" (ARM), is under the supervision of the Ministry of Public Works (MTP) and in charge for the management of the country's national highways network. Its mandates described in the decree No. 2019-1279 are as follows:

- Manage, invest, develop and maintain the road networks; road and related works and equipment;
- Assist in the planning of road projects including construction, rehabilitation and periodic and routine maintenance, in accordance with the strategic guidelines and planning established by the Government;
- Promote the reduction of investment and maintenance costs of the road network;
- Improving the service provided to users;
- Ensure better preservation and conservation of the national road heritage.

4.4.2. Capacity and Experience in Managing Foreign-Funded Projects

In the 2021 appraisal report of the World Bank on a project titled ‘’Madagascar Road Sector Sustainability Project’’, the Bank states:

> *‘’All components will be implemented by the Road Agency (AR) in line with the ongoing sector reforms to empower the AR as the implementing agency on all national roads. The Road Agency, as the successor of the formerly “Autorité Routière de Madagascar” (ARM), has extensive experience with donor-financed projects, including World Bank projects. The AR is supported by the Road Fund and the Ministry of Land Planning and Public Works (MPW) which have a satisfactory experience with the Bank in the ongoing Transport Connectivity Project (P166526) in Madagascar. ‘’*

Likewise, in 2013 appraisal report by the African Development Bank (AfDB) on its project titled ‘’Road Infrastructure Development Project (RN9, Befandriana and Pomay Bridges)’’, the AfDB states :

> *‘’The Madagascar Road Authority (ARM) has a good track record in the management of projects financed by the Bank and OFID, and also by other donors; its capacities were therefore deemed satisfactory. The Authority has the qualified human resources required to ensure technical monitoring of the project. However, a capacity building programme will be developed for some staff members, particularly in the area of accounting. ‘’*

4.4.3. Implementation of Iarivo Rocade by the Road Agency

To have a better understanding of implementation system by the Road Agency (AR) of foreign funded projects, the case of Iarivo Rocade Road project is discussed. It is an 8.2km road project composed of two phases: Phase 1-East Rocade and Phase 2- North East Rocade. This project aimed to reduce traffic congestion in Antananarivo and with funding support from French Development Agency (AFD), European Investment Bank (EIB) and European Union (EU). Accordingly, the loan amount is around 63 Million Euro and negotiation with funding institutions was led by the Ministry of Economy and Finance (MFB). It is said that land acquisition and compensation in the amount of 6 Million Euro was part of the loan as shown in Table 4-8. For this project, the number of Project Affected People (PAP) was registered at 1,095 households and 744 number of plot of lands were expropriated.

Table 4-8 Components of the Loan Agreement for Iarivo Rocade Project

Items	(Million Euro)	
A. Works	43.20	
A.1. Basic costs		38.10
A.2. Unforeseen costs		5.10
B. Project Management Assistance	1.00	
B.1. Support to ARM and AGETIPA for the implementation of the project		0.50
B.2. Technical Assistance		0.50
C. Project Management	4.10	
C.1. Basic costs		3.70
C.2. miscellaneous and unforeseen costs		0.40
D. Land acquisitions and compensation to populations	6.00	
E. Consultancy services	1.90	
E.1. Support and studies for urban planning		1.00
E.2. Various supports for mobility		0.90
F. Audits, communication activities and miscellaneous	0.70	
G. Miscellaneous (unforeseen, prices, capitalized interest, other)	1.90	
H. Other unforeseen prices	4.00	
TOTAL	62.80	

Source: Road Agency

The timeline of the project is presented in Table 4-9. It can be seen that the project gestation is about 14 years from the start of the feasibility study in 2007 until the completion of the road project and opened to traffic in 2021. Accordingly, the construction work took about 52 months to complete.

Table 4-9 Timeline of Iarivo Rocade Project

Item	Timeline and Details
a. Studies	• 2007: Antananarivo Northeast Bypass Feasibility Study (by BCEOM) • 2009-2010: Environmental and Social Impact Study North East Rocade (by EGIS BCEOM) • 2009-2010: Detailed technical studies of the North East Bypass (by EGIS BCEOM) • 2013-2014: Detailed technical studies of the East Ring Road (by BRL Group) • 2014-2016: Development of the Involuntary Resettlement Plan (AGETIPA - Project Management Assistance Contract) • 2015-2016: Additional detailed technical studies for the East and North East ring roads (BRL Group)
b. Implementation	**2016:** • Ministère de l'Economie et des Finances (MFB) and AFD Credit Financing Agreement (June) • MFB and EIB Credit Financing Agreement (June) • MFB and AFD Financing Agreement (Grant) (November) **2017** • Finalization of the Tender Document (ARTELIA, a French engineering firm) • Signing of Delegated Project Management Agreement with AGETIPA (Agency for the Execution of Works of Public Interest and Development) • Signing of the Institutional and Social Project Management Contract with EGIS International • Service contract for the execution of the expropriation administration process AGETIPA/BPPAR • Signing of Delegated Project Management Agreement with Road Agency (AR) **2018** • Signing of a Technical Work Contract with SETEC International • Signing of the Work Contract to SOGEA SATOM (French construction company) • Signature of the Project Management Assistance Contract with LOUIS BERGER • Signing of the Support Contract for vulnerable people at A2DM (a Non-Government Organization in Madagascar; Support for affected vulnerable people) **2019** • Signing of contract with HYDROTECMAD (in charge for administrative process of expropriation and payment of compensation) with AGETIPA • Signing contract with NOVO COMM for the recruitment of a communication agency for the implementation of the institutional communication plan of the Rocade project for the launch phase **2020** • Signing of Contract with Novo Comm for the recruitment of a communication agency for the implementation of the institutional communication plan of the Rocade project for the construction and inauguration phase • Signing of the Accounting and Administrative Audit Contract 2018-2021 with “Delta Audit Associés” **2021** • Handover and open to traffic (June)

Source: Documents received from Road Agency (AR) and Interview with AR

During the implementation, two government agencies which led the project implementation were Agency for the Execution of Works of Public Interest and Development (AGETIPA) and Road Agency (AR). The former was involved in the social and land issue (particularly compensation of affected people and properties) while the latter was in charged for the technical aspects of the project. As seen in Table 4-10, there is mixed of international and domestic firms engaged by the government to execute the project. Some of the key firms engaged by the government are as follows:

- Engineering consultant: SETEC International (French engineering firm)
- Contractor: SOGEA-SATOM (French construction Company)
- Involuntary Resettlement Plan (IRP): HYDROTECMAD (used to be an organization attached to the Ministry of Territory Development and Land Services)

Table 4-10 Concerned Agencies for Implementation of Iarivo Rocade Project

Item	Detail
a. Developer (Proponent)	Ministry of Territory Management and Public Works (MATP)
b. Financial Supervision	Ministry of Finances and Budget (MFB)
c. Fundings	• Government of Madagascar • French Development Agency (AFD) • European Investment Bank (EIB) • European Union (EU)
d. Contracting Authorities (Government side)	Social and Land Component Steering and general coordination in the implementation of the Involuntary Resettlement Plan (IRP): • Agency for the Execution of Works of Public Interest and Development (AGETIPA) Environmental and Technical Component Mission for the preparation of tenders, the preparation of contracts, the execution, and the Technical and Environmental monitoring of the works: • Road Agency (AR)
e. Project Management (Private sector)	Environmental and Technical Project Management : • SETEC International (French engineering firm) for management, control and supervision of works Communication Plan: • NOVO COMM (Public Relations firm)
f. Project Management Assistance	Environmental and Technical Project Management : • Louis Berger (Louis Berger was engaged to supervise SETEC International for Environmental and technical aspects: to follow and monitor environmental compliance measures and application, etc.)
g. Administrative process of expropriation and payment of compensation as part of Involuntary Resettlement Plan (IRP)	Involuntary Resettlement Plan and support for affected vulnerable people: • HYDROTECMAD (in charge for administrative process of expropriation and payment of compensation; used to be an organization attached to the Ministry of Territory Development and Land Services)
h. Support to vulnerable people	• Association d'Appui Au Développement De Madagascar (A2DM) (an Non-Governmental Organization in Madagascar)
i. Audit	• Delta Audit Associés (Audit firm in Madagascar) Accounting and administrative audit on the activities of Road Agency (RA) for the implementation of the Rocade project. It covers the following years : 2018, 2019, 2021
j. Construction	• SOGEA-SATOM (French Construction Company)

Source: Documents received from Road Agency (AR) and Interview with AR

4.5 Ministry of Transport, Tourism and Meteorology (MTM)

4.5.1. Mandate

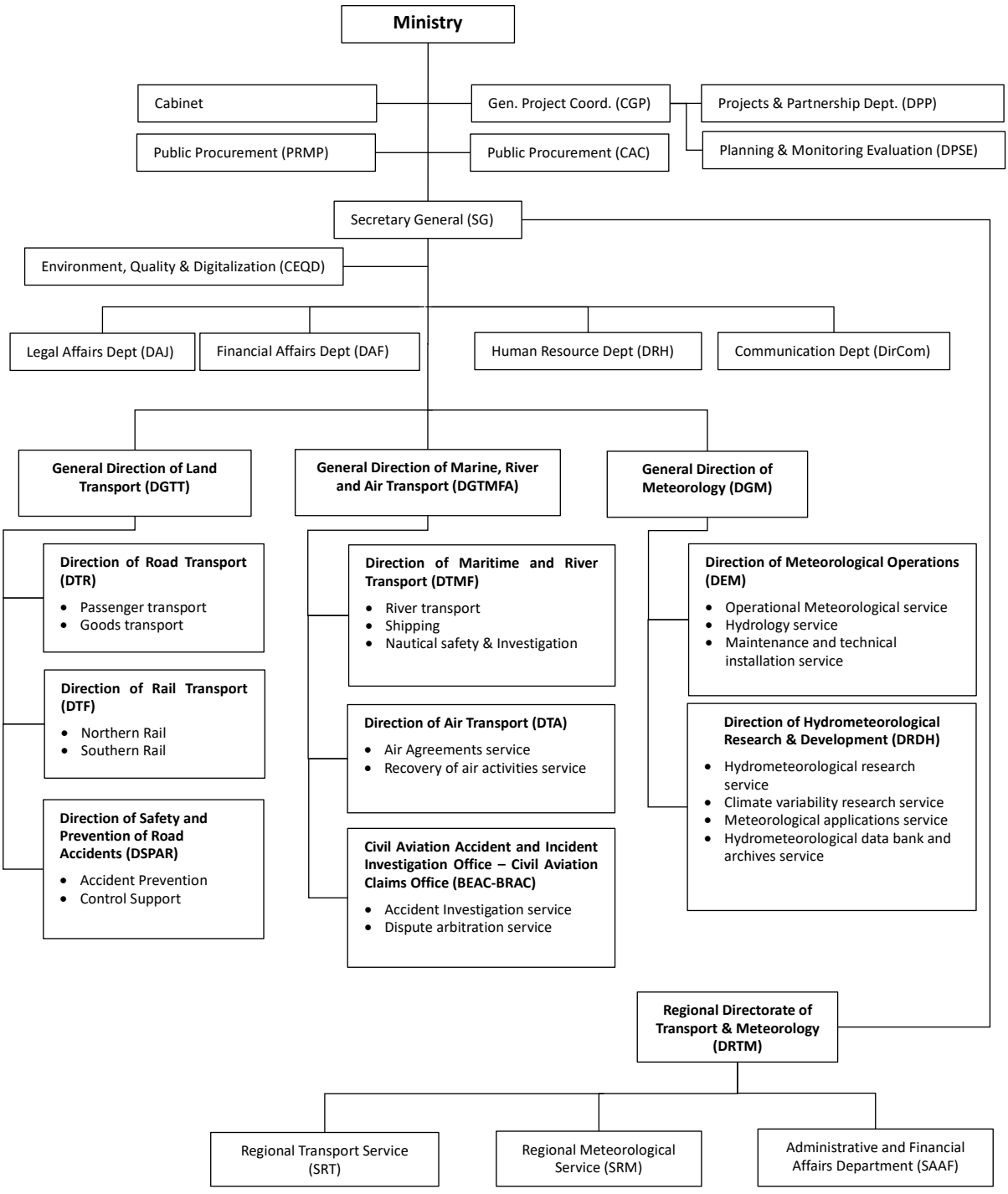
The Ministry of Transport, Tourism and Meteorology's (MTM) main missions are the design, implementation, monitoring and coordination of the General State Policy (PGE) in order to achieve the strategic objectives set out in the Madagascar Emergence Initiative (IEM) in transport and meteorology. The specific mandates involve the following:

- To define and develop policies and strategic orientations in the field of transport and meteorology, in accordance with the Sustainable Development Goals (SDGs), the General State Policy (PGE) and the Madagascar Emergence Initiative (IEM);
- To establish a legal environment conducive to the development of the transport sector;
- To develop rules governing the operation of road, rail, sea, river and air transport;
- To promote the integrated, harmonious and orderly development of transport;
- To establish standards for good governance in the transport and meteorological sectors;
- To encourage job creation in the transport and meteorological sector; to ensure the inter-ministerial coordination of policies for the development of transport and meteorology with the decentralized territorial entities;
- To put in place an incentive framework facilitating the activities of investors and operators in the perspective of Public-Private Partnership (PPP);
- To ensure better circulation of goods and people;
- To develop and implement transport safety and security strategies;
- To design, build and manage transport infrastructure and meteorology;
- To exercise technical supervision over the attached bodies in the transport sector;
- To anticipate the harmful effects of climatic and meteorological hazards with a view to protecting property and people;
- To promote employability in the transport and meteorological sector;
- To contribute to scientific and technical exchanges in the field of transport and meteorology;
- To represent the State in all regional and international meetings on transport and meteorology;
- To ensure compliance with obligations arising from international and national conventions and agreements;
- To ensure the promotion and development of the transport and meteorological sectors.

Source: Decree n° 2021-863

4.5.2. Organizational Chart of MTM

The organizational chart of MTM is illustrated in Figure 4-3.



Source: Decree n°2021-863

Figure 4-3 Organizational Chart of the Ministry of Transport, Tourism and Meteorology

Table 4-11 Organigramme du MTM

Abbreviation	French	English
Attached to the Minister		
SG	Secrétariat Général	Secretariat General
CABINET	Cabinet du Ministre	Cabinet of the Minister
CAC	Cellule anti-corruption	Anti-corruption unit
PRMP	Personne Responsable des Marchés Publics	Person Responsible for Public Procurement
CGP	Coordonnateur Général des Projets	General Project Coordinator
CGP	Attached to the General Project Coordinator	
DPP	Direction des Projets et du Partenariat	Department of Projects and Partnership
DPSE	Direction de la Planification et du Suivi-Evaluation	Department of Planning and Monitoring Evaluation
SG	Attached to the Secretariat General	
DGTT	Direction Générale des Transports Terrestres	General Direction of Land Transport
DGTMFA	Direction Générale des Transports Maritime, Fluvial et Aérien	General Direction of Maritime, River and Air Transport
DGM	Direction Générale de la Météorologie	General Direction of Meteorology
CEQD	Cellule Environnementale, de la Qualité et de la Digitalisation	Environmental, Quality and Digitalization Unit
DAJ	Direction des Affaires Juridiques	Legal Affairs Department
DAF	Direction des Affaires Financières	Financial Affairs Department
DRH	Direction des Ressources Humaines	Human Resources Department
DIRCOM	Direction de la Communication	Communications Department
DRTM	Direction Régionale des Transports et de la Météorologie	Regional Directorate of Transport and Meteorology
DGTT	Attached to the General Direction of Land Transport	
DTR	Direction des Transports Routiers	Direction of Road Transport
− STRV	− Services des Transports Routiers de Voyageurs	− Passenger Road Transport Section
− STM	− Service des Transports de Marchandises	− Goods Transport Section
DTF	Direction des Transports Ferroviaires	Direction of Rail Transport
− STFRN	− Service de Transport Ferroviaire Nord	− Northern Rail Transport Section
− STFRS	− Service de Transport Ferroviaire Sud	− Southern Rail Transport Section
DSPAR	Direction de la Sécurité et de la Prévention des Accidents Routiers	Direction of Safety and Prevention of Road Accidents
− SPA	− Service de la Prévention des Accidents	− Accident Prevention Service
− SAC	− Service d'Appui au Contrôle	− Control Support Service
DGTMFA	Attached to the General Direction of Maritime, River and Air Transport	
DTMF	Direction des Transports Maritime et Fluvial	Directorate of Maritime and River Transport
− STF	− Service de Transport Fluvial	− River Transport Section
− STM	− Service de Transport Maritime	− Maritime Transport Section
− SSEN	− Service de Sécurité et des Enquêtes Nautiques	− Nautical Safety and Investigation Section
DTA	Direction du Transport Aérien	Air Transport Department
− SAA	− Service des Accords Aériens	− Service of Air Agreements

Abbreviation	French	English
− SRAA	− Service de la Relance des Activités Aériennes	− Service for the Recovery of Air Activities
BEAC-BRAC	Bureau des Enquêtes Accidents et incident de l'aviation Civile – Bureau de Réclamation de l'Aviation Civile	Civil Aviation Accident and Incident Investigation Office – Civil Aviation Claims Office
− SIA	− Service d'Investigations des Accidents	− Accident Investigation Section
− SAC	− Service d'Arbitrage de Conflits	− Dispute Arbitration Section
DGM	Attached to the General Direction of Meteorology	
DEM	Direction des Exploitations Météorologiques	Direction of Meteorological Operations
− SMO	− Service de la Météorologie Opérationnelle	− Operational Meteorology Section
− SH	− Service de l'Hydrologie	− Hydrology Section
− SMIT	− Service de la Maintenance et Installation Technique	− Maintenance and Technical Installation Section
DRDH	Direction des Recherches et Développement Hydrométéorologiques	Direction of Hydrometeorological Research and Development
− SRH	− Service des Recherches Hydrométéorologiques	− Hydrometeorological Research Section
− SRVC	− Service des Recherches sur la Variabilité Climatique	− Climate Variability Research Section
− SAM	− Service des Applications Météorologiques	− Meteorological Applications Section
− SBDAH	− Service de la Banque des Données et des Archives Hydrométéorologiques	− Hydrometeorological Data Bank and Archives Section

Source: Décret n°2021-863

4.5.3. Number of Employees at the MTM Headquarters

The total number of MTM employees at their Headquarters is 33 as shown in Table 4-12.

Table 4-12 The Total Number of MTM Employees

Direction	No. of employees
General Direction of Land Transport	2
Direction of Rail Transport	5
Direction of Road Transport	7
Direction of Safety and Prevention of Road Accidents	5
General Direction of Maritime, River and Air Transport	2
Direction of Maritime and River Transport	4
Direction of Air Transport	4
Civil Aviation Accident and Incident Investigation Office (Civil Aviation Claims Office)	4
Total	33

Source: MTP, 2023

4.5.4. Budget of MTM

The budget of MTM is provided in Table 4-13.

Table 4-13 Budget of MTM

Unit: (in thousands of Ariary)

		LFR 2022	*LFI 2023*	*Forecast 2024*	*Forecast 2025*
REVENUE FORECAST	**A. TRANSPORT**	3,473,000	1,827,010	1,883,076	2,093,678
	Road and Rail Transports	3,473,000	1,827,010	1,883,076	2,093,678
	B. METEOROLOGY	298,810	298,810	307,981	342,426
	Meteorological Development	298,810	298,810	307,981	342,426
TOTAL		3,771,810	2,125,820	2,191,057	2,436,104
EXPENDITURE FORECAST	**A.TRANSPORT**	47,779,613	95,020,610	215,544,540	354,922,036
	Administration and Coordination	7,054,420	8,111,479	9,227,720	11,210,586
	Road and Rail Transports	37,857,001	82,123,769	125,251,138	129,801,650
	Sea, River and Air Transports	2,868,192	4,785,362	81,065,682	213,909,800
	B.METEOROLOGY	524,000	12,383,027	12,659,520	13,954,554
	Meteorological Development	524,000	12,383,027	12,659,520	13,954,554
TOTAL		48,303,613	107,403,637	228,204,060	368,876,590

Note: LFI= Loi de Finances Initiale (Initial Budget Law); LFR= Loi de Finances Rectificative (Revised Budget Law)
Source: "Document Budgétaire annexe à la Loi N° 2022 - 015 portant Loi de Finances pour 2023" (Budgetary document annexed to Law N° 2022 - 015 on the Finance Law for 2023)

4.6 Ministry in Charge of New Cities and Housing (SENVH)

4.6.1. Mandate

The SENVH (State Secretary in charge of New Cities and Housing at the Presidency of the Republic) is an agency that existed until the end of 2023 and was abolished when the new Cabinet was formed in 2024. Confirmation of the ministry to be merged into the new agency is currently underway. In this section, an overview of SENVH will be summarized.

SENVH is responsible of the following aspects:

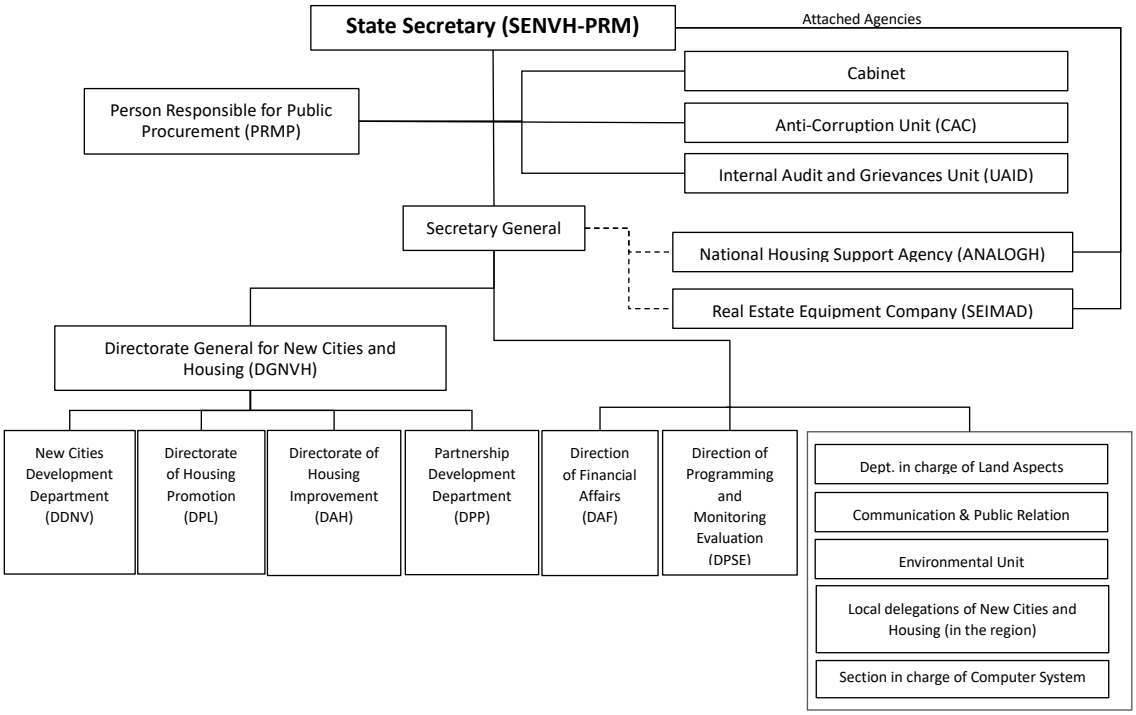
- To ensure the implementation of Velirano n°11 (the 11th commitment of President related to Modernization of Madagascar) and the General State Policy (EMI) point n°11 consisting in the Modernization of Madagascar through the creation of New Cities to support major investments, the construction of social housing and the facilitation of credits to housing, the development of digital cities (smart cities), the promotion of transparency, good governance and the fight against corruption through all its interventions ;
- To develop and promote Partnership in the implementation of policies and strategies on New Cities and Housing;
- To develop and monitor the application of legislation adapted to the needs of the population in terms of housing and habitat ;
- To ensure the promotion, facilitation and implementation of other sectoral policies in connection with new cities, housing, and habitat ;

- To contribute to the implementation of the National Policy for Urban Development, the National Policy for Housing, and the National Policy for Habitat.
- To carry out government directives in terms of housing and new cities in line with the vision and strategy of the President of the Republic and the development programs set by the General State Policy;
- To create new modern cities in Antananarivo (TANA-MASOANDRO) and in the provincial capitals;
- To build forty thousand (40,000) housing units in five (5) years, i.e. ten thousand (10,000 housing units/ per year to meet the needs of the population;
- To guarantee good governance and transparency in the management of all its activities;
- To ensure the supervision of the attached organizations and ensure that they contribute effectively to the achievement of the objectives set by the General State Policy.

Source: Decree n° 2022-1217

4.6.2. Organization Chart of SENVH

The organizational chart of SENVH is illustrated in Figure 4-4.



Source: Decree n° 2022-1217

Figure 4-4 Organizational Chart of the Ministry in Charge of New Cities and Housing

Table 4-14 Organizational Chart of SENVH

Abbreviation	French	English
Cabinet and Directions Attached to the Minister		
SG	Secrétariat Général	Secretariat General
Cabinet	Cabinet du Ministre	Minister's Office Head
PRMP	Personne Responsable des Marchés Publics	Person Responsible for Public Procurement
CAC	Cellule Anti-Corruption	Anti-Corruption Unit
UAID	Unité de l'Audit Interne et Doléances	Internal Audit and Grievances Unit
DCR	Direction du Contrôle et de Régulation	Directorate of Control and Regulation
Attached to Secretariat Général		
DGNVH	Direction Générale des Nouvelles Villes et de l'Habitat	General Direction of New Cities and Housing
DAF	Direction des Affaires Financières	Direction of Financial Affairs
DAJ	Direction des Affaires Juridiques	Direction of Legal Affairs
DPSE	Direction de la Programmation et de Suivi Evaluation	Direction of Programming and Monitoring Evaluation
SAF	Services en charge des Aspects Fonciers	Sections in charge of Land Aspects
SCRP	Service Communication et Relations Publiques	Communication and Public Relations Section
SSI	Service du Système Informatique	Section in charge of Computer System
CE	Cellule Environnementale	Environmental Unit
DLNVH	Délégations locales des Nouvelles Villes et de l'Habitat	Local delegations of New Cities and Housing
DGNVH	General Direction of New Cities and Housing	
DDNV	Direction de Développement des Nouvelles Villes	New Cities Development Department
DPL	Direction de la Promotion du Logement	Directorate of Housing Promotion
DAH	Direction de l'Amélioration de l'Habitat	Habitat Improvement Department
DPP	Direction de Développement de Partenariat	Partnership Development Department
DAEC	Direction de l'Architecture, des Etudes et Conceptions	Department of Architecture, Studies and Designs
Attached Organisations / Institutions of the SENVH		
ANALOGH	Agence Nationale d'Appui au Logement et à l'Habitat	National Agency for Housing Support
SEIMad	Société d'Equipement Immobilier de Madagascar	Real Estate Equipment Company of Madagascar

Source: Decree n° 2022-1217

4.6.3. Number of Employees at SENVH Headquarters

According to SENVH, the total number of its employes is about 100.

4.6.4. Budget of SENVH

The budget of SENVH is provided in Table 4-15.

Table 4-15 Budget of SENVH

Unit: (in thousands of Ariary)

		LFR 2022	*LFI 2023*	*Forecast 2024*	*Forecast 2025*
REVENUE FORECAST	**A.NEW CITIES AND HABITAT**	1,000,000	1,000,000	-	-
	New Cities and Housing	1,000,000	1,000,000	-	-
TOTAL		**1,000,000**	**1,000,000**		
EXPENDITURE FORECAST	**A.NEW CITIES AND HABITAT**	69,172,870	356,741,256	559,958,155	489,998,333
	Administration and Coordination	8,762,648	7,661,892	9,583,535	11,018,452
	New Cities and Housing	60,410,222	349,079,364	550,374,620	478,979,881
TOTAL		**69,172,870**	**356,741,256**	**559,958,155**	**489,998,333**

Note: LFI= Loi de Finances Initiale (Initial Budget Law); LFR= Loi de Finances Rectificative (Revised Budget Law)
Source: "Document Budgétaire annexe à la Loi N° 2022 - 015 portant Loi de Finances pour 2023" (Budgetary document annexed to Law N° 2022 - 015 on the Finance Law for 2023)

4.7 Antananarivo Urban Commune (CUA)

4.7.1. Mandate

The mandates of the Antananarivo Urban Commune (CUA) which are found in two decrees (Law 2014-018 related to Decentralized Government Structures and Operations and the Law 2015-011 related to Special Status of CUA) are quite broad which covers economic (e.g. management of local roads), social, cultural (e.g. housing projects) and environmental areas. For brevity, only the CUA's mandates which are related to urban development and transportation will be presented.

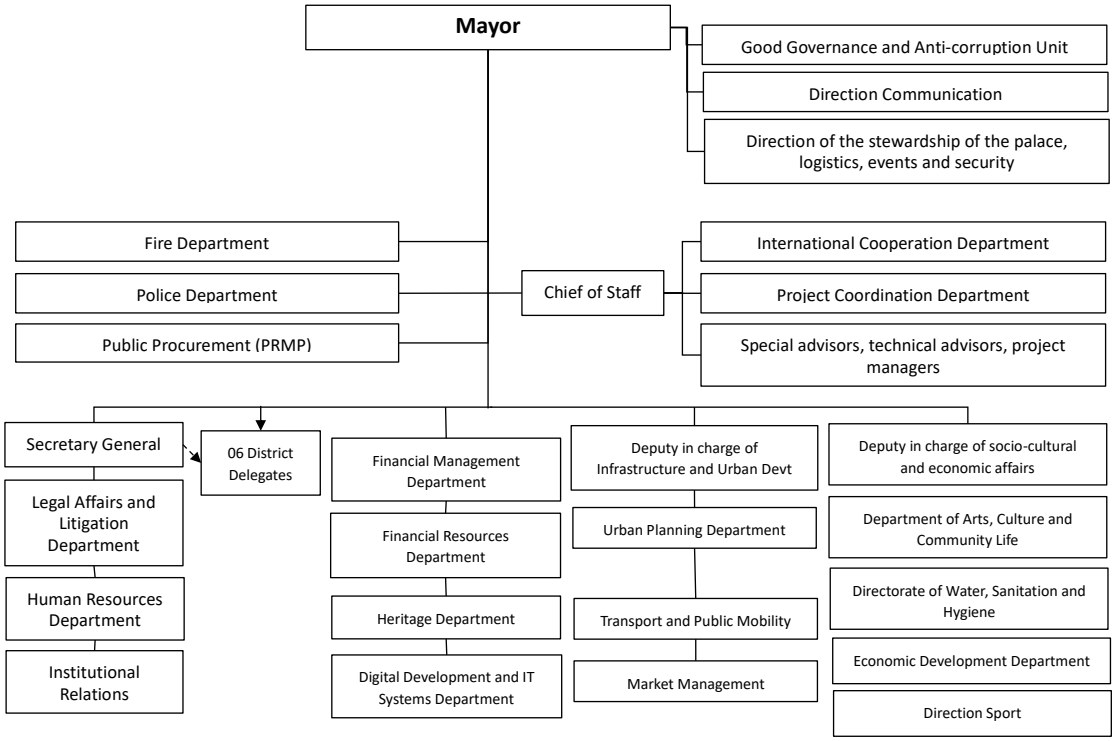
Table 4-16 Mandate of CUA in Urban Development and Transportation Field

Mandate	Details
Economy	a. Construction and management of **market infrastructures and facilities** such as public squares and markets, cattle markets and **vehicle parking areas,** and any other income-generating facilities such as slaughterhouses and green spaces. b. **Management of roads, feeder roads, bridges** and ferries of communal interest.
Culture	a. Communal development planning and implementation of operations relating to: • **Management of roads**, water and sanitation, hygiene, household waste management. • Implementation, at its level, of appropriate actions and measures against **natural disasters.** • **Defining and implementing housing programs and urban and rural public facilities**; • Managing the allocation of **social housing.** • Management of basic **public social, educational, cultural, sports and health infrastructures and facilities.** b. Creation and management of **municipal parks** and leisure areas.
Environment	**a. Contributing to, preserving, enhancing and managing the environment and natural resources.** b. Preventing and fighting against bush fires and deforestation.
Special status of CUA	By virtue of its special status, the Urbane Commune of Antananarivo is also responsible for: • Organizing, planning and coordinating the Commune's development activities; • Transportation; • Managing roads, sanitation and hygiene; • **Managing water and public lighting**; • Ensuring compliance with town planning regulations. To this end, it can order the demolition of any constructions that present a danger. A decision by the Court of Reference is required; • Ensuring respect for the environment and quality of life.

Source: Decree n° 2014-018 (Decentralized Government Structures and Operations); and Decree n° 2015-011 (Special Status of CUA).

4.7.2. Organization Chart

The organizational chart of CUA is illustrated in Figure 4-5.



Source: Official website of CUA (https://www.cua.mg/organigramme-de-la-cua/)

Figure 4-5 Organizational Chart of the Antananarivo Urban Commune (CUA)

4.7.3. Number of Employees

The total number of employees in 2021 was 4,262 and increased to 4,460 in 2022.

4.7.4. Budget of CUA

The budget of CUA is provided in Table 4-17.

Table 4-17 Budget of CUA

Unit: (Ariary)

		2021	*2022*	*2023*
REVENUE	**A. OPERATION**	58,184,804,000	67,460,806,000	87,334,346,000
	Taxes on income and gains	6,000,000,000	9,000,000,000	10,700,000,000
	Taxes on assets	18,647,380,000	18,624,880,000	23,765,880,000
	Taxes on goods and services	10,001,035,000	11,226,189,000	11,351,189,000
	Other tax revenues	242,040,000	242,040,000	242,040,000
	Contributions received from third parties	1,440,000,000	1,440,000,000	1,440,000,000
	Non-tax revenues	21,854,349,000	26,927,697,000	39,835,237,000
	B. INVESTMENT	17,096,398,000	13,100,000,000	4,100,000,000
	Capital grants	17,096,398,000	13,100,000,000	4,100,000,000
Total		75,281,202,000	80,560,806,000	91,434,346,000
EXPENDITURE	Administration and coordination	2,872,471,000	2,105,021,000	2,621,631,000
	Finances and budget	43,956,738,721	43,271,338,103	56,250,400,000
	Infrastructure and development	32,233,874,117	28,385,173,822	15,830,687,878
	Socio-cultural and economic development	12,677,768,840	9,537,248,265	7,883,246,000
	Support, security, logistics, control/monitoring	9,882,208,000	9,652,537,000	11,802,874,000
Total		101,623,060,678	92,951,318,190	94,388,838,878

Source 1: 2023 is culled from "Additional Budget, Fiscal Year 2023 of the Urban Commune of Antananarivo", CUA

Source 2: 2022 is culled from "Administrative Account of the Urban Commune of Antananarivo, Fiscal Year 2022", CUA

Source 3: Administrative Account of the Urban Commune of Antananarivo, Fiscal Year 2021, Voted on April 12, 2022, following deliberation No. 005-CUA/CM/Delib.22, CUA

4.8 Latest Plans in the Field of Transportation and Urban Development

4.8.1. Project Maps and List of Projects in Transportation and Urban Development

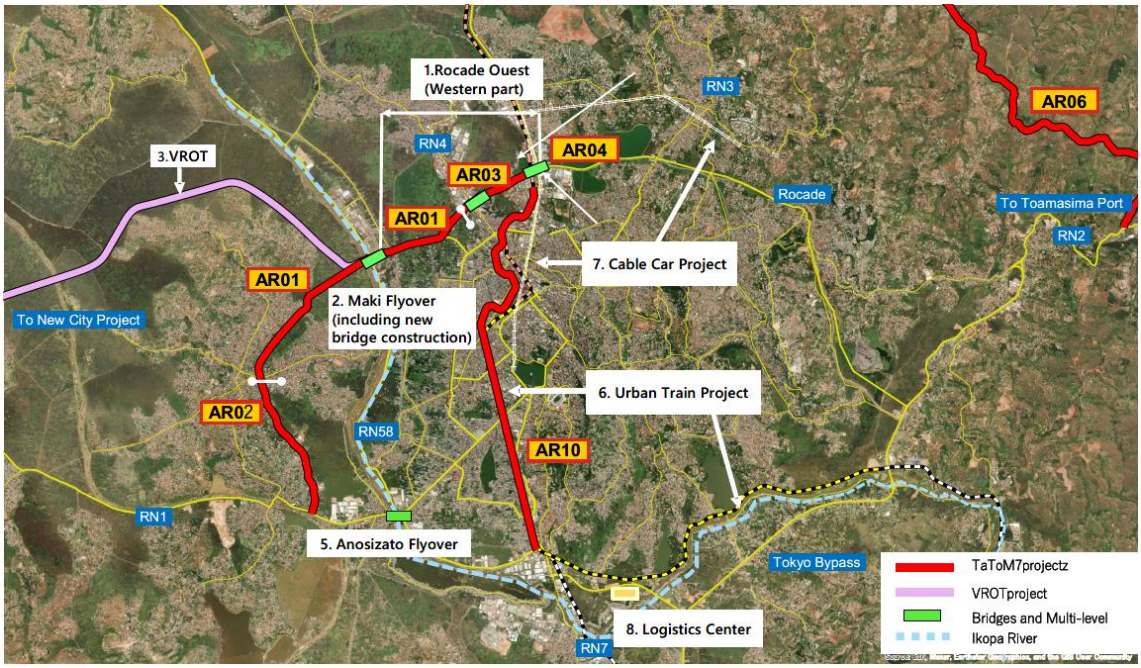
Table4-18 shows the list of projects in transportation and urban development currently implemented or being planned in the city of Antananarivo.

Table 4-18 Project List for Transportation and Urban Development

No. in the map	Project Name	Type	Details
1	Rocade West (Western part)	Road	• 4-lane road project between the Ankorondrano intersection and the Maki Stadium intersection, positioned as an extension of the Rocade conducted by AFD and others • A-R-03, 04 and a section of A-R-01 • The F/S contract was being negotiated (EIB funds), but the contract was not signed and the F/S study was cancelled.

No. in the map	Project Name	Type	Details
2	Maki Flyover (including new bridge construction)	Road	• Bridge construction project at the Maki Stadium intersection and the Ikopah River crossing • Part of A-R-01 includes construction of a long bridge at the Ikopa River crossing • F/S is scheduled to start in 2024 with BADEA support.
3	VROT	Road	• An approximately 25km, 4-lane, toll urban expressway connecting the New City + New International Airport and the Antananarivo metropolitan area. • Connect to Maki flyover project • Implementation through PPP is planned, and MTP is negotiating contracts with overseas private companies
4	Antananarivo-Toamasina Expressway	Road	• PPP contract already signed with Egyptian general contractor • 260 km long, 4 lanes toll road • Phase 1 construction (80 km) started. • The project is scheduled to be completed by the end of 2023, but was suspended due to environmental certification and land acquisition issues.
5	Anosizato Flyover	Road	• Multi-level project including bridge at Anosizato intersection. Includes partial widening of RN-1. • Project is on-going with BADEA financing (construction company has been selected).
6	Urban Train Project	Train	• Urban rail project utilizing existing track. • Three lines are planned, with the first line parallel to A-R-10 currently on-going (track rehabilitation, station construction, construction of related facilities, etc.). • Implementation of the second phase, which intersects with A-R-03 and 04, has not yet been determined.
7	Cable car Project	Cable car	• Approximately 9km in length which will connect Anosy and Ambatobe districts. Construction is on-going.
8	Logistics Center	Logistics	• Multimodal logistics facility project for rail and truck transshipment. • Land for construction has been secured, but funding has not yet been secured.

Source: JICA Study Team



Source: JICA Study Team

Figure 4-6 Location of Major Transportation Projects

Table 4-19 Relationship between Transportation projects and TaToM Master Plan

No. in the map	Project Name	Type	TaToM Master Plan
1	Rocade West (Western part)	Road	• Priority project under Phase 1 (2019-2023) of TaToM Master Plan. It's a combination of [A-R-03] and [A-R-04] projects in the TaToM MP. These two projects in the TaToM MP are considered part of the middle ring road (La Rocade Ouest) to enhance the potential of new urban development area at Ankorondrano.
2	Maki Flyover	Road	• Priority project under Phase 1 (2019-2023) of TaToM Master Plan [A-R-01] Project for Construction of a Flyover at Ankorondrano Intersection of Tsarasaotra Road and Marais Masay Road • TaToM MP envisioned it to form part of the middle ring road connecting Ankorondrano and Andranonahoatra to accommodate the traffic between city centre and east area of Antananarivo. This will enhance the potential of new urban development area at Ankorondrano.

No. in the map	Project Name	Type	TaToM Master Plan
3	VROT	Road	• TaToM MP has a project under Phase 1 (2019-2023) called [A-R-08] Project for Construction of Primary Arterial Road between Tana-Masoandro and Andranonahoatra which might serve the same function as the VROT • This project (A-R-08) is a primary road project to connect Tana-Masoandro and the middle ring road. This is essential route to access to Tana-Masoandro from primary urban centres in central city. The project promotes the development of Tana-Masoandro. • VROT however is planned as a toll urban expressway while the A-R-08 is just ordinary 4-lane road. • VROT length is longer (25km) while A-R-08 is just 4km implying that there might be major differences in alignment and end point.
4	Antananarivo-Toamasina Expressway	Road	• The Antananarivo – Toamasina Expressway was not among the project list proposed by the TaToM Master Plan. However, the MP acknowledged its potential contribution on industrial development in Antananarivo because of the good and fast connection to Toamasina Port it can offer.
5	Anosizato Flyover	Road	• Priority project under Phase 1 (2019-2023) of TaToM Master Plan (Project for Construction of Flyover at Anosizato Intersection of RN4 and RN1) • It's a 4-lane flyover aims to address the bottleneck intersection by setting RN58A functioning as a ring road as a flyover type intersection and to improve the traffic function of the two main roads as the main arterial road.
6	Urban Train Project	Train	• Priority project under Phase 1 (2019-2023) of TaToM Master Plan titled [A-F-02] Project for Urban Passenger Railway Development between Ankorondrano – Tanjombato • Unlike the TaToM proposed project which end at Tanjombata, the Urban Train Project extends until Amoronakona. • The Urban Train Project has also Phase 2 and Phase 3 in addition to the Phase 1 (which largely similar to the TaToM proposed project).
7	Cable car Project	Cable car	• Not available in the TaToM Master Plan
8	Logistics Center	Logistics	• Priority project under Phase 1 (2019-2023) of TaToM Master Plan titled [A-F-01] Project for Development of Multimodal Freight Terminal in Amoronakona.

Source: JICA Study Team

4.8.2. Rocade West

(1) Overview

It is a four-lane road project between the Ankorondorano intersection and the Maki Stadium intersection and positioned as an extension of Rocade, which was conducted by AFD. An F/S study funded by EIB (European Investment Bank) was scheduled to be conducted starting July 2023, but the contract was not awarded and the F/S study was cancelled.

(2) Survey Details

The F/S survey by the EIB consisted of the following tasks:

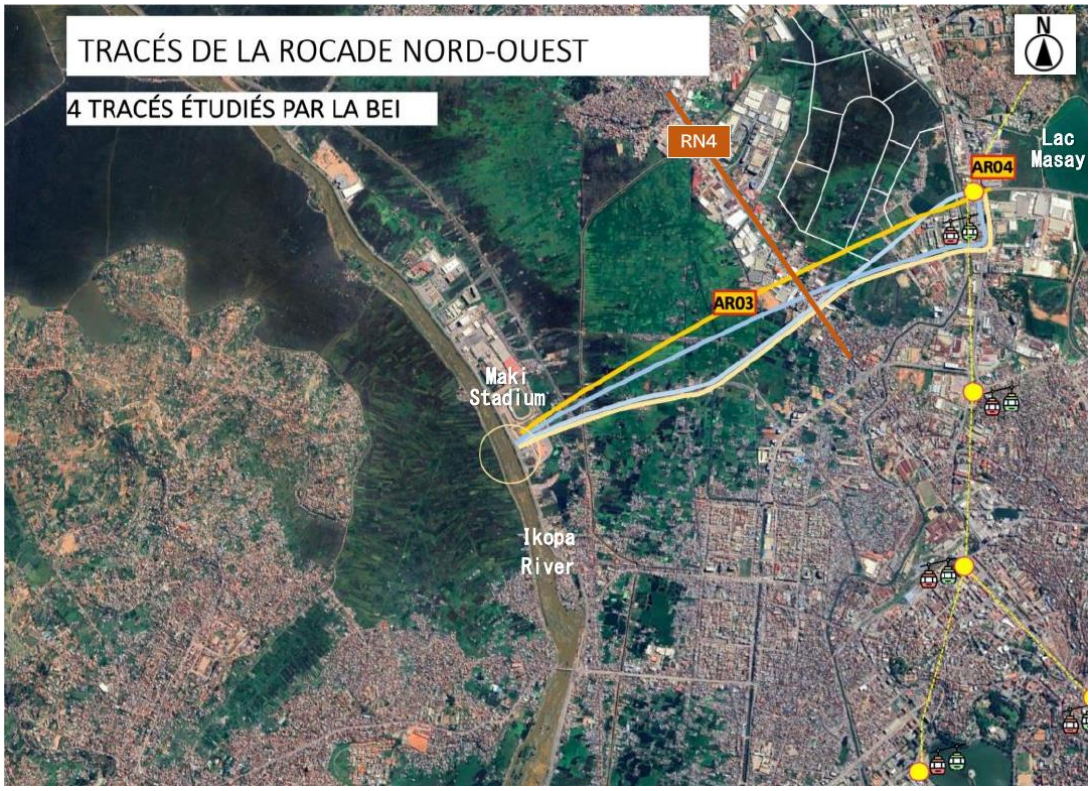
1 : Socio-economic Survey
2 : Roadside urban planning and public transportation planning
3 : Outline design (APS)
4 : Study of traffic safety measures and climate change adaptation measures

(3) Client

Road Authority (AR)

(4) Financing

European Investment Bank (EIB)



Source: Prepared by JICA Study Team based on draft special specification prepared by AR.

Figure 4-7 Alternative 4 Routes (Rocade West)

4.8.3. VROT Project

(1) Project Name

West Tana Urban Expressway Project (VROT：Projet Voie Rapide de l'Ouest de Tana)

(2) Overview

- Approximately 25 km, including the Ikopa Bridge
- 4-lane, toll road project
- Urban expressway connecting Tanamasoandro new city and Rocade West projects

(3) Current Status

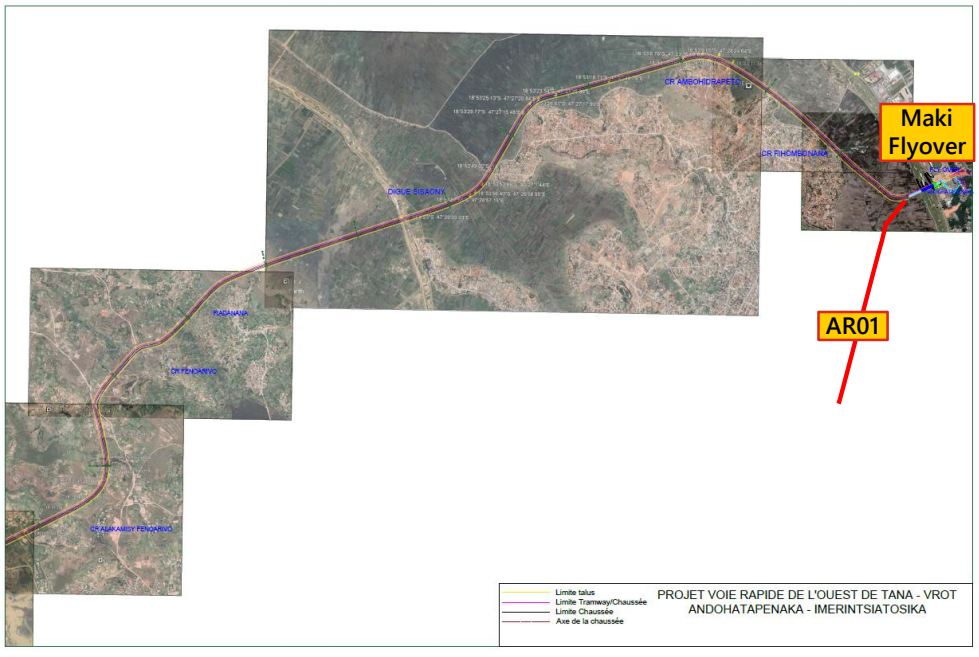
- Initially, an EPC contract was envisioned, but a PPP contract-like approach, including O&M and equity participation, is being procured for implementation.
- MTP Office is currently negotiating a contract with one company.

(4) Client

Ministry of Public works (MTP)

(5) Financing

Proposed PPP with private company investment



Source: MTP

Figure 4-8 VROT Planned Route

4.8.4. Urban Train

(1) Background

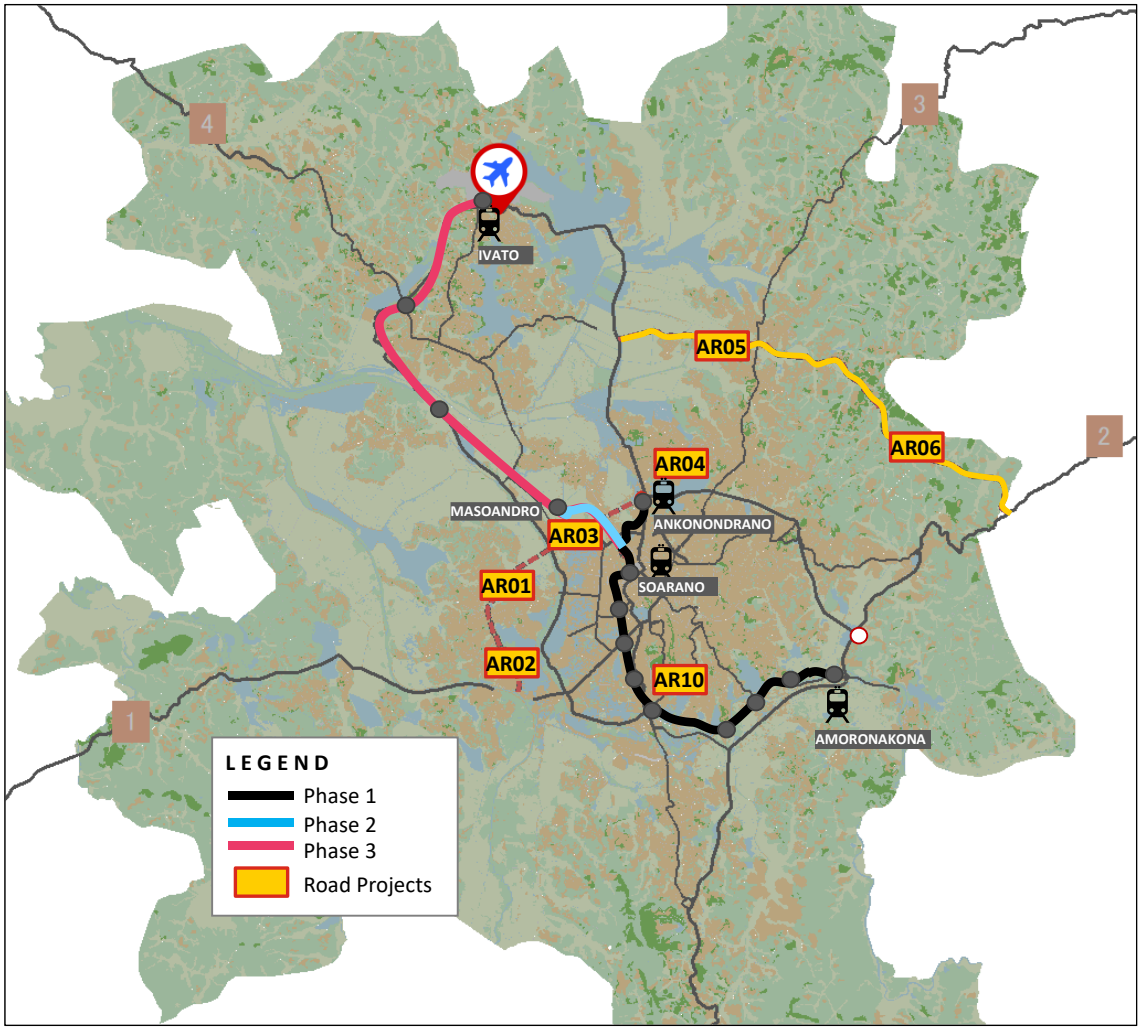
The project is an urban rail project utilizing the existing track and started in 2021 with government funding. According to MTM, the urban rail system is planned to be powered by electricity (trains). The project consists of three (3) phases. The target routes for each phase are shown in the figure below.

- Phase 1 [14km, 13 stations]: Ankorondrano – Soarano – Amoronakona Station
- Phase 2 [6km, 5 stations]: Soarano – Masoandro Station
- Phase 3 [12km, 5 stations]: Masoandro Station – Ivato Airport

Currently, 12 km of Phase 1 (Soarano Station to Amoronakona Station), is on-going. Approximately 40% of the project has been completed.

(2) Overview

- Electrification of tracks (not started)
- Rehabilitation of track
- Earthworks, Reinforcement of slop
- Construction of 10 station buildings and platforms
- Installation of concrete and metal fencing
- Construction of pedestrian bridges



Source: Prepared by the JICA Study Team based on an interview with MTM

Figure 4-9 Phasing of the Urban Train Project

(3) Rolling Stock

- The rolling stock has already been secured and the next step is familiarization of the train operation including training of drivers.
- Similarly, the Swiss Government donated 28 wagons (second hand/previously used) in 2021 currently parked in Toamasina Port. Per information from MTM, this can be among the wagons for use under the Phase 1. These wagons are for electric train hence Phase 1 is envisioned to be an electric train. Similarly, in 2005, Switzerland also donated 14 train wagons (second hand) and locomotives.

(4) Current Status

Originally envisioned to complete in eight (8) months since its commencement in 2021, the project faces delays. One of the mentioned causes of the delay is due to the difficulty of

undertaking the expropriation procedures.

(5) Client

MTM, Madarail (Operators of existing railroads)

(6) Financing

Financing of the project comes from the budget of the Government (MTM Budget)

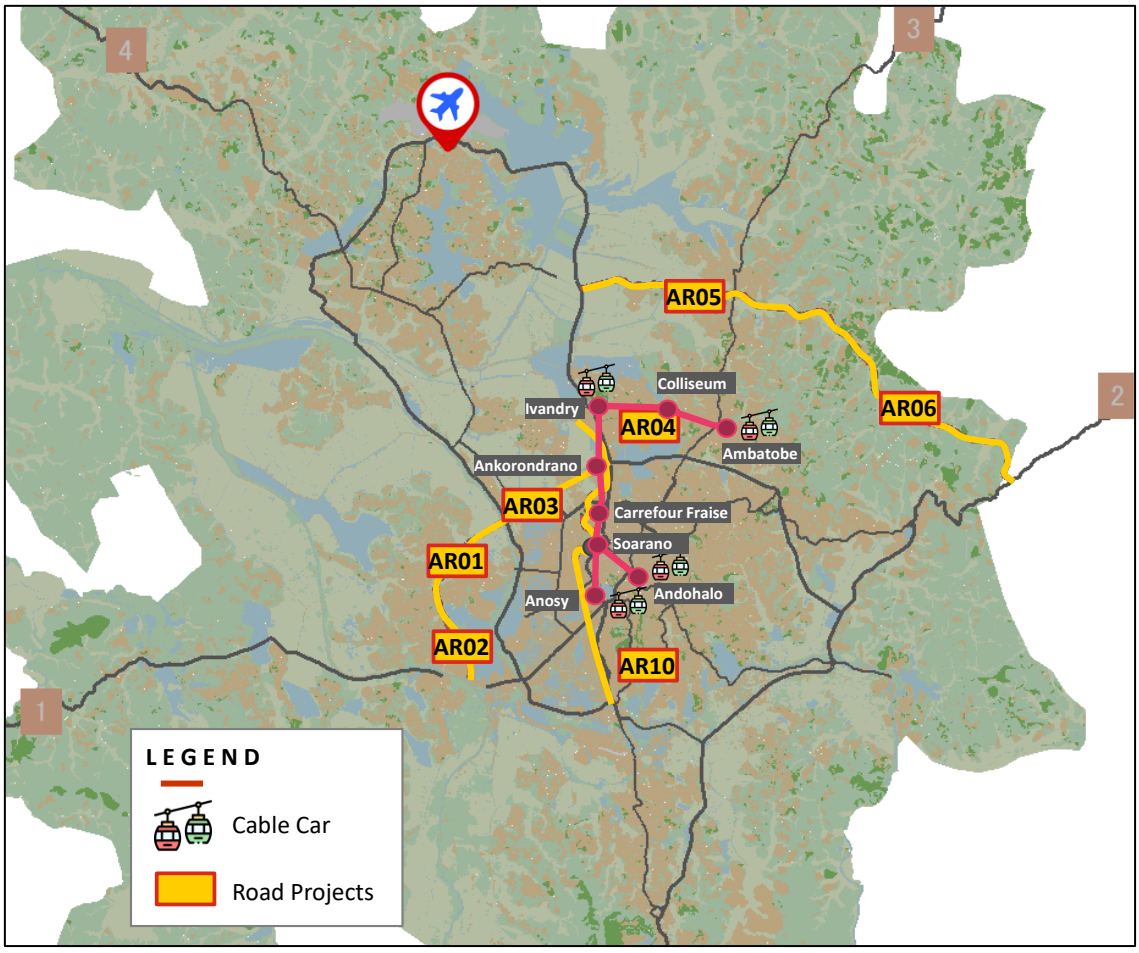
4.8.5. Cable car

(1) Background

The project is led by SENVH with the objective of achieving the modernization of Madagascar. The specific goals of the project are stated as follows.

- Establishment of new modes of transportation adapted to the terrain and needs of citizens according to existing and future transportation systems.
- Development of new urban roads and re-dimensioning of the infrastructure
- Provision of modern and integrated urban transport

Since the route of this project intersects with the A-R-04 project (flyover), the A-R-04 project plan requires attention to building limits. Details are provided in Chapter 7.



Source: Prepared by the JICA Study Team based on an interview with SENVH

Figure 4-10 Indicative Alignment of the Cable car

(2) Characteristics of the Cable car Transport

The characteristics of the cable car are as follows:

- Two lines connected with the future urban train line (blue line)
- Number of stations: 12 (Public lands)
- Number of pylons: 78 (70% on public lands)
- Lines capacity: More than 40,000 passengers/day
- Capacity per cabin: 10 to 12 persons
- Targets: users of taxi-be, taxis, private cars and motorcycles, visitors and tourists
- Daily service: 6:00 am – 9:00 pm
- Power: 2.2 MgW

(3) Client

SENVH

(4) Financing

French Commercial Bank Loan and Government of Madagascar National Budget

(5) Current Status

- Construction of Anosy Station: Progressing well
- Installation of Pylons: Four (4) pylon has been installed as of 10 July 2023

Back of the Anosy Station

Front of the Anosy Station with pylon

Pylon installed at Ampefiloha

Preparation of installation of pylon at Antanimena

Source: JICA Study Team

Figure 4-11 Current Progress of the Cable Car Project (as of July 10, 2023)

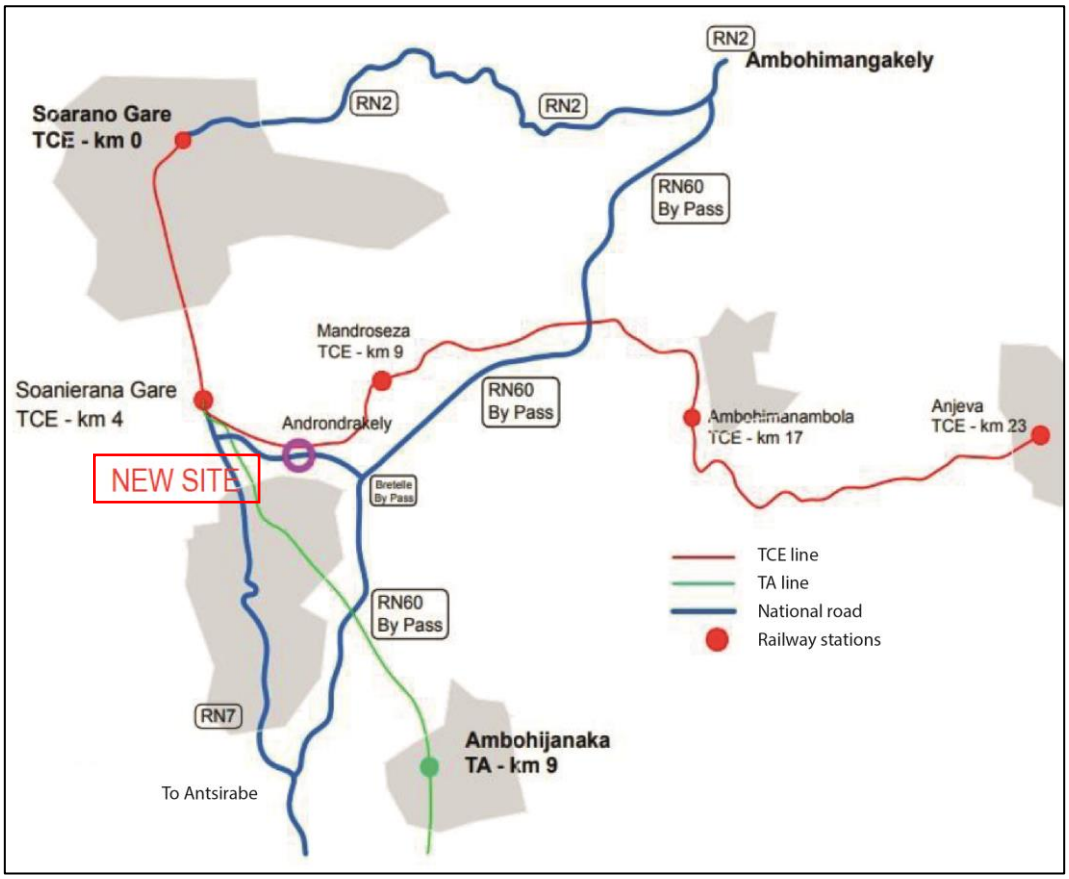
4.8.6. Logistics Facilities

(1) Background

According to the MTM, the development of multimodal logistics facilities is necessary to improve the efficiency of distribution between the port of Toamasina and Antananarivo. The facilities will serve as a relay station for rail and truck transport, as well as a relay station for truck transport and shipment transport. It will envision to function as a dry port to efficiently support the import and export industry in Antananarivo.

The initial site for the multimodal platform was located in Amoronakona as shown in the Figure 4-12. However, there was a difficulty of securing the necessary land. A single person owns about 60 hectares in the area and he is not entertaining the offer of the government to purchase. As a consequence, the site in Androndrakely was chosen as alternative site (Figure 4-12). The size is rather small at 6.0 hectares. The government continues to discuss ways to secure land at Amoronakona while advancing the realization of the Androndrakely Logistics Platform.

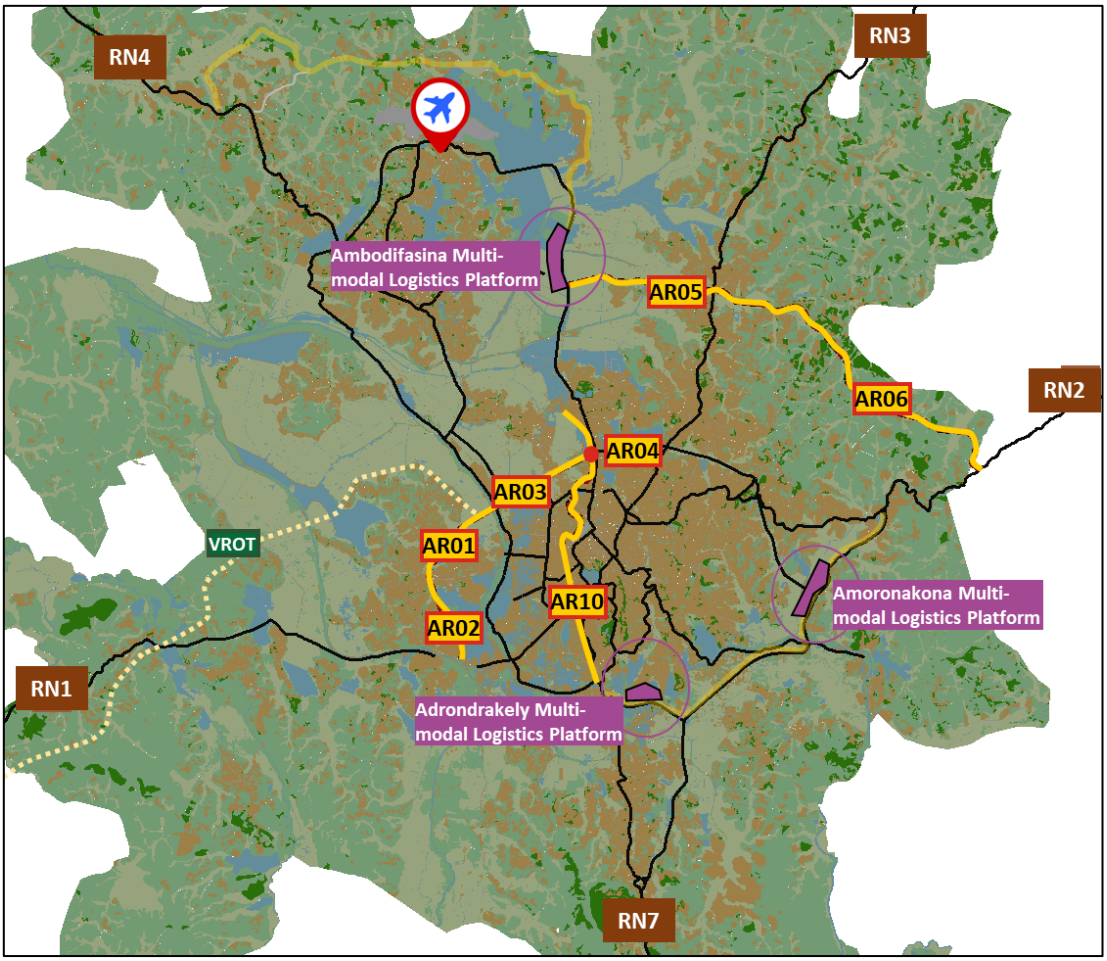
Similarly, a PUDé initiated by AFD has identified another logistics platform to be located in Ambodifasina as shown in Figure 4-13. No study has been conducted yet in this direction.



Androndrakely Logistics Platform and Railway Network

Source: MTM

Figure 4-12 Locations of the Identified 3 Logistics Platforms



Source: Prepared by the JICA Study Team

Figure 4-13 3 Candidate Logistics Platform Overlapped with the 7 candidate Road Projects

(2) Characteristics of the Androndrakely Lositics Platform

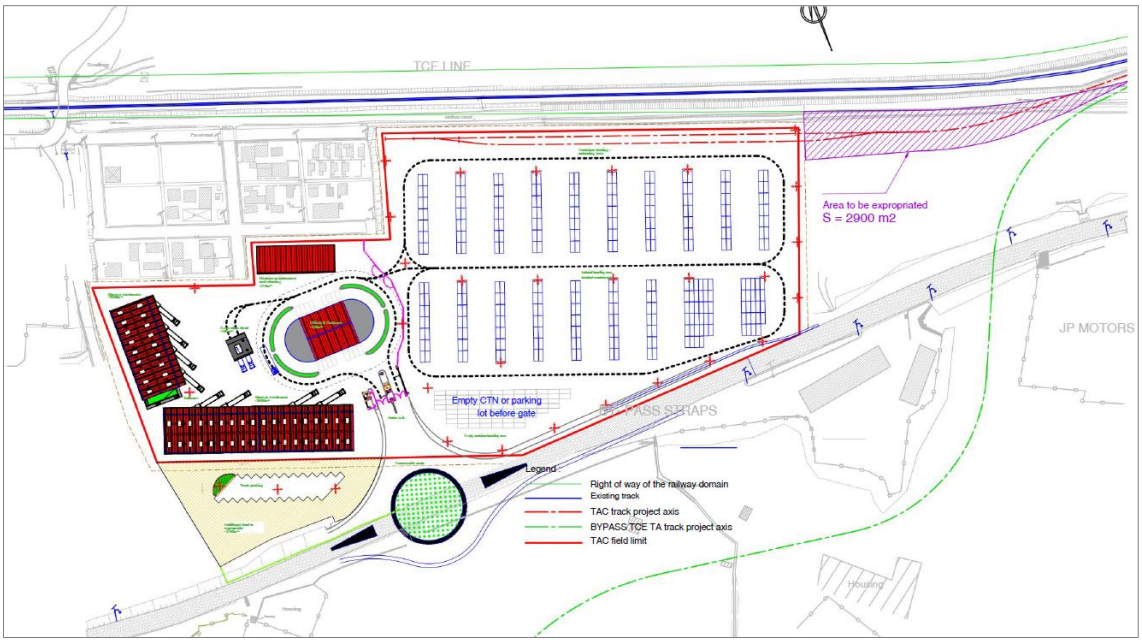
The following are the details of the planned Logistics Platform at Androndrakely:

- Land Area: 6.0 hectares
- Estimated Construction Cost: USD 10.25 Million
- Level of completed study: L'avant-projet sommaire (APS) has been completed which was the basis of the USD 10.25 Million
- Mode of transport to access the Logistics Platform: Accessible both railway and truck (road)

Similarly, that plan has the following facilities:

- Train terminal
- Customs office
- MTM Office in charge of goods transportation (representative office)
- Land Transport Agency (ATT) office

- Parking area for heavy trucks
- Commercial center



Source: MTM

Figure 4-14 Schematic Plan of Androndrakely Logistics Platform

(3) Financing

Source of finance is not yet identified, and the government is currently looking for a partner.

(4) Current Status

- No observed activity at the site yet.
- MADARAIL (in charge for O&M) reached an agreement with Logistique Petroliere (a major oil company) to transport their oil from Toamasina Port to Antananarivo once the Logistics Platform is in operation.

4.9 Overview of Urban Development Projects

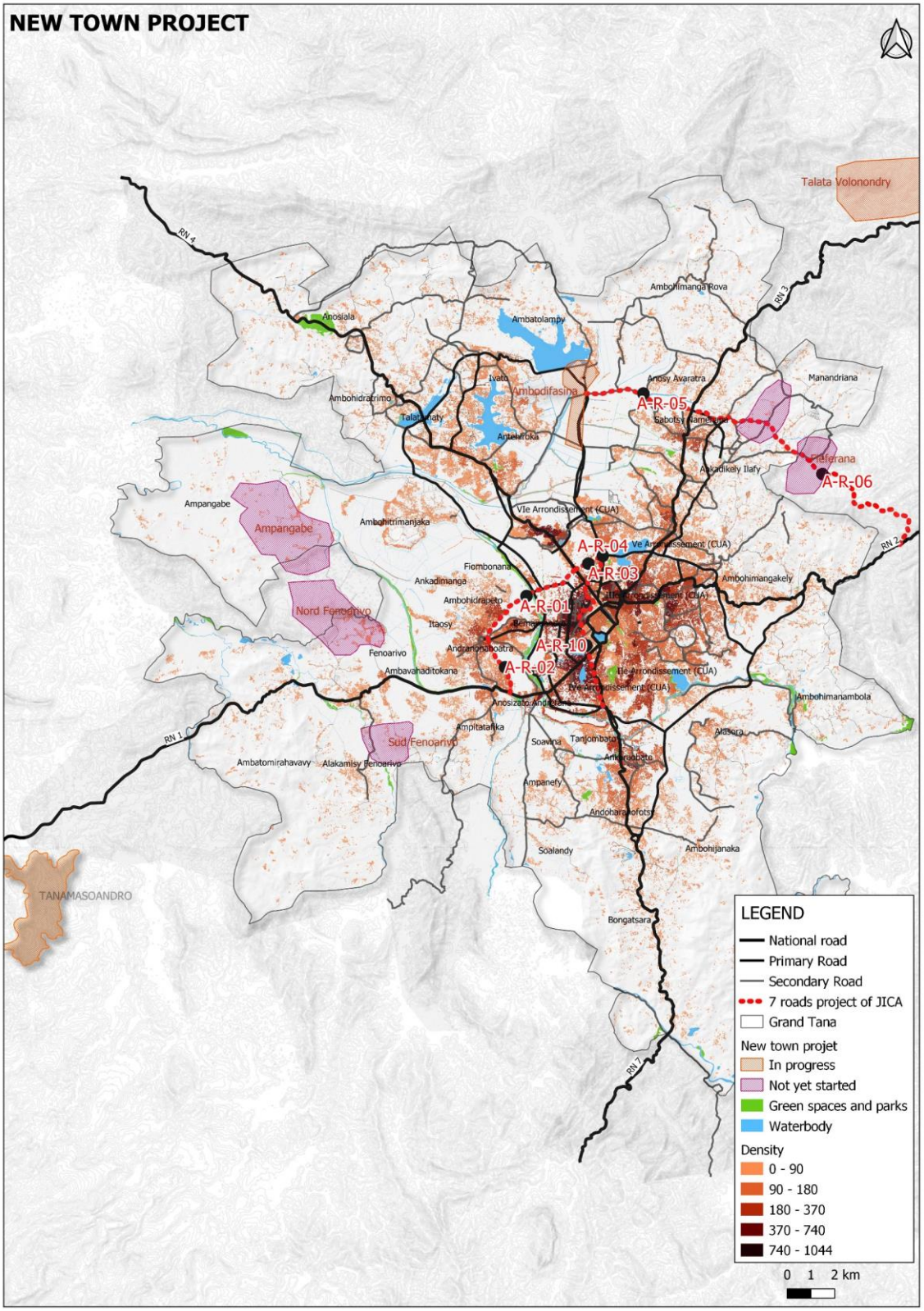
4.9.1. Project Lists and Maps of Urban Development Projects in Antananarivo Metropolitan Area

The list of urban development projects and urban planning is summarized in Table 4-20, and project location maps are shown in Figure 4-15 and Figure 4-16. The new urban development called “Tana Masoandro new town” and number as (1) in Table 4-20 will be connected to the Middle Ring Road through the VROT project. The PUDé (3) through (5) are planned along and near the western section of the Middle Ring Road. The PUDé in (8) is planned in the vicinity of the Outer Ring Road.

Table 4-20 List of Urban Development Project and Urban Planning

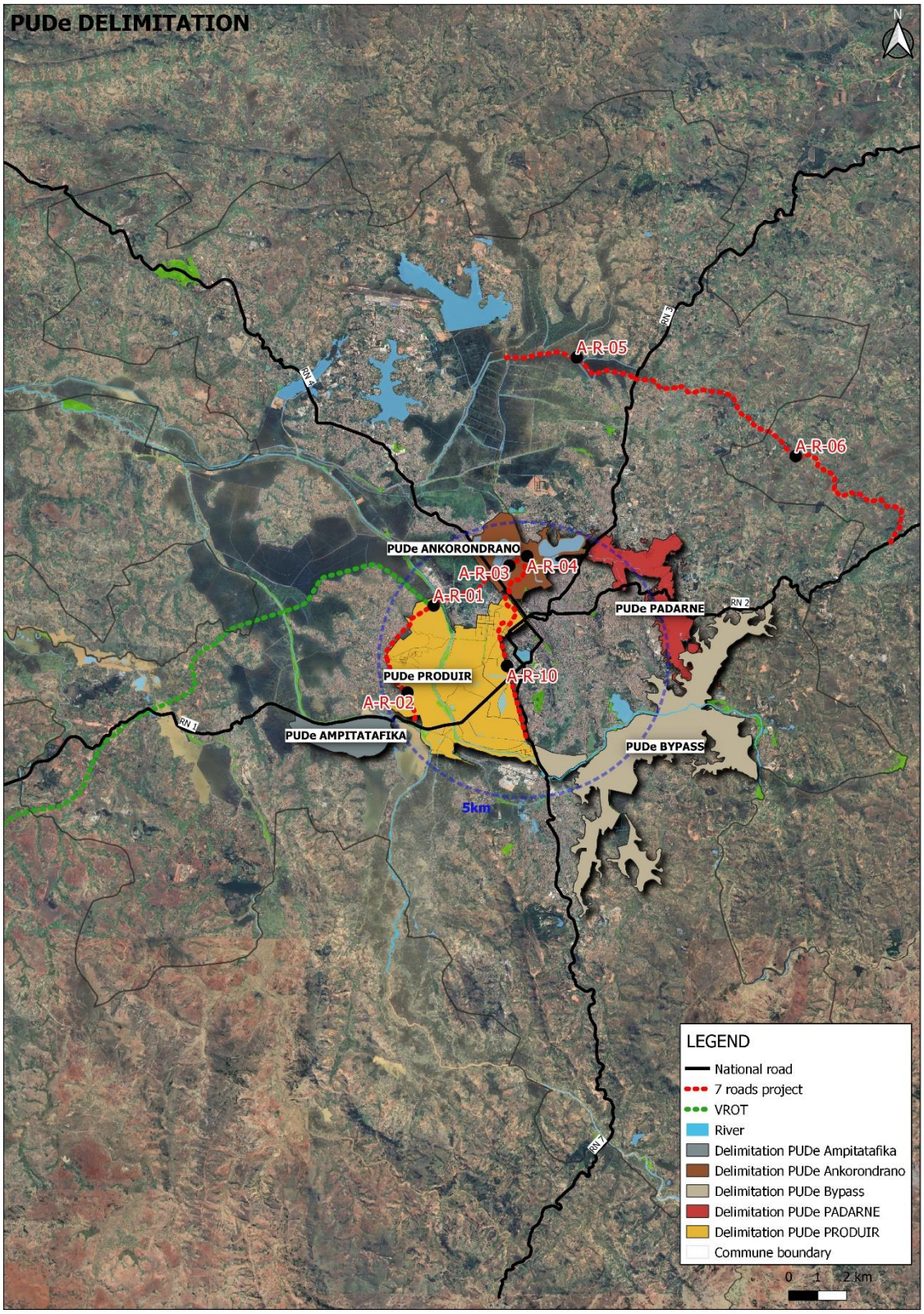
PROJECT	OVERVIEW	RELEVANT MINISTRY	DONOR	STATE OF PROGRESS	PROJECT SCOPE	Projected population/ employment
(1) Tana Masoandro new town	Transfer of administrative functions / special economic zones / cultural facilities / residential areas / Smart City / development	SENVH	Dubai based donor	Phase 01 Primary roads started	Development area: 1 020 ha	224 000 pers 200 000 jobs
(2) Talata-Volonondry new town	New Town Project	SENVH	No donor yet	Planning phase	Development area: 62 ha	23 000 pers
(3) PRODUIR	Flood control / community development / detailed urban planning	MATSF	WB	PUDé under development Commercialisation (e.g. flood control projects)	Development area: 2 000 ha	150 000pers
(4) PUDé Ankorondrano	Detailed urban planning / Development plan for the new urban centre	MATP	landowners' association (A2P4R)	PUDé (2019) Revision work in progress	Development area : 668 ha	46 300 pers
(5) PUDé Ampitatafika	Detailed urban planning / Development along RN1	MATSF	MATSF	PUDé Created (2019)	Planning area: 360 ha	-
(6) PUDé PADARNE	Detailed urban planning / Development along the ROCADE	MATSF	AFD (French Development Agency)	PUDé under development	Development area: 26 ha Study area : 860 ha	8350 pers 5 570 jobs
(7) PUDé Bypass	Detailed urban planning / Development along the Tokyo ring road	MATSF	MATSF	PUDé Created (2018)	Planning area: 1 016 ha	-
(8) PUDé Ampitatafika	Detailed urban planning / Development along RN1	MATSF	MATSF	To be confirmed	To be confirmed	100,000 pers
Other new town projects	Ampangabe, Fenoarivo North and South, Namehana, Fieferana (Newtown in PUDi TaToM)	MATSF / SENVH	No donor yet	Not yet started	-	-
Other new town projects	Namehana, Fieferana	MATSF / SENVH	No donor yet	Not yet started	-	-

Source: SENVH, MATSF, JICA Study Team, 2023



Source: SENVH, JICA Study Team, 2023

Figure 4-15 New Town Project



Source: MATSF, JICA Study Team, 2023

Figure 4-16 PUDe in Grand Tana

Table 4-21 Relationship between Urban Development Plans and TaToM Master Plan

Project	TaToM Master Plan (Propose similar projects and/or supporting projects)
Tana Masoandro new town	This project is also proposed in the TaToM MP titled [A-C-07] "Project for Promotion of Development of Tana-Masoandro Urban Sub-Centre" Two road projects were proposed in the TaToM MP to support the new town: • [A-R-08] Project for Construction of Primary Arterial Road between Tana-Masoandro and Antsavatsava • [A-R-16] Project for Construction of Primary Arterial Road between Bypass Road of RN4 and Ampangabe Suburban Centre (through Tana-Masoandro)
Talata- Volonondry new town	Not covered in the TaToM Master Plan
PRODUIR	There is a proposed project in the TaToM Master Plan titled "Project for Local Road Development and Improvement of Informal Settlements in CUA" which support the PRODUIC project of the World Bank. In the objective of this project, it states: To assist the PRODUIR Project by the World Bank, which aims to improve living environment of highly congested residential areas in CUA, and surrounding three communes, by developing and basic infrastructure and public facilities such as roads, water supply, parks and open space, and community centres and by providing technical assistance for urban management.
PUDé Ankorondrano	This project is also proposed in the TaToM MP titled [A-C-01] "Project for Promotion of Development of Ankorondrano Primary Urban Centre"
PUDé Ampitatafika	This project is also proposed in the TaToM MP titled [A-C-06] "Project for Promotion of Development of Ampitatafika Urban Sub-Centre"
PUDé PADARNE	Not covered in the TaToM Master Plan
PUDé Bypass	PUDE Bypass is part of the "[A-C-01] "Project for Promotion of Development of Ankorondrano Primary Urban Centre" in the TaToM Master Plan. In the description of A-C-01, it mentioned: "Re-zoning of PUDé Bypass in order to accommodate industrial activities and create the Urban Sub-centre, guide urban developments."
Other new town projects	• Ampangabe: Proposed also in the TaToM Master Plan under Phase 3: 2029-2033 titled "Project for Development of Ampangabe New Town (390 ha)". Likewise, the TaToM also proposed the development of it sub-urban center under Phase 2: 2024-2028 (Ampangabe Suburban Centre) • Fenoarivo North and South: Proposed also in the TaToM: Phase 1: 2019-2023 titled "Project for Development of Fenoarivo South New Town (140 ha)". Phase 2: 2024-2028 "Project for Development of Fenoarivo North New Town (440 ha)". Similarly, the development of suburban center of Fenoarivo is also proposed in the TaToM MP under Phase 2: 2024-2028 (Alakamisy Fenoarivo Suburban Centre). • Namehana: Also proposed in the TaToM Master Plan under Phase 2: 2024-2028 titled "Project for Development of Namehana New Town (200 ha)". Likewise, development of its urban sub-center is also proposed in the TaToM for Phase 1 2019-2023 titled [A-C-03] Project for Promotion of Development of Namehana Urban Sub-Centre Phase 1 (Phase 2 is under 2014-2028 time frame). The proposed Outer Ring Road in the TaToM Master Plan also supported the urban development of Namehana since its alignment cuts through the urban area of Namehana. • Fieferana (Newtown in PUDi TaToM): Proposed also in the TaToM under Phase 3: 2029-2033 titled "Project for Development of Fieferana New Town (180 ha)".

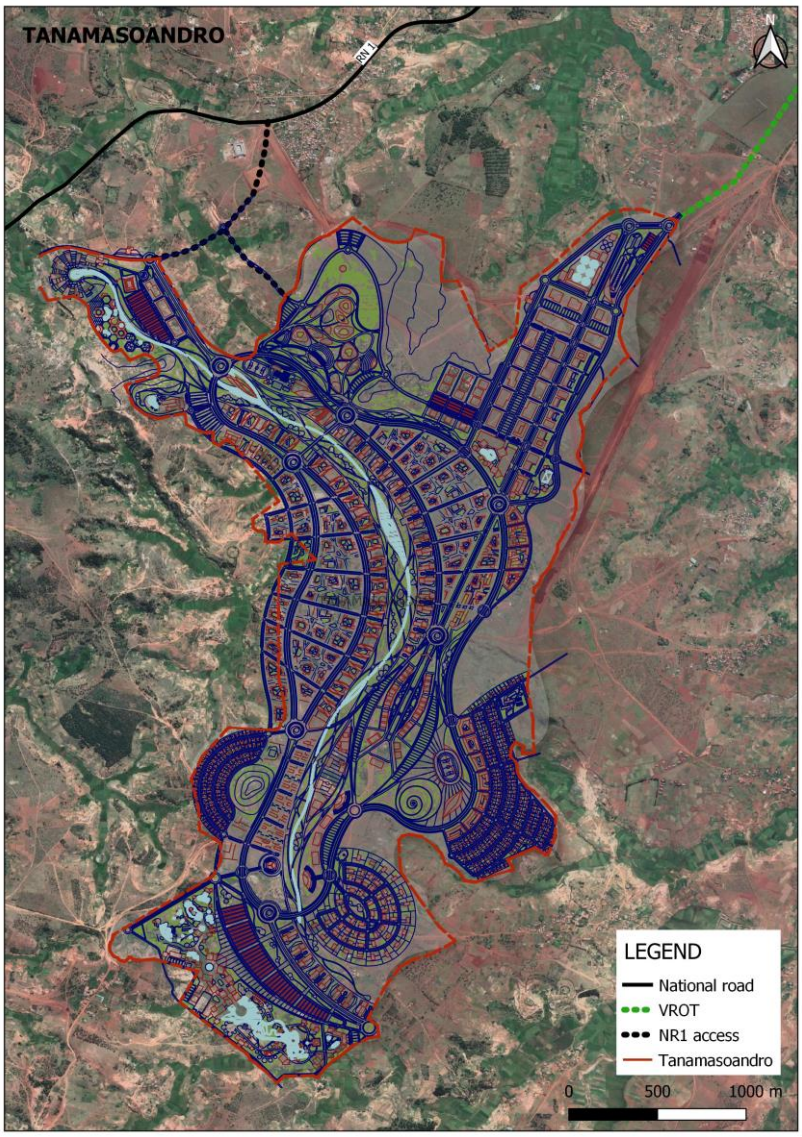
Source: JICA Study Team

4.9.2. Tana Masoandro Administrative New Town (Smart City) Project

(1) Background

The Tana Masoandro project is a new urban development project led by the Office of the President of Madagascar and administered by SENVH. The project is located 26 kilometers from the center of Antananarivo, with a total development area of 1,020 hectares.

The core objective of the project is to relocate ministries and agencies from the densely populated urban center of Antananarivo and build a " Ministerial City" at the core of the future new town. The project is also a smart city and is considering the introduction of an optimal O&M using ICT technology. The plan of the Tana Masoandro New City project is shown in Figure 4-17.



Source: SENVH, 2023

Figure 4-17 Master Plan of TanaMasoandro

(2) Accessibility of the New Town and Infrastructure Projects

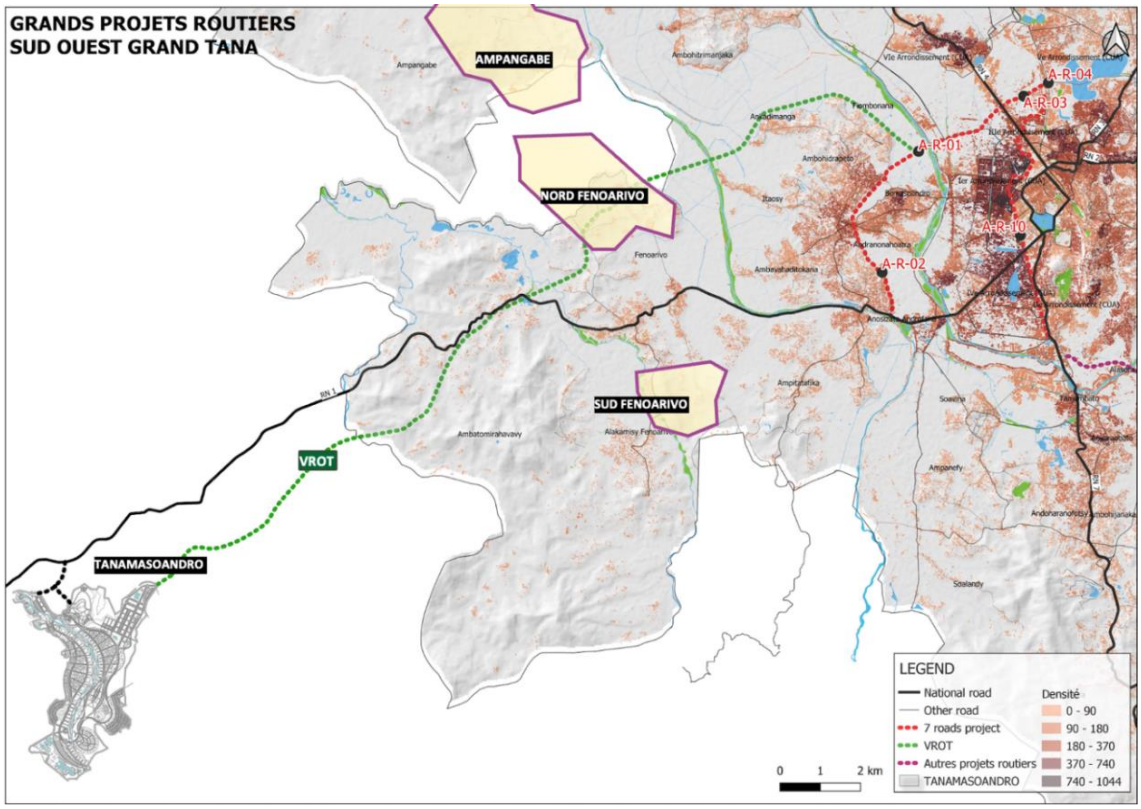
- During the first phase of development, Tana Masoandro will be accessible via the existing RN1 road and connect the Northeastern and the Northwestern gates of the new town.
- The VROT road project is being planned to become the highway connecting Antananarivo (and more specifically Ankorondrano sub-center) and the new town's Northeastern gate.
- Technical feasibility studies are still in progress (per information from SEVNH), it is planned to combine the highway project with a railway line. The railway station will be located outside of the new town itself, at the edge of the Northeastern gate.

The feasibility of train operations along the VROT axis cannot rely only on the development of

Tana Masoandro and Ankorondrano. It is therefore important to consider two aspects to make such railway infrastructure project feasible:

- Prioritize the construction of North Fenoarivo as an intermediate new town between Ankorondrano and Tana Masoandro
- Start the railway project with a Phase 01 in the central urban areas by connecting the existing urban railway (running along Andriantany canal) and VROT to form a complete regional railway network.

However, according to interviews with SENTV, the prevailing view is that the early feasibility of an urban rail system connecting the new cities is difficult and needs to be considered over the long term.



Source: SENVH, PUDi TaToM, INSTAT, JICA Study Team, 2023

Figure 4-18 Location Map of Urban Development Prospects in the Western Part of Greater Tana

(3) Planning Principles and Quantitative Analysis of the New Town Project

The Administrative New Town is planned to provide an important share to non-residential areas and business areas, public and green spaces. It's therefore not a high-density project, but a project aiming at creating an important amount of direct and indirect jobs (around 200,000 employment units planned in total) for a total of 51,000 households.

This planning approach has multiple implications on the traffic demand outside of Tana Masoandro, as many jobs will be taken by people living away from the new town itself. During the first phase of the project, traffic pressure will impact the current RN1 and it can be anticipated that multiple attempts of constructions and informal urbanisation will happen along the single road giving access to the new town.

The VROT project will balance the traffic distribution and will become a second catalyst of linear urbanisation. Planned areas per category of land use, total length of road networks, population and employment projections are shown in the succeeding tables.

Table 4-22 Planned Areas per Category of Land Use

Land use	Planned area
Administrative Areas	29.4 ha
Ministerial City	18 ha
Business District	7 ha
“Green River” Green Space	6 km
Commercial and retail area	28.7 ha
Cultural district	8 ha
Entertainment Park	71 ha
Hotels and restaurants	10.4 ha
Sport infrastructure	28 ha
Residential areas	145.5 ha
Total housing units	51000 units
International Zone: *Embassies Headquarter, Conference center, International Expo Area*	25.9 ha
Education (primary, secondary schools and university)	52.2 ha
Health infrastructure	17.7 ha
Light Industry Zone	6.9 ha
Main Bus Station and service area	6.6 ha
Solar power plants	6.7 ha (on 3 sites)

Source: SENVH, 2023

Table 4-23 Total Length of Road Networks within the New Town Project

Monumental avenues	3.6 km
Primary roads	14.5 km
Secondary and tertiary roads	28.9 km
Cycling routes	unknown
TOTAL	47 km

Source: SENVH, 2023

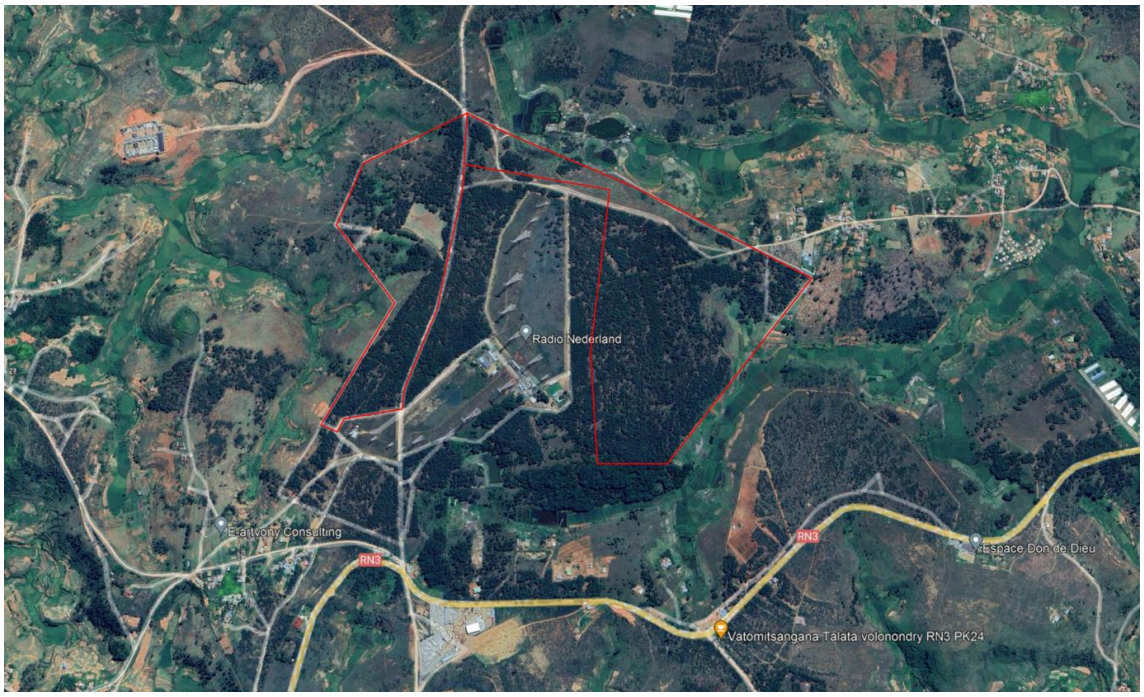
Table 4-24 Population and Employment Projections

Total housing units	51,000 units
Total projected population (with 4.4 people/household)	224,400 inhabitants
Total planned employment	200,000 jobs

Source: SENVH, 2023

4.9.3. Talata-Volonondry New Town

SENVH is planning the Talata-Volonondry project in the northeast area along RN3 in the Antananarivo metropolitan area. The project aims to develop mainly residential housing, with a site area of 62 ha, which will accommodate approximately 23,000 inhabitants. The location map of the planned new city of Tarata-Volondry is shown in Figure 4-19. Currently, the project is still in the conceptual stage, and there is no funding in sight for the study and design.



Source: SENVH, 2023

Figure 4-19 Location of Talata-Volonondry New Town

4.9.4. PUDé Urban Detailed Plan of Ankorondrano

(1) Overview

The target area is approximately 670 ha, including Ankorondrano, Andraharo, and Fokontany in Masai Mara. The plan is to turn the CBD (Central Business District) into a new sub-center, which aims to disperse employment from the city center. It also establishes the following development policies.

Policy 1: Creation of an economic and financial hub in Antananarivo

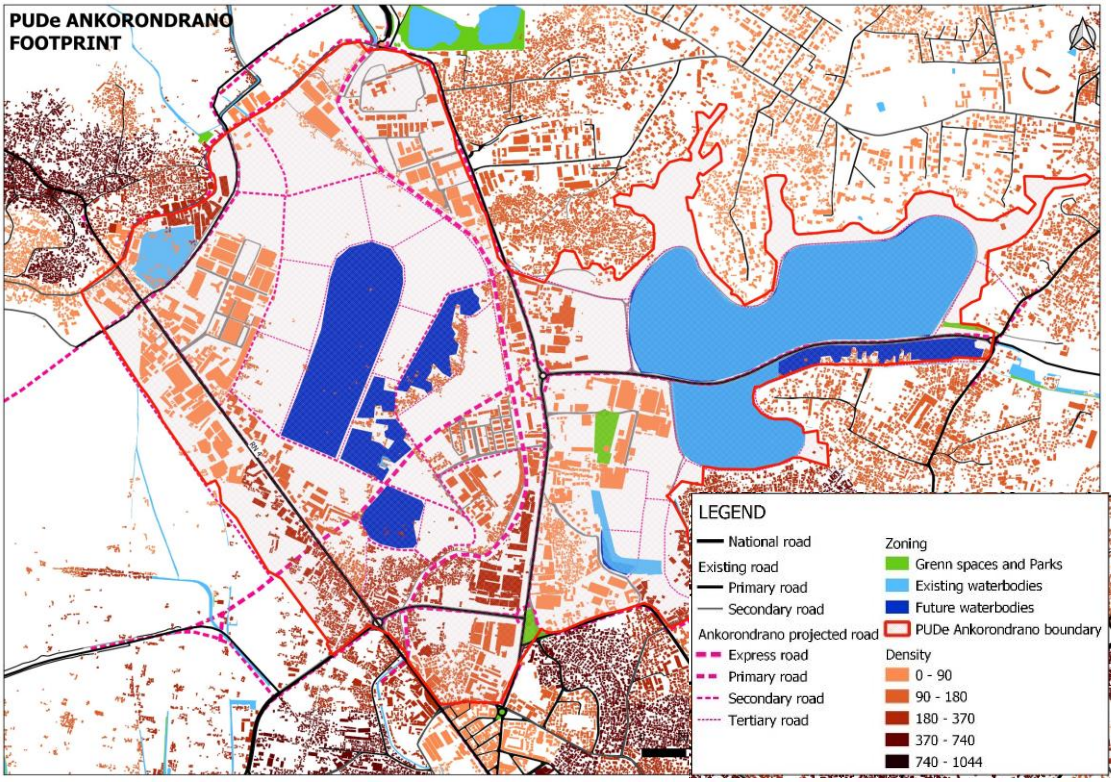
Policy 2: Improve urban livability and equalize urban density

Policy 3: Optimize urban mobility and accessibility

Policy 4: Development of areas for efficient local government implementation

Policy 5: Promote social inclusion

Policy 6: Protect the environment and address flood risks



Source: PUDé of Ankorondrano, MATSF 2020 , JICA Study Team, 2023

Figure 4-20 Overview Ankorondrano Urban Development

(2) Findings from Related Plans

The Antananarivo Integrated Sanitation Program "PIAA" recommends that flood risk considerations should be taken into account in the development of the area.

- Securing a recreational water area of 172 ha with a capacity of 1,720,000 m3
- Expansion of canals and construction of new pumping stations

The PUDi and TaToM Master Plan also states the following directions for PUDé:

- PUDé lacks a quantitative plan for anticipated building area, projected population, and employment by economic sector. There is also no detailed master plan embodying this planning tool.
- The VROT project and the Western Section of the Middle Ring Road project are likely to affect the feasibility of the proposed urban development of the PUDe due to the route options for connecting the two projects to the area in question. Therefore, coordination with this PUDé is necessary when planning both roadway projects.

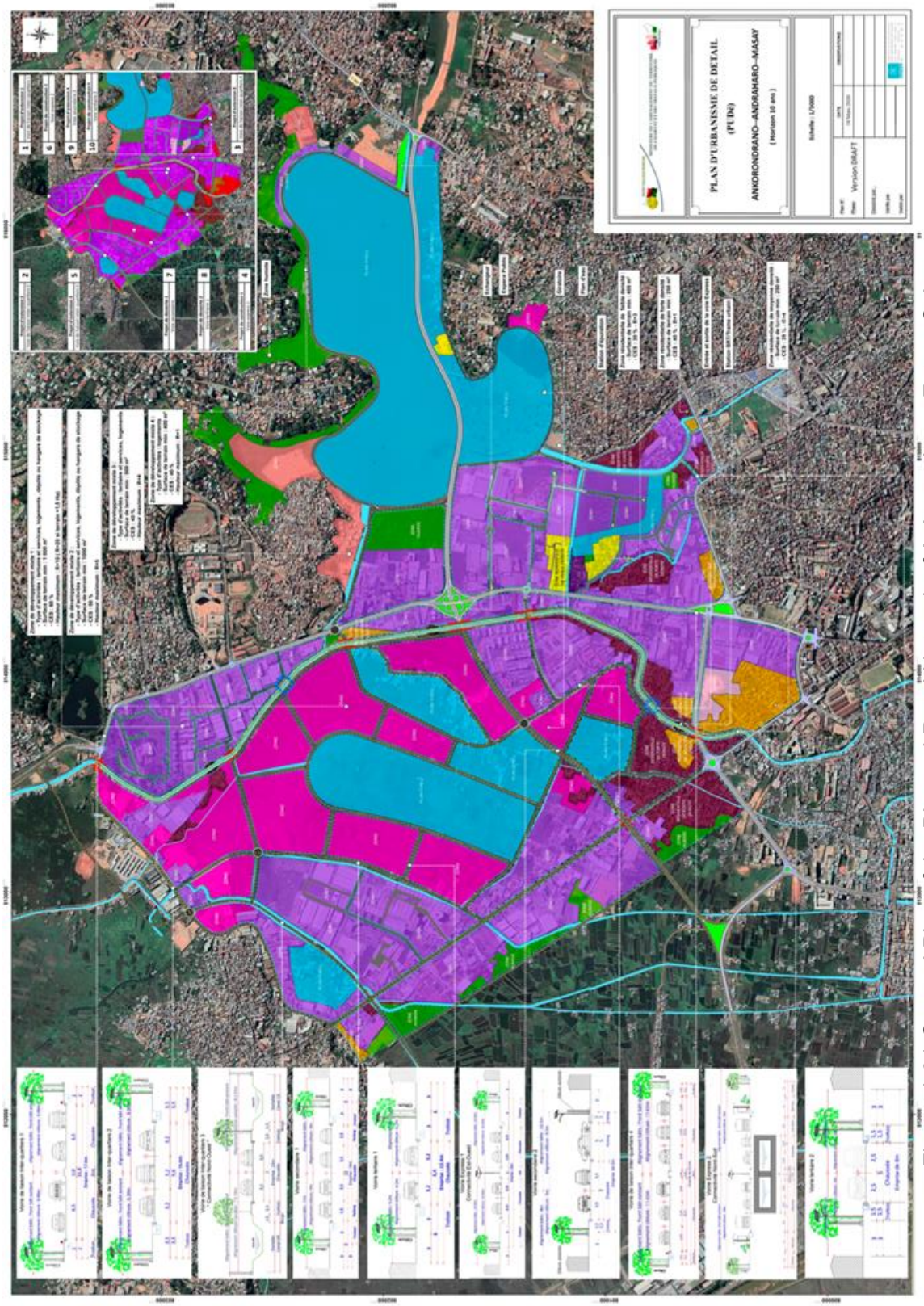


Figure 4-21 General Plan of the Planned Road Network of Ankorondrano Future Subcenter

Source: PUDé of Ankorondrano, MATSF, 2020

(3) Land use plan

The land use projection is as follows:

- Mixed Used Development Zone ZDM1: Total area of 21 ha, including the backfilled area;
- Mixed Used Development Zone ZDM2: Total area of 89 ha, including the backfilled area on the plain of Andranomahery;
- Mixed Used Development Zone ZDM3: Total area of 12 ha, including the area to be flooded near the Lake Masay;
- Mixed used Development Zone ZDM4, with an area of 6 ha, including the area to be backfilled near Lake Masay;
- A low-density residential zone, with an area of 4 ha, which covers the TAF Ankorondrano sector;
- A medium-density residential area, with an area of 13 ha
- The slum area with an area of 31 ha, considered to have high density of population;
- The water bodies have a total area of 163 ha
- The wetland areas cover 36 ha: they play a role of buffer zone;
- Green spaces and public spaces have a total area of 2.2 ha, and the purification zone of 0.6 ha
- The existing and projected road networks have a total area of 89.4 ha

Following data analysis on population density in Fokontany, typical high density in Antananarivo reaches 900 inhabitants/ha, medium density approaches 400 inhabitants/ha and low density equals 100 inhabitants/ha. New mixed-used development zones will combine business activities and middle-class housing units with expected lower density (<100 inhabitants/ha).

Table 4-25 Average Projected Population in Ankorondrano PUDé Area

Land area	Planned area	Planned resident population
ZDM1	21 ha	2,100
ZDM2	89 ha	8,900
ZDM3	12 ha	1,200
ZDM4	6 ha	600
Low density residential area	4 ha	400
Medium density residential area	13 ha	5,200
High-density housing	31 ha	27,900
Water bodies	**163 ha**	0
Wetland areas	36 ha	0
Green spaces and humid zones	2.8 ha	0
Roads and urban streets	89.4 ha	0
Total Population	**467.2 ha**	**46,300 inhabitants**

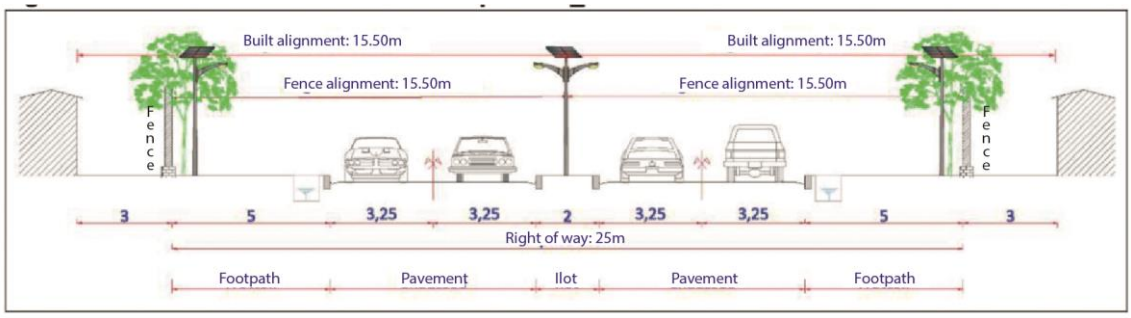
Source: JICA Study Team, 2023, based on data in PUDé of Ankorondrano, 2020

(4) Road Network Planning

The road network plan identifies two expressways (Rocade West and Andriantany canal road), 4 inter-district connecting roads, secondary roads and tertiary roads (urban streets), one interchange (at the LP) and 4 road intersections.

- Rocade West

The exact route of the Rocade West (2x2 lanes) of Antananarivo will be studied in detail with 4 scenarios to be assessed. In the PUDé, the crossing of the RN4 and its industrial area is not considered. BADEA is considering to fund the construction of the bridge crossing the Ikopa river at Maki Stadium.

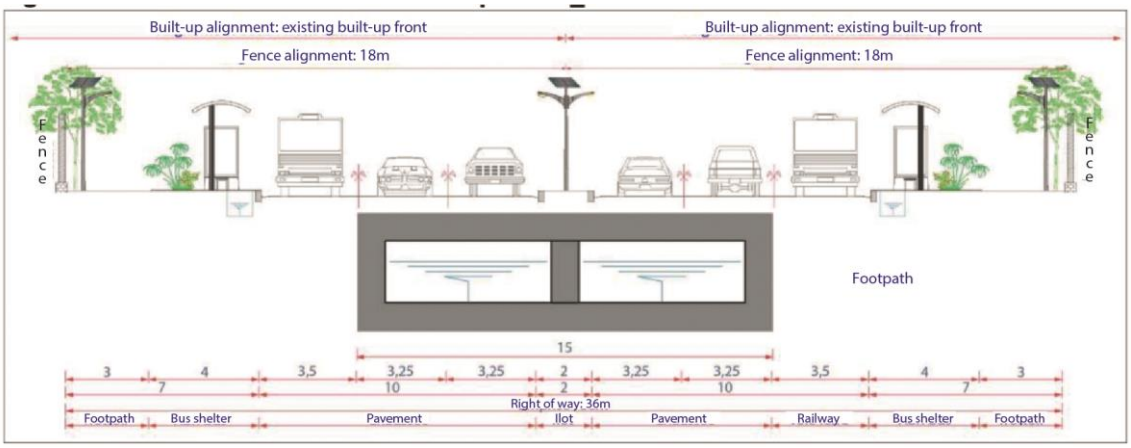


Source: PUDé of Ankorondrano, 2020

Figure 4-22 Proposed Cross Section of the Rocade West

- Andriantany Canal Road

The North-South axis (2x3 lanes) is planned to be built over the existing Andriantany Canal, along the existing railway track. Currently, no donor support is received by the government and alternative design studies is not available. The opportunity to build a second parallel track for the urban railway is not considered here, despite the opportunity of developing North-South mass transit for optimised public transport. The road+railway infrastructure scenario of the VROT expressway project raised uncertainty on the type of connectivity with the existing railway and road network and the potential opportunity to create a multimodal logistic hub and passenger hub in Ankorondrano sub-center.



Source: PUDé of Ankorondrano, 2020

Figure 4-23 Proposed Cross Section of the Andriantany Canal Road Project

4.9.5. PUDé Urban Detailed Plan of PRODUIR Area

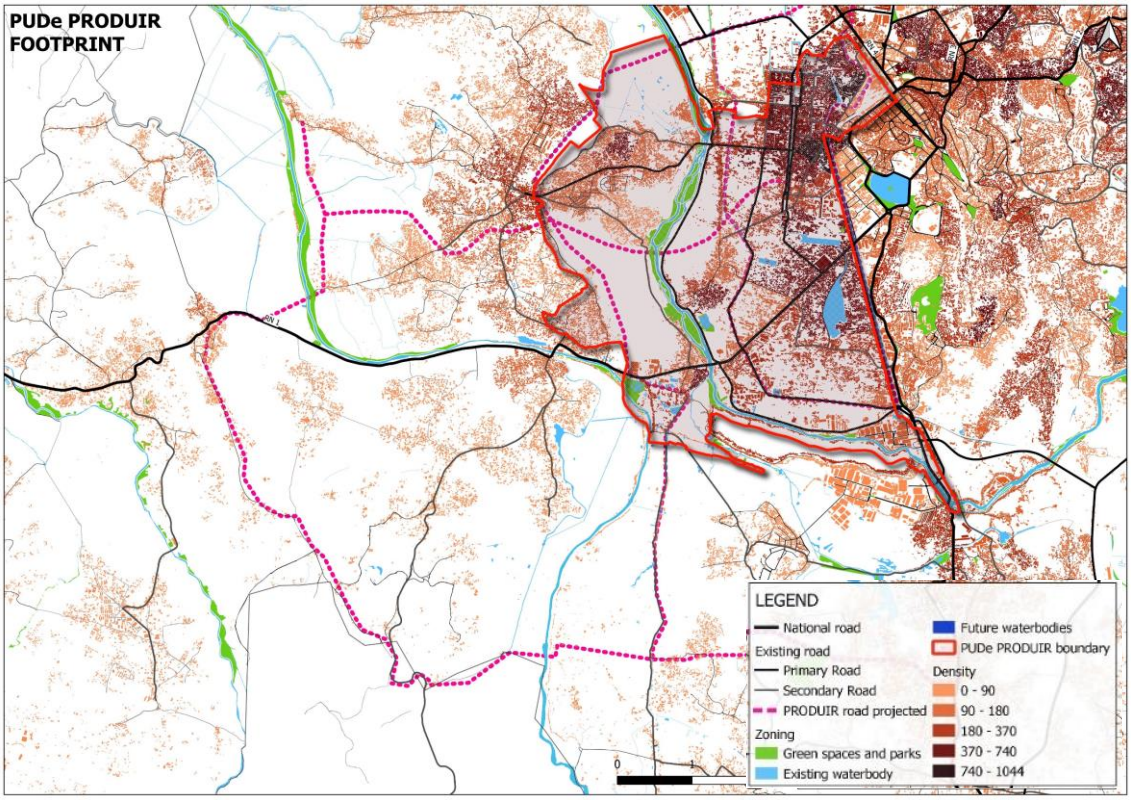
(1) Background

PRODUIR is an urban development project financed by IDA of the World Bank Group to strengthen urban resilience. The PUDé is intended to address the current severe vulnerability of the targeted areas to flooding. Thus, PUDé is not intended to develop new cities or other urban areas, but rather to improve the current situation with respect to disaster risk.

The goal of PRODUIR is to break the urbanization trends of the past that led to the emergence of vulnerable slums and the location of illegal populations in wetlands. However, the lack of reliable information on land tenure, coupled with the rapid expansion of slums on the one hand, complicates the restructuring and treatment of the targeted areas for the realization of the plan. The PUDé adopts two complementary approaches:

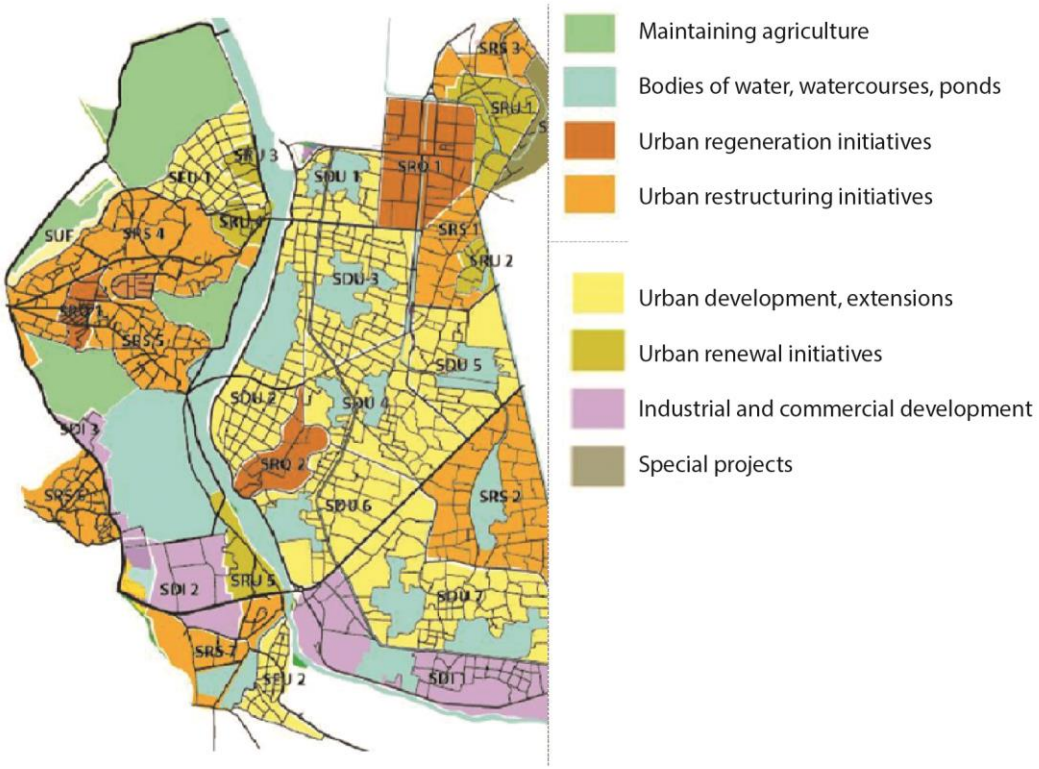
- Sectoral approach aiming at rehabilitating and upgrading slums with small-scale infrastructure projects.
- Territorial (spatial) approach aiming at integrating spatial planning and rainwater management (retention, storage, landscaping) coupled with land preservation and renaturation.

From a road infrastructure perspective, land preservation and reliable land ownership information is essential to assess the feasibility of road project. The overview of PRODUIR and planned roads are illustrated in Figure 4-25.



Source: PUDé of PRODUIR Area, 2023 , PUDi TaToM, 2019, JICA Study Team, 2023

Figure 4-24 Overview of PRODUIR PUDe Area and Planned Roads



Type	Superficie en hectare	Population 2016	Densité brute 2016
SDU 1	42,35	13 890	328
SDU 2	93,17	11 199	120
SDU 3	80,65	25 957	322
SDU 4	98,26	36 593	372
SDU 5	77,27	22 660	293
SDU 6	84,60	20 925	247

Source: PUDé of PRODUIR Area, 2023

Figure 4-25 Land Use of the PRODUIR Area

(2) Planning Vision and Main Orientations of the PUDé

The four (4) main principles of PUDé are as follows:

- Ensure flood prevention by building, securing and managing 'intermediate water retention basins';
- Improve neighbourhoods and provide them with facilities (water, drainage, emergency services) which made possible due to the construction of a street system;
- Identify and prioritize "urban development zones" where well-located land is available;
- Implement and operationalise regulatory planning for all land plots, monitor construction permits and contribute therefore to infrastructure development.

(3) Action Plan and Projects

The main projects prioritized in PRODUIR's PUDé are listed below and illustrated in Figure 4-26.

a) The urban railway project and Soarano station
- One railway line of 12km with one rail track only
- 10 railway stations
- Soarano station displaced to Amoronakona

b) Development of Namontana market and reduction of Anosibe market activities

c) C3 Canal dredging and cleaning on 12 km
- Project started in 2017 and did not achieve much progress due to compensation issues
- Sanitation and drainage of canals networks
- 420 households to be displaced (80 households currently displaced)

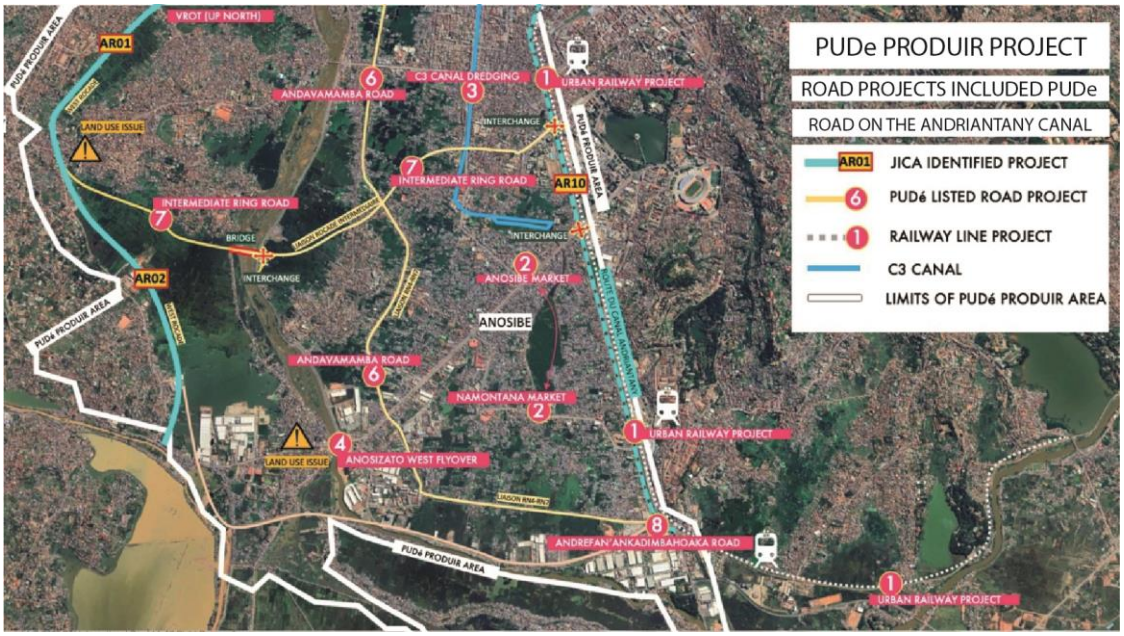
d) Flyover project of Anosizato West
- Detailed plans not available yet in the PUDé of PRODUIR (Draft version)

e) VROT (Voie Rapide Ouest Antananarivo) Highway project
- Connection highway between Maki Stadium Area and Tanamasoandro
- Bridge project passing across RN58A and Ikopa river (at Maki Stadium location) of 160 meters long

f) Andavamamba primary road
- PUDi TaToM proposal connecting Ampitatatfika sub-center, Andavamamba, Anosipatrana and Andranonahoatra
- Aims to ease traffic congestion on RN1 and on Ikopa river bridge

g) Intermediate Ring Road (Rocade) – Western part
- PUDi TaToM proposal connecting Ankononandro, Ampitatafika via Andranonahoatra
- Connecting RN1, RN58A and RN4, Hydrocarbures Road
- Important to study feasibility in relation with land ownership, displacement of households and compensation mechanisms

h) Secondary road infrastructure at Andrefan'Ankadimbahoaka, Fokontany
- Funded by FILATEX to ease access to its industrial area
- Located close to RN58A-RN7 road intersection



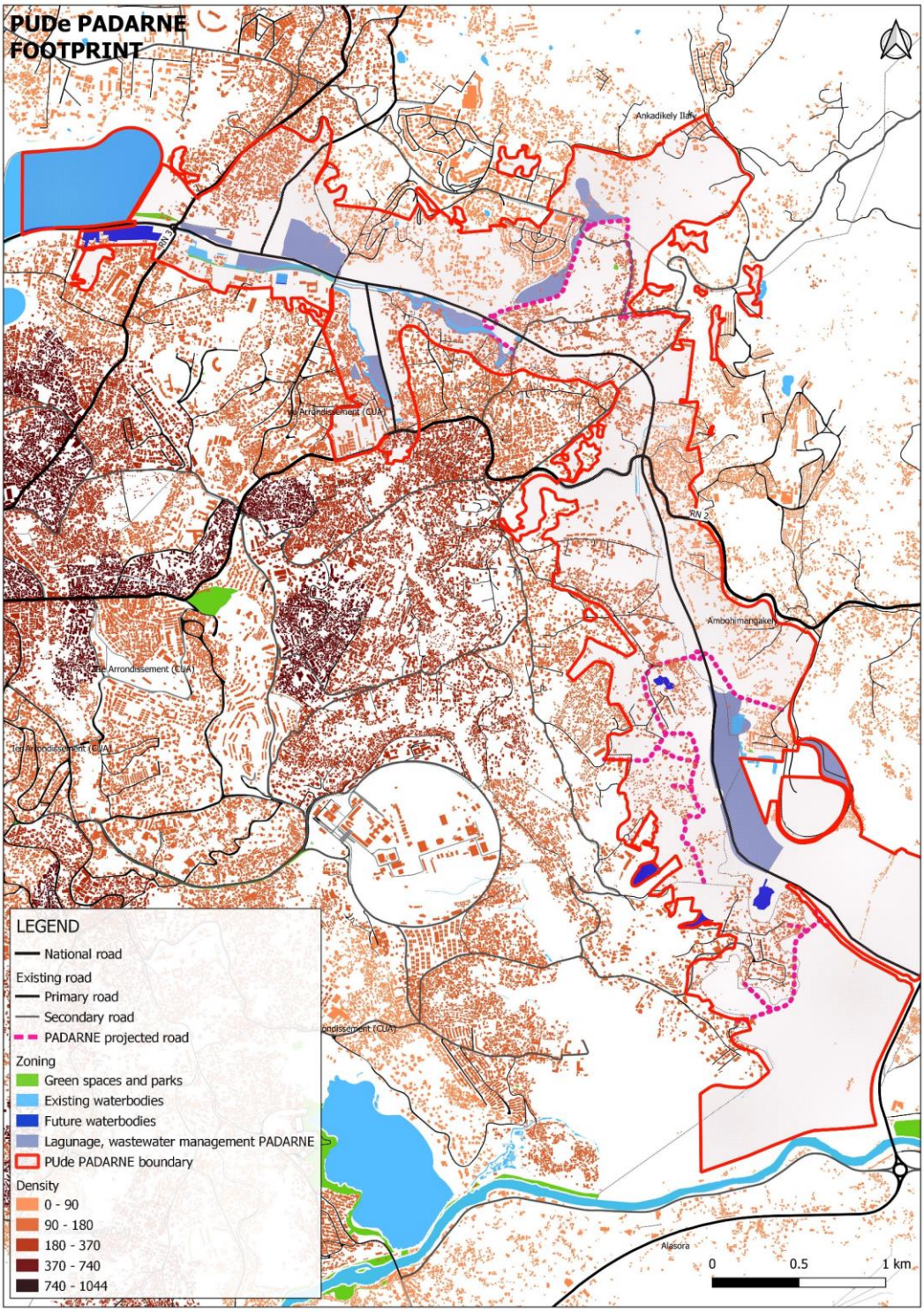
Source: PUDé of PRODUIR Area, JICA Study Team, 2023

Figure 4-26 Overview of Planned Road Infrastructure Projects in PRODUIR Area

The road infrastructure projects planned on the Andriantany Canal are not included in the primary list of projects of the PUDé. But the road covering the Canal is mentioned as potential project, taking into account its existence without validating it. During the meeting with the team of PRODUIR, the opportunity of keeping the Andriantany canal open air (in line with PRODUIR project idea) and the possibility of partial construction of double railway tracks instead of one was mentioned. In this scenario, an elevated road project (including BRT lanes) with a metallic structure would be a new project option, but it requires careful analysis of interchange points connecting the flyover and secondary roads crossing it below.

4.9.6. PUDé Urban Detailed Plan of PADARNE Area

PADARNE PUDé is dedicated for development along the eastern section of the Intermediate ring road supported by AFD. It is currently under development and covers an area of approximately 860 hectares, including three areas (Ambatobe, Ankerana, and Ampacimbe).



Source: PUDé of PADARNE Area, MATSF, JICA Study Team, 2023

Figure 4-27 Spatial Footprint of the PADARNE PUDé Area

Three scenarios are being elaborated to create an axis of metropolitan services, logistic hubs, health facilities, cultural and sport activities that cannot be integrated in dense urban areas. Their

difference resides in the allocation of lands for housing, logistics, mixed-used facilities, water epuration, industrial activities, green spaces, etc.

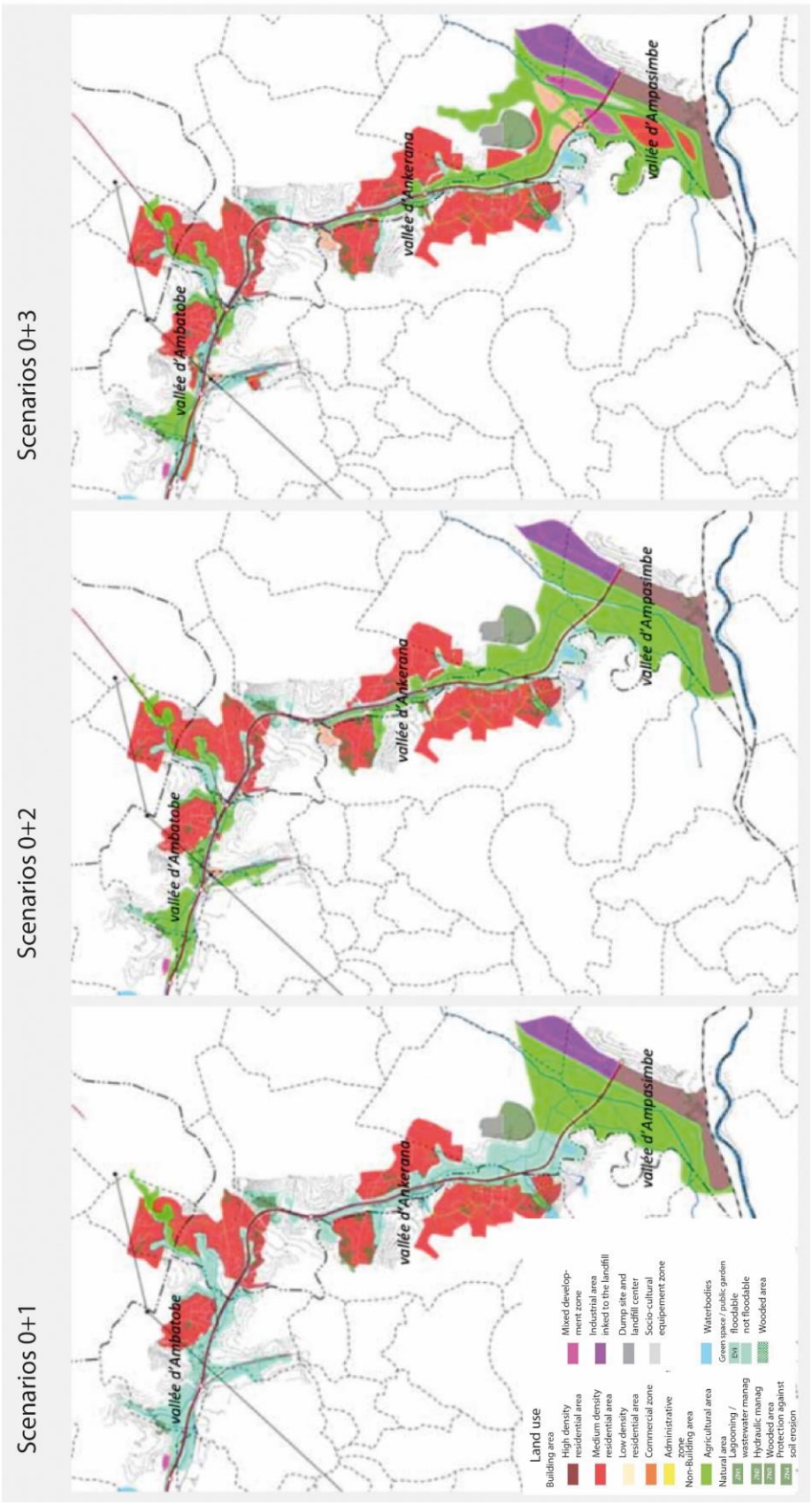


Figure 4-28 Three Scenarios of PADARNE Pudé Area

Source: PUDé of PADARNE Area, MATSF, 2023

With regard to urban development, PUDé will first focus on the development of urban amenities (education, health, transportation) and public spaces for local communities. With regard to logistics, PUDé plans to develop a 400,000 sq. m. multi-modal platform (Madarail) that will create approximately 1,600 jobs between the Middle Ring Road and the Tokyo Bypass. The area of each development zone in the PADARNE area and the number of jobs planned to be created are shown Table 4-26.

Table 4-26 Temptative Urban Programming of PADARNE Area (in progress)

Location industry/facility	Planned area	Employment/resident population
Textile factory	10 ha	1000 jobs
Logistic Hub Madarail	100 ha	1600 jobs
Call Center	10 ha	1500 jobs
Agro-Industrial Platform	15-20 ha	350 jobs
Hospital	2 ha	600 jobs
Public swimming pool	0.5 ha	35 jobs
Housing	2385 housing units	8350 people

Source: PUDé of PADARNE Area, MATSF, 2023

In total, the PUDe identifies 26 ha for the development of metropolitan facilities. The plan identifies 80 hectares for potential residential densification/compaction, which comprises 2,385 housing units and 8,350 inhabitants. The overall objective of the land use treatment of the area is to measure how to combine urban development and urban resilience to floods along the Rocade, by preventing disordered urbanization of the rice paddy fields.

The PUDe of PADARNE illustrates the urgent need to plan and anticipate urban, industrial and rural development along road infrastructure projects that run through highly floodable areas, such as the A-R-03, A-R-02 and A-R-01 projects in the West of Tana.

Source: PUDé of PADARNE Area, MATSF, 2023

Figure 4-29 Dump Transformation into a Recreational Green Space, PADARNE Area

4.9.7. PUDé of Tokyo By-Pass Area

The PUDe of Tokyo By-Pass focuses on the landscape and hydraulic treatment of the Bypass road to make it a green and blue infrastructure resilient to floods and preventing disorganized

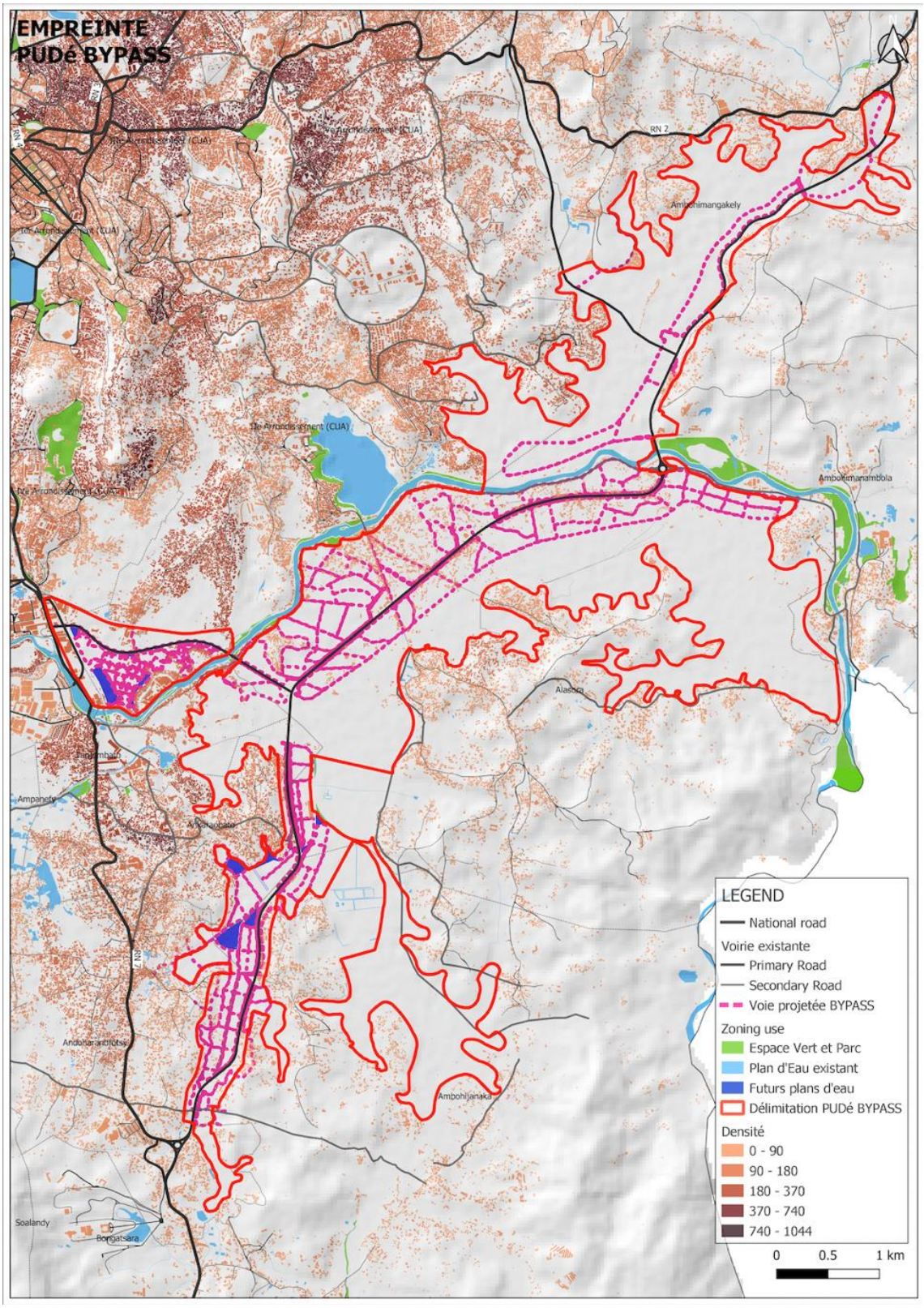
constructions along the road. The plan proposes several key developments such as:

- The administrative center of Iavoloha-Mahazoarivo
- The sport and entertainment park of Ankadievo

The plan doesn't provide any population and employment projections though, as its main focus is to make the By Pass Road a green and livable environment by 2030.

The PUDe is based on the orientations of the PUDi 2004, which proposes:

- The development of a Logistic Multimodal Platform at Bretelle Ankadimbahoaka
- The preservation of Alasora lowlands as floodable agricultural lands
- The development of Amoronakona as an industrial development zone



Source: PUDé of BYPASS Area, MATSF, 2016, JICA Study Team, 2023

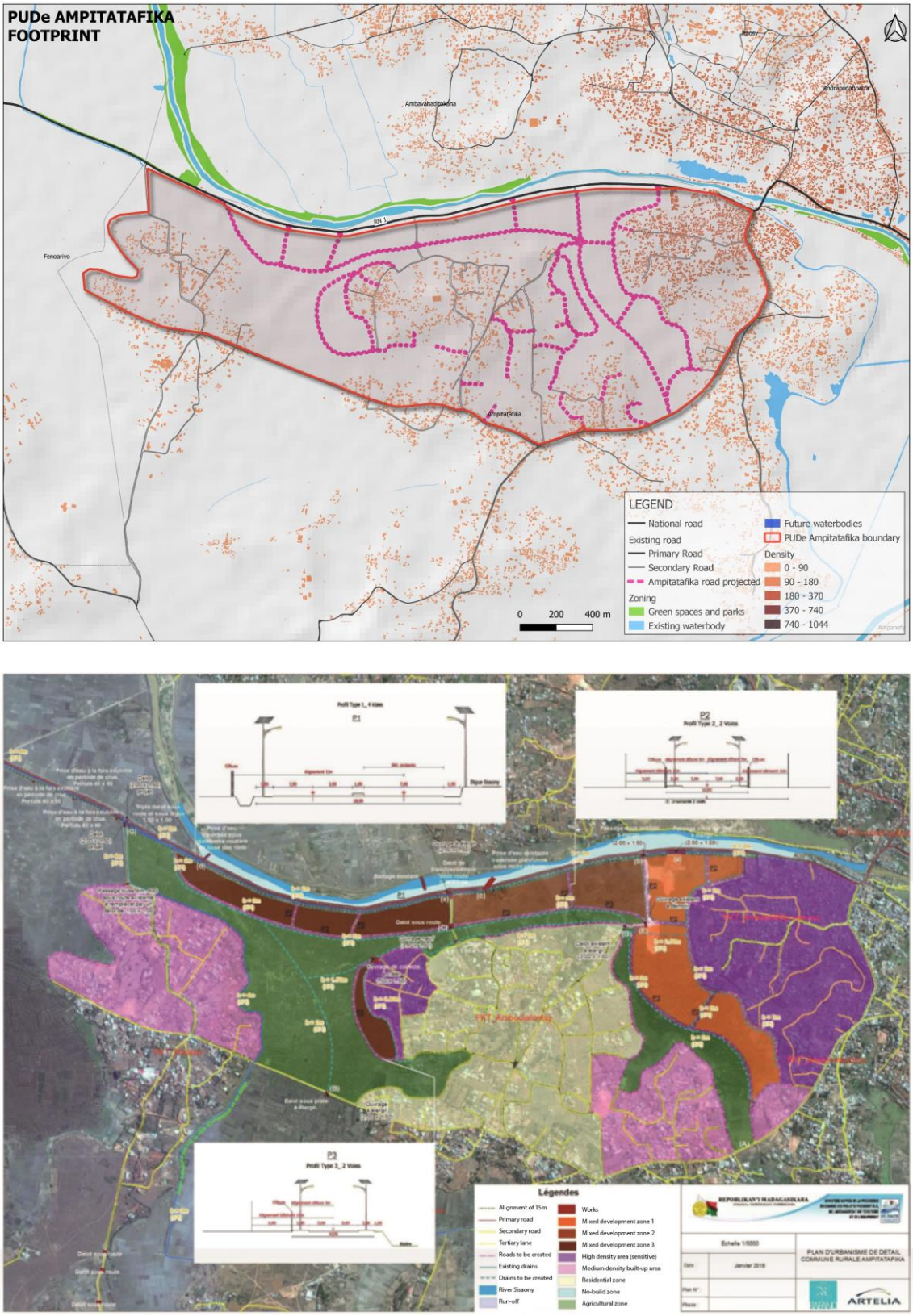
Figure 4-30 Spatial Footprint of PUDe Tokyo By-Pass and Primary/Secondary Roads

4.9.8. PUDé of Ampitatafika

The PUDe of Ampitatatafika was elaborated in 2018 and based on the PUDi of 2004 and on the simplified rural planning scheme of the district (2009) with 2 main objectives:

- Planning residential areas and human activities on the hills of the area
- Preserving and organizing farming activities (paddy fields) in the lowlands

The plan mainly focuses on land use regulations to preserve the rural character of the district, and highlights the need to widen the RN1 road to 2x2 traffic lanes, with hydraulic works to be achieved along the paddy fields.



Source: PUDé of Ampitatafika, MATSF, 2018

Figure 4-31 Future Land Use of Ampitatafika, PUDé

CHAPTER 5 Current Status and Prospects of Urban Structure of Antananarivo Metropolitan Area

5.1 Population Distribution

The metropolitan area of Antananarivo has a total population of 2,539,926 inhabitants with an average density of 57.17 inhabitants/hectare in 2021 (Table 5-1 and Figure 5-1). Its central area (CUA: La Commune Urbaine d'Antananarivo) has a population of 1,274,225 inhabitants and its average density almost three (3) times higher than those in metropolitan area at 163.8 inhabitants/hectare in 2021 (Figure 5-2).

Table 5-1 Population of Antananarivo Agglomeration (1993-2033)

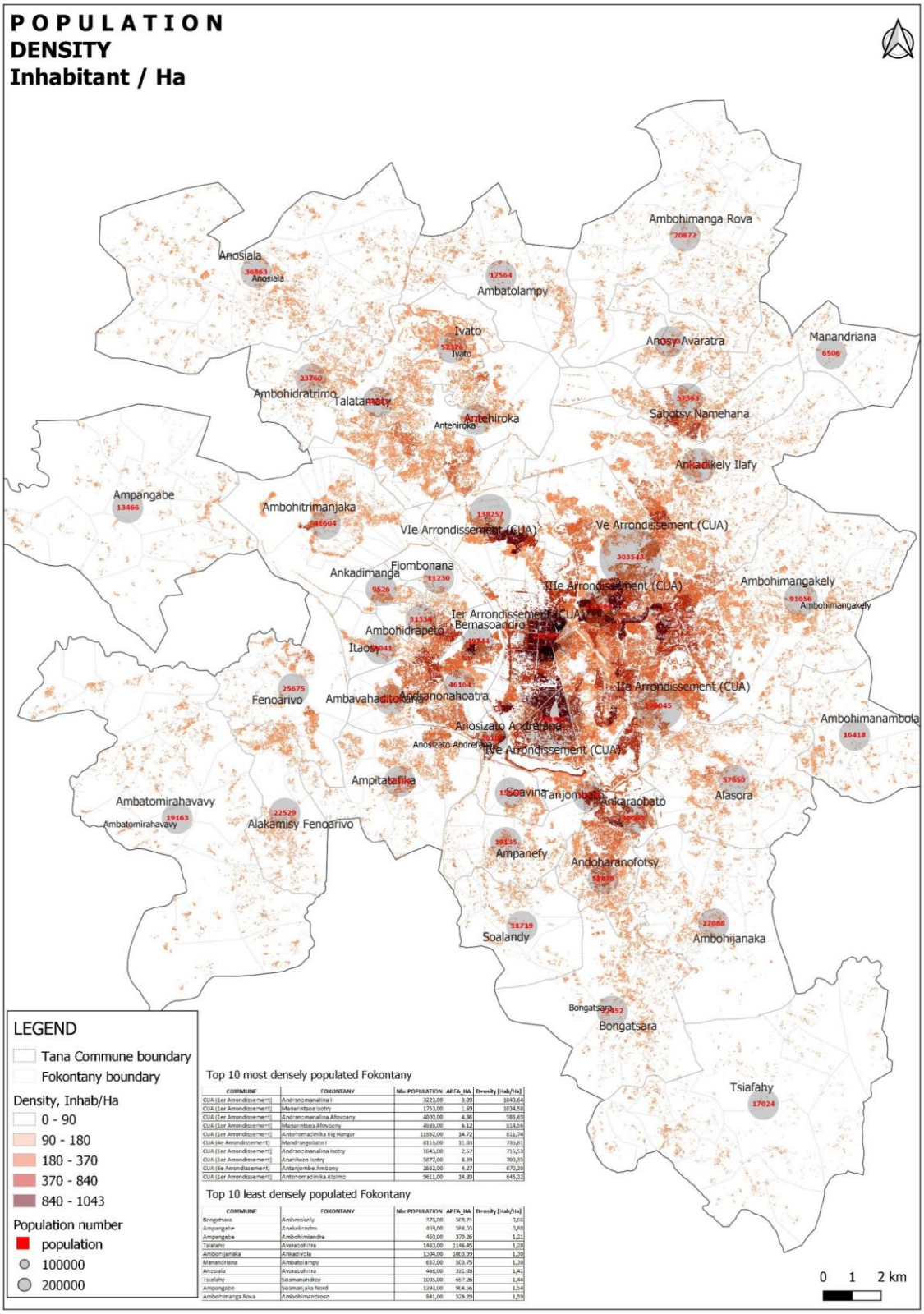
		1993	2018	2023*	2028*	2033*
Antananarivo Renivohitra	Population	710,236	1,275,000	1,426,000	1,587,000	1,763,000
	Growth rate		2.37%	2.27%	2.15%	2.13%
Antananarivo Avaradrano	Population	163,471	449,000	545,000	654,000	779,000
	Growth rate		4.13%	3.95%	3.71%	3.56%
Ambohidratrimo	Population	185,146	442,000	532,000	634,000	750,000
	Growth rate		3.54%	3.80%	3.56%	3.63%
Antananarivo Atsimondrano	Population	229,597	642,000	782,000	942,000	1,126,000
	Growth rate		4.30%	4.02%	3.78%	3.63%
Agglomeration of Antananarivo (without Ambatomirahavavy)	Population	1,116,000	2,521,000	2,971,000	3,476,000	4,052,000
	Growth rate		3.31%	3.34%	3.19%	3.11%

*Note: 2023, 2028, and 2033 are projected population

Source: INSTAT, 2018

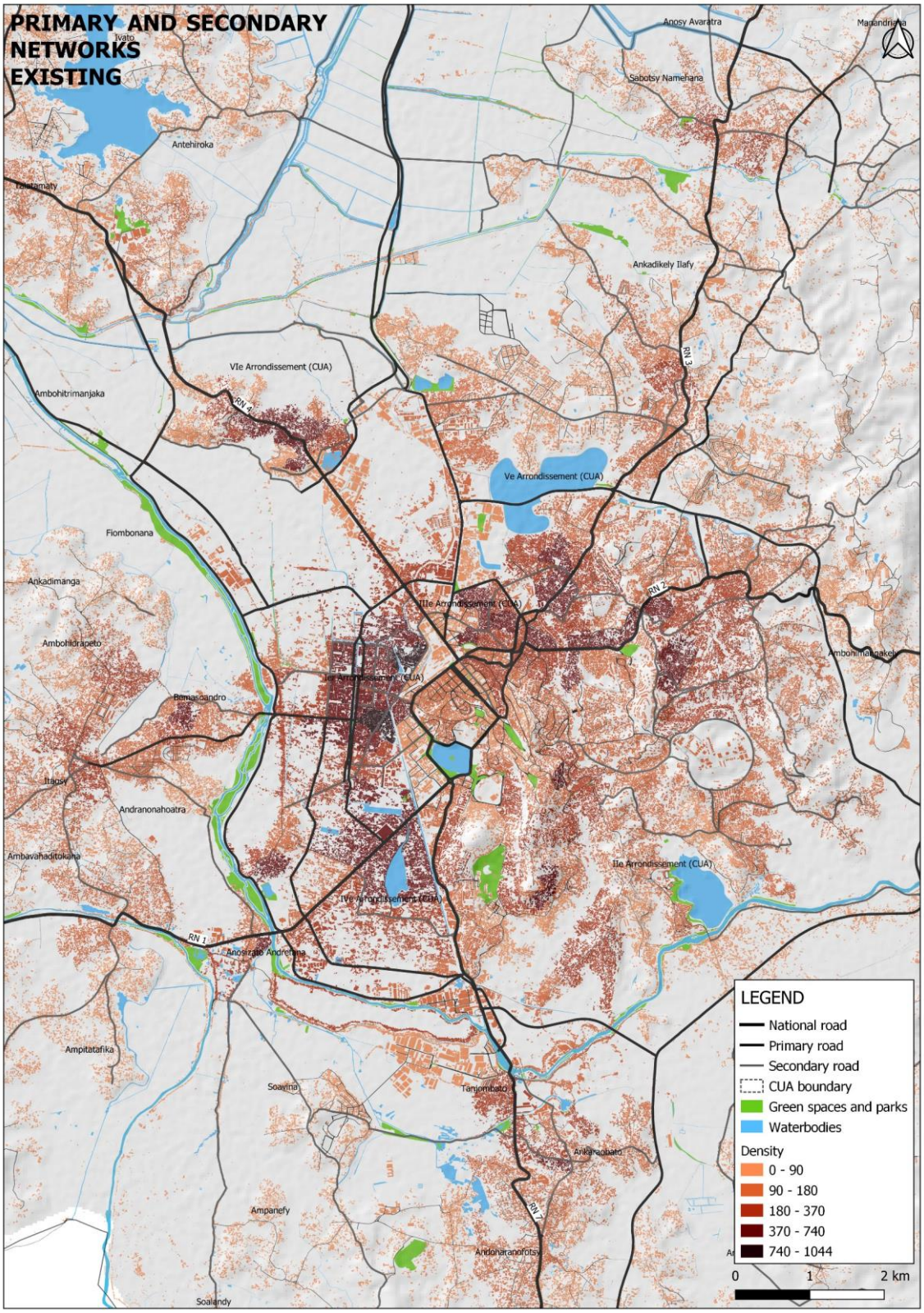
Located in the "Hauts Plateaux" (highlands) region of Madagascar, the spatial urban structure of Antananarivo is shaped by the duality between plains and steeply sloping hills. Historically, at the time of the Kingdoms, the city of Antananarivo was built on the hills. It was during colonization that urbanization continued on the floodable rice-growing plains. Nowadays, the city's population distribution has a form which is largely affected by factors such as socio-professional classes and type of job.

Despite the city's population expanding towards the suburbs, the CUA (Commune Urbaine d'Antananarivo) and its 6 districts concentrate most of the major urban functions: administrative, commercial, economic and social, making it a monocentric city. This structure is further reinforced by the presence of five national roads converging towards the city centre, (the RN2 to the East, the RN3 to the North, the RN4 to the West, the RN1 to the Middle West and the RN7 to the South), a source of several challenges in terms of mobility and infrastructure.



Source: INSTAT, RGPH 2018

Figure 5-1 Population Density in Greater Tana Area



Source: INSTAT, RGPH 2018

Figure 5-2 Population Density in CUA Area

5.2 Urban Density Indicators

5.2.1. Indicators Relating to Land Use

Lands with importance or high development potential within the urban area is used mainly for agriculture. Thus assessing the Antananarivo urban area according to urban density by land use shows that it has a special urban structure (Table 5-2).

Table 5-2 Urban Density Indicators

Total Area of CUA	85 sq.km
Urbanized Area within CUA	47.55 sq.km
Urbanisation Ration within CUA	55.9%
Total Area of Greater Tana (metro area)	768 sq.km
Urbanized Area within Greater Tana (metro area)	163.61 sq.km
Urbanisation Ratio within CUA	21.3%
Average density within CUA	150 inh./ha
Maximum density within CUA	
Average density within Greater Tana (metro area)	33 inh./ha
Average built density in CUA	20 buildings/ha
Average built density in 46% of densiest fokontany	+50 buildings/ha
Average construction area per built unit	62 sq.m

Source: PUDi TaToM, 2019, JICA study team, 2023

The urban density indicators should be compared with the maps showing the distribution of built-up areas and populations, which illustrate the great contrasts in density between fokontanys and between urban districts. Antananarivo's urban form is made complex by the combination of flood-prone agricultural plains and concentrations of urban density that keep growing on the farmlands.

The Malagasy capital could be defined as an "Archipelago city", where the urban fabric coexists with water and agriculture on a permanent basis. The average density within the CUA is 150 inhabitants/hectare, but it can reach up to 500 inhabitants in the densest neighborhoods. These neighborhoods are also the most precarious and informal, and the most exposed to flooding.

The result is sporadic pockets of urbanization and a very low density of road infrastructure to connect them. Population densities vary widely by Fokontany, depending on the type of buildings and standard of living. Moreover, it is in the most flood-prone and precarious areas that population densities are highest.

5.2.2. Indicators for Road Traffic

Table 5-3 shows an outline of urban roads in CUA area.

Table 5-3 Outline of Urban Roads in CUA Area

Total length of urban roads and streets	416 km
Total length of primary roads	126 km
Total length of secondary roads	69 km
Total length of tertiary roads	220 km
Density of urban roads	4.89 km/sq.km
Density of primary roads	1.48 km/sq.km

Source: PUDi TaToM, 2019

The low density of urban roads in the CUA (4.89 km/km2) is correlated with the importance of agricultural areas and hills. Moreover the density of primary roads is lower that of urban roads and their capacity is insufficient to handle traffic volumes in the urban area resulting to serious traffic congestion.

Urban mobility is characterized by a predominance of pedestrian modes as 2/3 of people moving around the city are walking. Public transport, mainly TaxiBé (minibus) represents a quarter of motorized traffic (Table 5-4).

The emergence of motorized 2-wheelers and even bicycles on the primary axes increasingly diversify mobility means.

Table 5-4 Transport Modal Shares in CUA

Pedestrians	66.65%
Public transport	24.03%
Car	5.90%
2-Wheelers	2.21%
Taxis	0.65%
Average annual growth of the automobile park	*10.56%*

Source: Transport master plan, Antananarivo, SCET, Egis, 2021

Increasing traffic congestion in Antananarivo can be analyzed through the lens of these 5 factors:

- A vast archipelago-agglomeration with a very low density of road networks;
- Unequal and spread concentrations of urban densities across the metro area;
- No mass transit lines (Heavy Rail Transit, Bus Rapid Transit) and no metropolitan transport authority;
- Concentration of administrative and economic functions in the central communes of the CUA;
- Saturated transport infrastructure albeit high transport demands

5.3 Administrative Organization Responsible for Urban Planning

5.3.1. Introduction

The Antananarivo Agglomeration (or Greater Tana) is designated as a special zone, including the Antananarivo Urban Commune (CUA: divided into 6 urban districts) and 36 peri-urban communes and having an area of 163 sq.km (Figure 5-3).

The Greater Tana Area is covered by the guidelines of the PUDi, which is the reference framework for urban planning, initiated by the Ministry of Town and Country Planning (Planning Department). The capacity of the CUA and the communes to implement and monitor urban plans (PUDi, PUDé) remain limited due to insufficient local capacity. In order to coordinate PUDi and PUDé plans across the agglomeration at the district level, the Urban Planning Agency IPAM has been created.

- CUA in yellow
- Peri-urban districts in brown
- Outer districts in green

Source: JICA study team, 2023

Figure 5-3 Map of the Greater Tana Agglomeration

5.3.2. The Urban Commune of Antananarivo (CUA) and its 6 Urban Districts

The urban management of the Commune Urbaine d'Antananarivo (CUA) is governed by the Law no. 2015-11 of 1 April 2015. This law confers specific powers of CUA as the capital of Madagascar, particularly in the areas of:

- Leading, planning and coordinating CUA's development activities
- Transport planning and demand management
- Management of roads, sanitation and hygiene
- Management of water and public lighting
- Compliance with town planning regulations
- Respect for the environment and quality of life

At municipal level, and following the example of urban communes, deliberative functions are exercised by the Municipal Council. Executive functions are exercised by the Mayor. In accordance with the provisions of Article 152 in fine of the Constitution, the representatives of the Fokontany participate in drawing up the development program for their Commune.

The Mayor, as head of the executive, is responsible for carrying out the decisions of the deliberative body of the decentralized local authority and manages the communal administration.

The commune has the main departments and services for running the administration and managing the municipal territory. However, the initial training levels of its staff are insufficient to ensure sustainable municipal management.

5.3.3. Urban Development's Coordination and Planning

Coordination and urban planning by related organizations have two main problems:

- Continuity of planning and priorities in the development of the CUA is sometimes unclear and/or non-existent;
- Consultation between stakeholders within CUA (at all levels: between CUA executives and the urban districts, between the CUA and the outer districts, between the CUA and the Fokontany, etc.) is very weak and needs to be significantly improved.

Continuity in planning should be ensured by the global documents (PUDi and PUDé), but they are regularly revised by the government's administration.

If urban development planning is to remain continuous and constitute a genuine single frame of reference for urban planning, it seems essential that the strategies be fixed for a given period of time, in accordance with the Law.

Consultation on urban planning remains weak, but initiatives are being put in place, such as the creation of an Urban Planning Agency for Greater Tana: IPAM, with the support of the French Development Agency (AFD)

The current technical and planning capacities of the CUA, of the outer districts and the Fokontany need to be strengthened in order to meet the challenges that accompany rapid urbanization: massive increase in waste, dysfunctional public transport systems, lack of access to employment opportunities, air pollution, as well as investment choices in urban infrastructure and services, etc.

5.3.4. Fokontanys : Smallest Administrative Units

The smallest administrative units, called Fokontany, remain the closest to the citizens, although they are the least well-endowed in terms of staff, equipment and finance.

This level is fundamental to citizen participation, the implementation of public policies and precise knowledge of local issues.

Article 3 of the Constitution states that "the Republic of Madagascar is a State based on a system of decentralized territorial authorities made up of Communes, Regions and Provinces", and the Fokonolona, in accordance with the provisions of article 152 of the Constitution, "organized into Fokontany, which is the basis for development and socio-cultural and environmental cohesion". The heads of the Fokontany participate in drawing up the program for their Commune (district). The Fokontany, as a local administrative district, is thus an essential national pillar to apply decentralization at the most local level.

5.4 Issues of Urban Structure

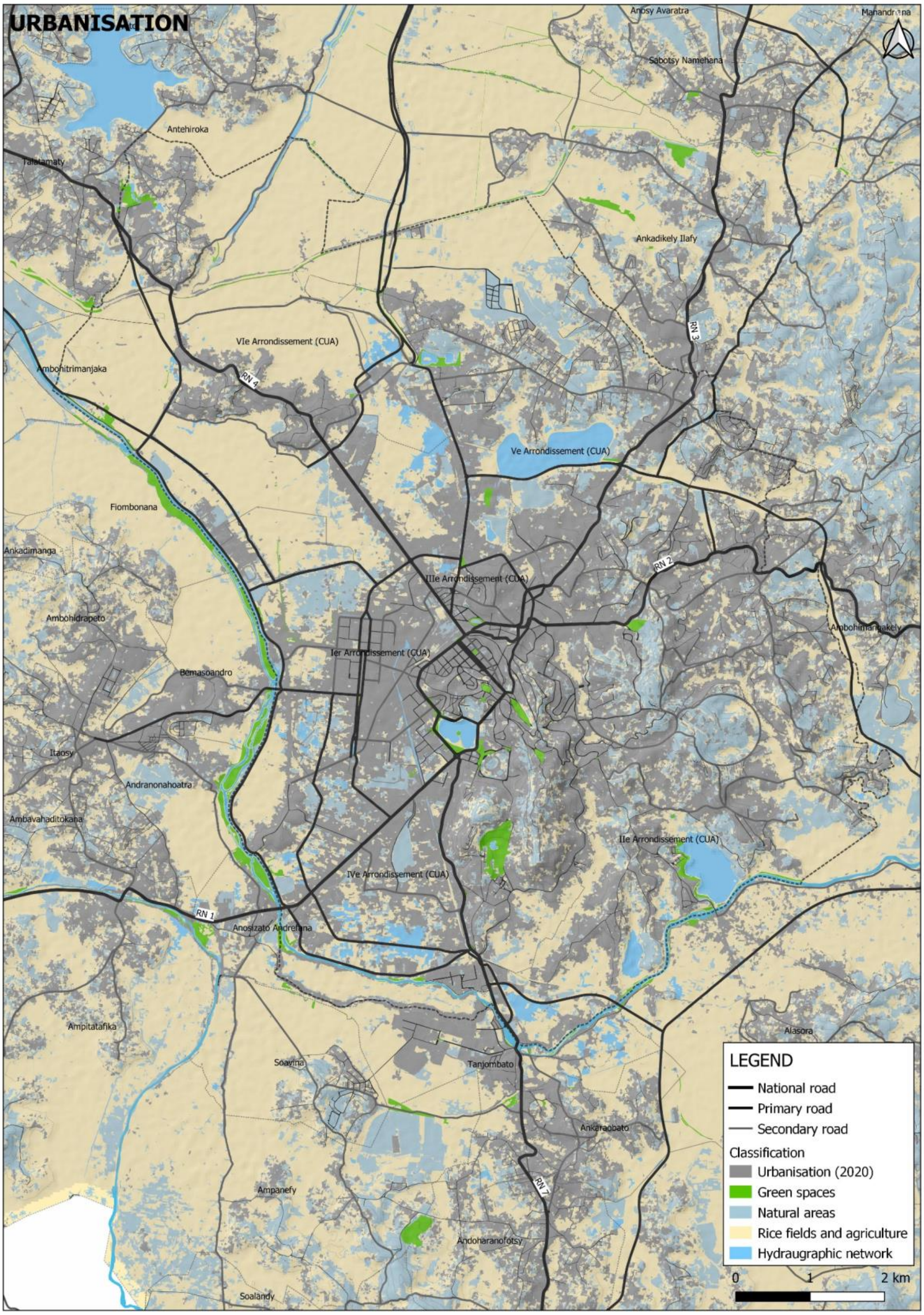
Although Antananarivo is the national capital city and an administrative center, land use is predominantly characterized as residential in the city (Figure 5-4 and Table 5-5). Promoting land use plans taking into account the four points below will mitigate concentration of population and will influence future urban structures and transport demand:

- Governmental and administrative functions in relation with the capital city status: very centralized today around the Lake Anosy, but a large part of those functions is aimed to be displaced to TanaMasoandro New Town, 25 km away;
- Connectivity between the Tokyo Bypass and Toamasina Port should be improved to facilitate more manufacturing and logistics activities because industrial activities and logistics hubs have formed along this bypass.
- Tertiary activities gradually form a “Business District” in Ankorondrano for the private sector and international institutions, and have a potential to grow into a well-planed business sub-center with the extension of the eastern rocade towards West;
- Large public wholesale markets shape an important part of human activity and movement

in the agglomeration.

Most of neighborhoods take place in rice paddies and swamps, but their growth is also limited by natural areas. Rice paddies and marshes account for 31% of the total surface area of the urban area and around 20% of the surface area of the CUA.

The majority of (collective) buildings in the CUA are intended for residential use, but despite this, they represent less than half of all dwellings in the Greater Tana as a whole. This confirms the saturation of space in the CUA and its limited capacity to meet exponential housing needs. The PUDi 2019 studies have shown that 46% of the Fokontany in the CUA have a high residential density, exceeding 50 dwellings/ha, while the land available is increasingly limited. This applies in particular to the 1st arrondissement (64% of Fokontany), the 4th arrondissement (50% of Fokontany) and the 6th arrondissement (68% of Fokontany). It should be noted that the average density of built-up areas in the CUA is 20 dwellings/ha.



Source: PUDi TaToM, 2019, JICA study team, 2023

Figure 5-4 Land Use Map of CUA Area

Building height and footprint are defined according to zoning categories in the planning tools, but in reality, vary widely in the city of Antananarivo, depending on the type of housing. The studies carried out for the PUDi indicated an average building footprint of 62 sq.m in the CUA, with the largest footprints observed in the fifth arrondissement, with an average surface area of 71 sq.m, and the smallest in the sixth arrondissement, with an average surface area of 48 sq.m.

Table 5-5 Land Use Area of Antananarivo Agglomeration

	Residential areas	Industrial zones	Other urban areas	**Total Urbanized Areas**	Humid zones including farming lands	Other unbuilt area	**Total of Unbuilt Areas**	***Total***
	Sq.km	Sq.km	Sq.km	**Sq.km**	Sq.km	Sq.km	**Sq.km**	***Sq.km***
Greater Tana	139.7	4.81	25.53	**170.04**	244.97	352.98	**597.95**	***767.99***
CUA	36.20	1.98	9.66	**47.85**	26.86	9.23	**37.10**	***84.94***
Periurban Area	105.50	2.83	15.87	**122.2**	217.11	343.74	**560.85**	***683.05***

Source: PUDi TaToM, 2019

According to the land use projections in 2023 and in 2033 drawn by the PUDi study of 2019, the share of residential area will grow from 49 to 61% land coverage in the CUA, while its proportion will triple in the Greater Tana Area (Table 5-6). A growing demand for housing combined with limited capacity to build new planned urban extensions will result in the expansion of vulnerable and floodable residential areas characterized by limited accessibility.

It is, therefore, essential to align programs of mixed-used development with the construction of multimodal urban roads and railways responding to traffic demand with mass transit, walkable and cyclable spaces and enough capacity for motorized traffic.

Table 5-6 Land Use Projection in Antananarivo Agglomeration 2023 and 2033

	2023		**2033**	
	AREA (sq.km)	Percentage (%)	AREA (sq.km)	Percentage (%)
CUA	**84.94**	**100**	**84.94**	**100**
Residential Area	41.61	49	51.42	60.50
Industrial Area	1.98	2.3	0.99	1.2
Others	41.35	48.70	32.53	38.30
Greater Tana Area	**767.99**	**100**	**767.99**	**100**
Residential Area	169.30	22	290.86	37.90
Industrial Area	4.82	0.60	15.39	1.70
Others	587.71	76.50	461.74	60.10

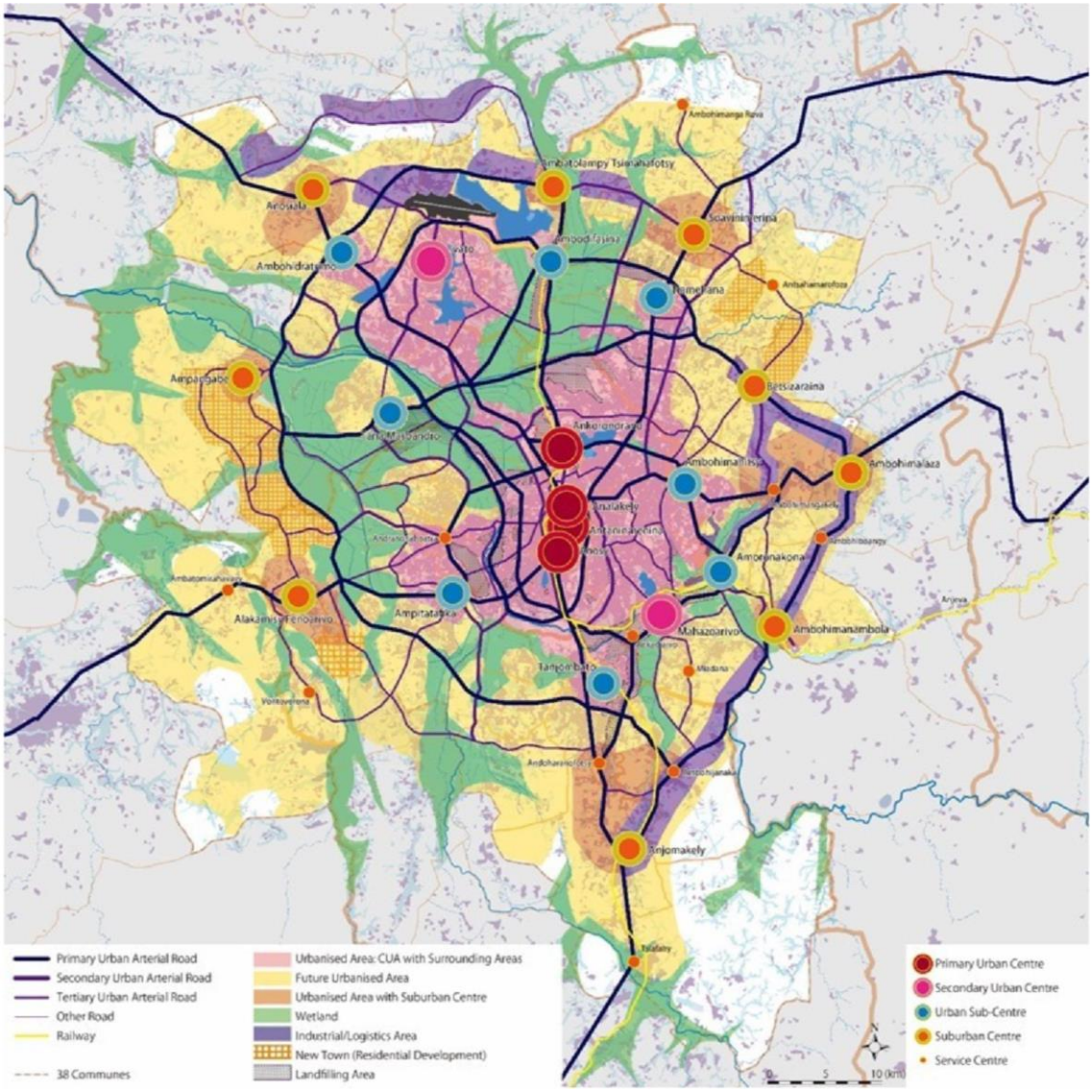
Source: PUDi TaToM, 2019

5.5 Review of TaToM Mater Plan

5.5.1. TaToM Mater Plan

The TaToM Master Plan, an urban development master plan with a target year of 2038, proposes a future urban structure as shown in Figure 5-5. The said masterplan has development projects per five-year phase. The original TaToM Master Plan, however, has been revised because the PUDé of sub-center plans and new urban development are being reviewed. For instance, the projects of Phase 1, which are scheduled from 2021 to 2025, are not proceeding despite rapid population growth and may extend the schedule to 2025-2030. The gap between urban planning and the situation described above may lead to unplanned urbanization and may affect in realizing the objectives of the plan. Therefore, in road planning, it is essential to plan based on projections of realistic urban expansion and future population.

The TaToM Master Plan was approved by the Cabinet in March 2020 as the Plan for Urban Development of the Antananarivo Metropolitan Area (PUDi) by the former MATSF, and the PUDi is the master plan for urban development of the Antananarivo metropolitan area. MATSF, MTP, MTM, and SENVH) held a round table discussion to promote the TaToM Master Plan and share information on major projects.



Source：TaToM Master Plan

Figure 5-5 Future Urban Structure of Antananarivo Agglomeration

5.5.2. Urban Development Projects in Each Phase of TaToM

The TaToM Master Plan proposes urban development projects per five-year phases beginning in 2021 (Figure 5-6). However, while some progress has been made in planning process for Phase 1, there has been no progress in land development, infrastructure development and other projects. The urban development projects for each phase identified in the TaToM Master Plan are discussed below.

(1) Phase 1 (2021-2025)

The urban projects to be initiated in Phase 1 (2021-2025) concern:

- The development of urban centers within the CUA, specifically Ankorondrano, which has a PUDé but no master plan as yet.
- The development of a residential new town in Talata-Volonondry along RN3, close to the future entry point of Toamasina Highway (project led by SENVH): population estimated to 23,000 inhabitants.
- Development of the secondary centers of Ambodifasina (in progress: 50 to 100,000 inh.), Namehana, Amoronakona, Tanjombato, Ampitatafika and Ambohidratrimo (no detailed planning).
- Development of housing areas in Ivato
- Construction of the new town of Tana Masoandro. Once the smart city is up and running, some of the central administrations currently located on the Anosy site will be transferred to the new town: population estimated to 224,000 inhabitants. And 200,000 jobs after completion of 4 phases.
- Construction of the Ankorondrano business park and improvement of the light industrial zone along the Tokyo Bypass.

(2) Phase 2 (2026-2030)

The urban projects to be undertaken in Phase 2 are:

- Development of the suburban center of Ampangabe to the west
- Development of the suburban center of Alakamisy Fenoarivo along the RN1 road
- Development of The suburban center of Ambohimalaza
- Development of the new town of Nord Fenoarivo
- Development of the new town of Namehana
- Development of industrial and logistics zones in the southern zone of Ambohimalaza (south of the RN2 road)
- Development of industrial and logistics zones on the Ambohimalaza - Namehana axis to be created
- Development of The first phase of the industrial and logistics complex north of the airport.

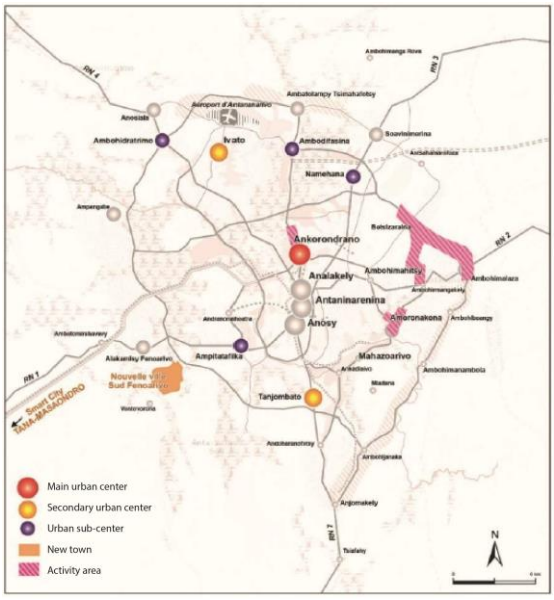
(3) Phase 3 (2031-2035)

The urban projects to be undertaken in Phase 3 includes:

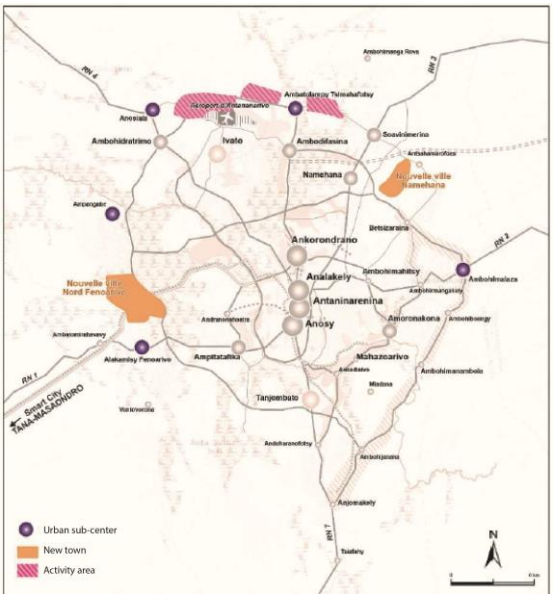
- Development of the suburban center of Ambohimanambola in the southeast zone
- Development of the suburban center of Anjomakely to the south on the RN7 road
- Development of the new town of Ampangabe
- Development of the new town of Fieferana in the northeast zone
- Development of the Anjomakely-Ambohijanaka industrial zone to the south.

(4) Phase 4 (2036-2040)

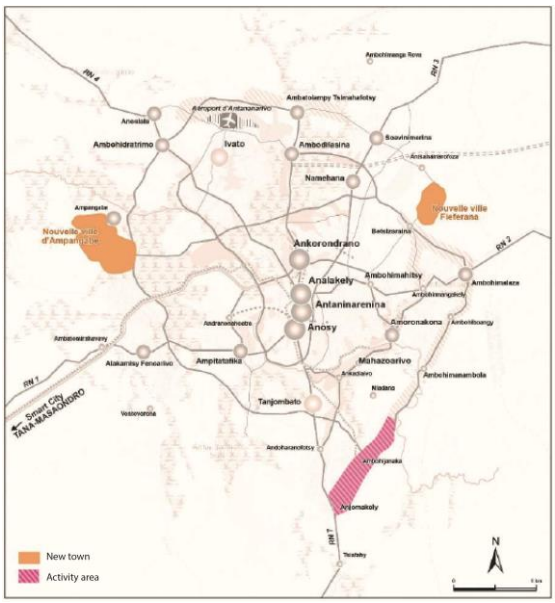
The projects in Phase 4 concerns the suburban center of Anosy Avatra, north of Namehana. An industrial and logistics zone will be developed on the axis linking Anosy Avaratra and Ambatolampy.



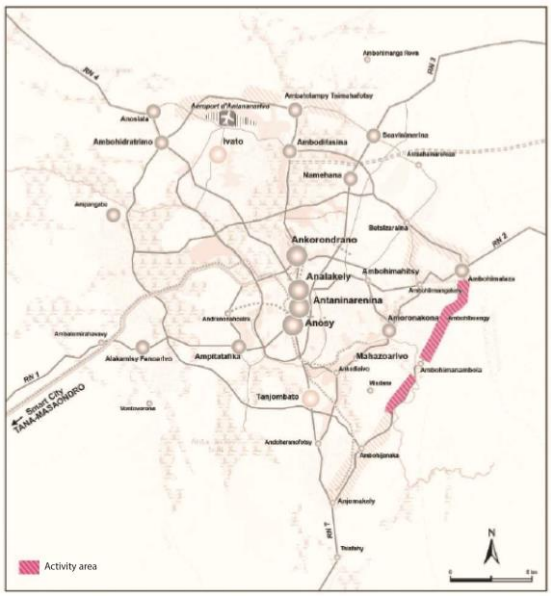
Phase 1 (2021-2025)



Phase 2 (2026-2030)



Phase 3 (2031-2035)



Phase 4 (2036-2040)

Source: PUDi TaToM, 2019, Transport Master plan of Antananarivo, (SCET, Egis, 2021)

Figure 5-6 Future Urban Development in Each Phase

5.6 Projections of Future Population and Urban Area Expansion

5.6.1. Population Projection

Long-term population projections were conducted based on data from the National Institute of Statistics (INSTAT) and other sources. The current population of the metropolitan area is estimated to be around 3.0 million and is expected to grow to 4.2 million in 10 years (2033), 5.2 million in 20 years, and over 6.0 million in 30 years (Table 5-7 and Figure 5-7).

Table 5-7 Population Projection

Antananarivo Agglomeration	2018	2023	2028	2033	2043	2053
	Census	Base	in 5 years	in 10 years Short	in 20 years Medium	in 30 years Long
Population (1,000 people)	2,521	2,971	3,476	4,200	5,216	6,089
Growth Rate	3.31%	3.34%	3.19%	3.11%	2.11%	1.11%

Source：Prepared by JICA Study Team based on INSTAT data and other sources

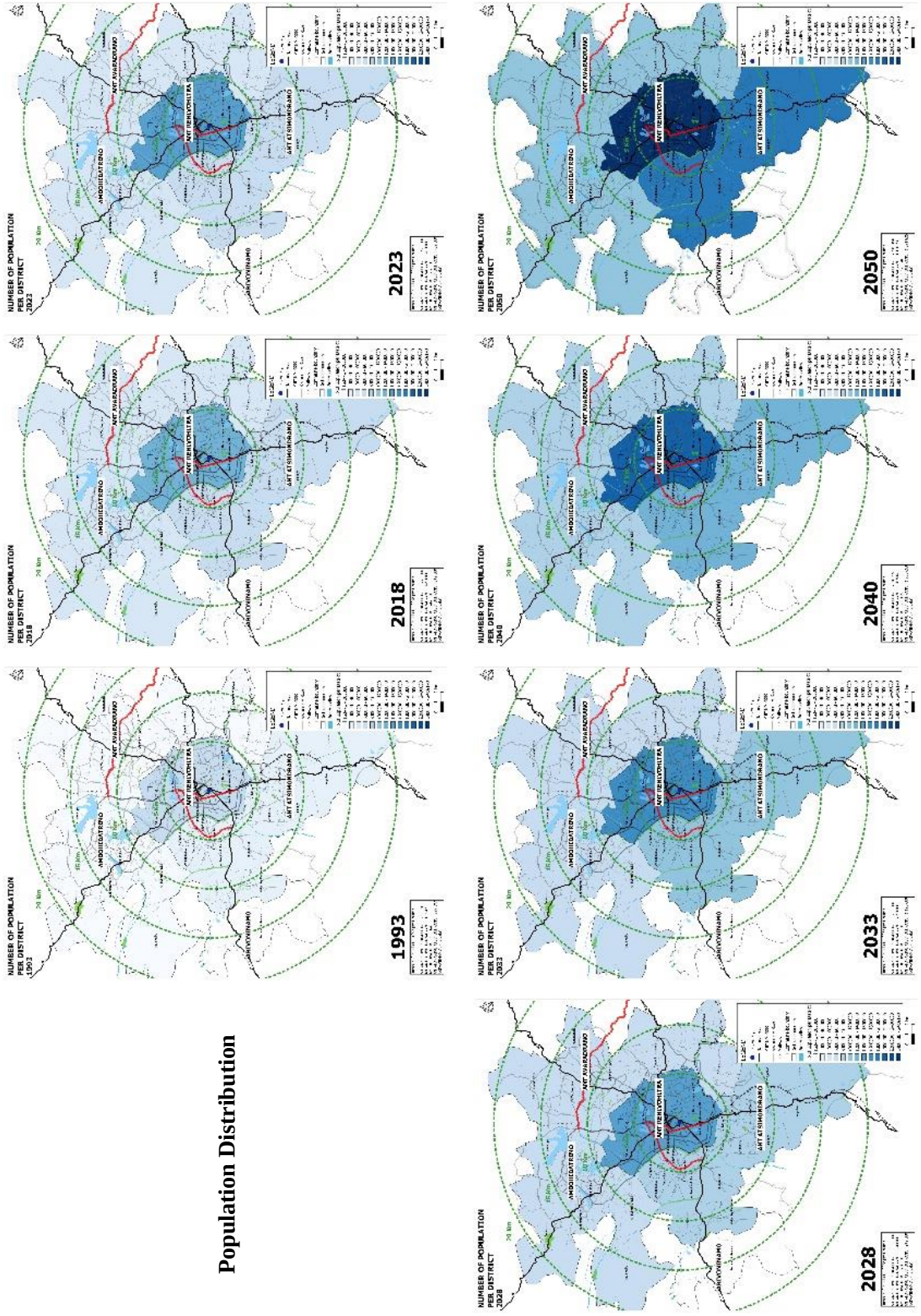


Figure 5-7 Future Population Distribution of Antananarivo Agglomeration

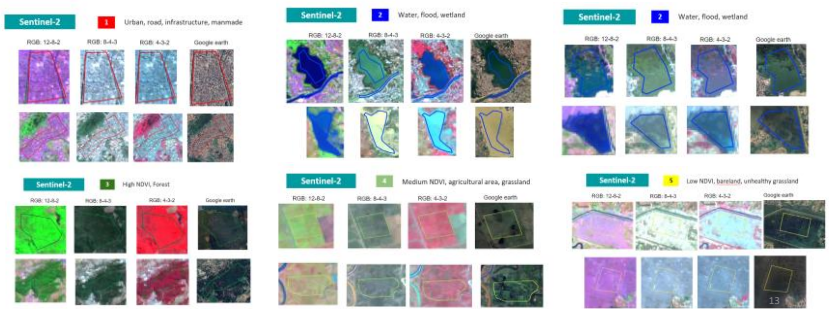
Source：INSTAT, JICA Study Team, 2023

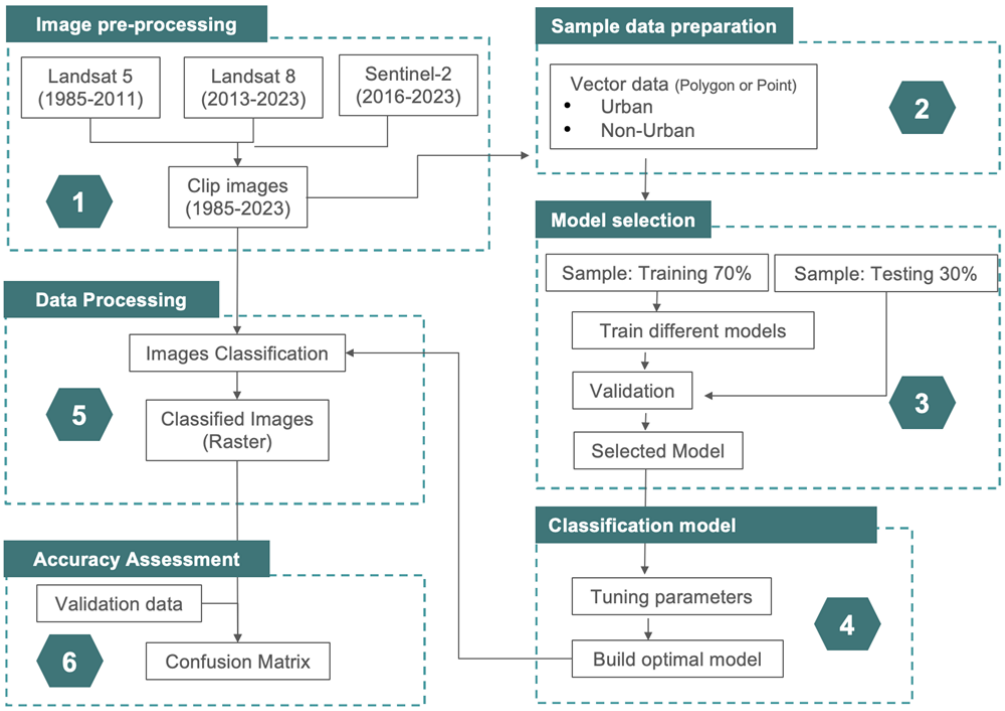
5.6.2. Projections of Urban Area Expansion in Antananarivo Agglomeration

In the Antananarivo metropolitan area, its urban development will not necessarily proceed in a planned way, and it is expected that urban sprawl occurs depending on locations of existing urban areas and roads, and topographical conditions. For the above reason, future expansion is projected based on the analysis of land use transition using satellite images over time. The flowchart of the analysis is depicted in Figure 5-8 and the result of the analysis is shown in Figure 5-9. As seen in Figure 5-10, by plotting the value of urbanization area from 1985 to 2022, trend can be confirmed through the value of R2 which is rather high indicating good fit of the simulation model.

[Data used in the analysis]

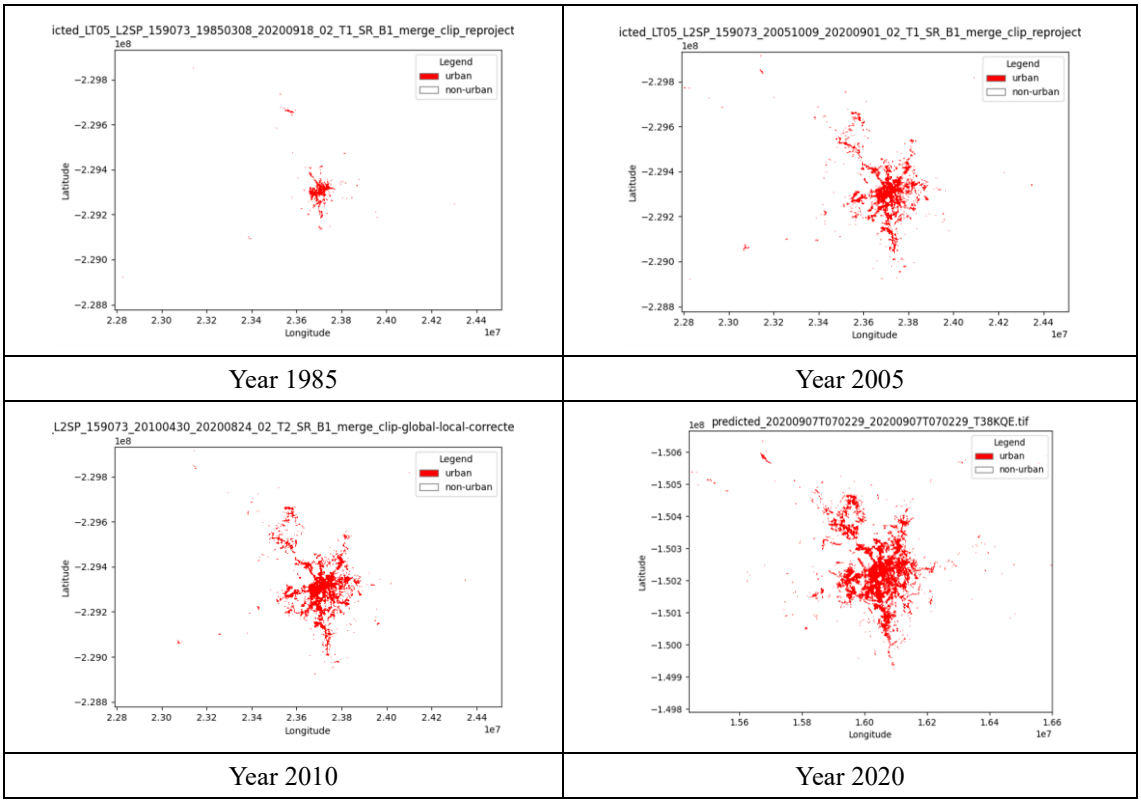
- Satellite Images: Landsat-5, Landsat-8 and Sentinel-2
- Target Year/Period: 1985, 1990, 1995, 2005, 2010, 2015, 2020 to 2022
- Land use classification:

Classification	Analysis of Land use classification based on satellite images
1. Urban Area 2. Water Area (wetland, etc.) 3. Forest Area 4. Agricultural Area 5. Unused Area (bare land, etc.)	



Source：JICA Study Team

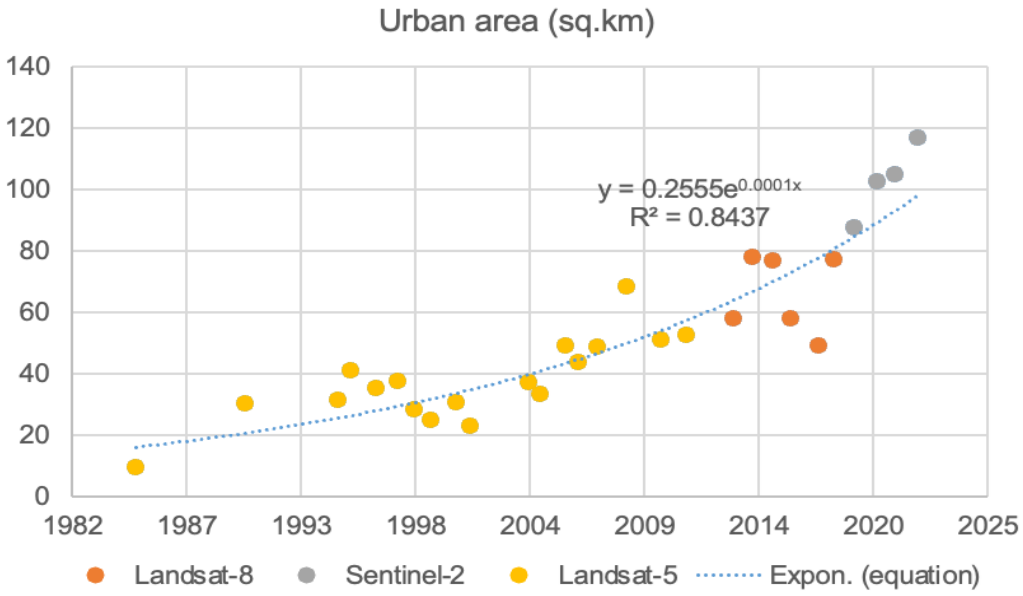
Figure 5-8 Flowchart of Satellite Image Analysis Over Time



Year 1985	Year 2005
Year 2010	Year 2020

Source: JICA Study Team

Figure 5-9 Analysis Result Regarding Urban Area Based on Satellite Image Over Time



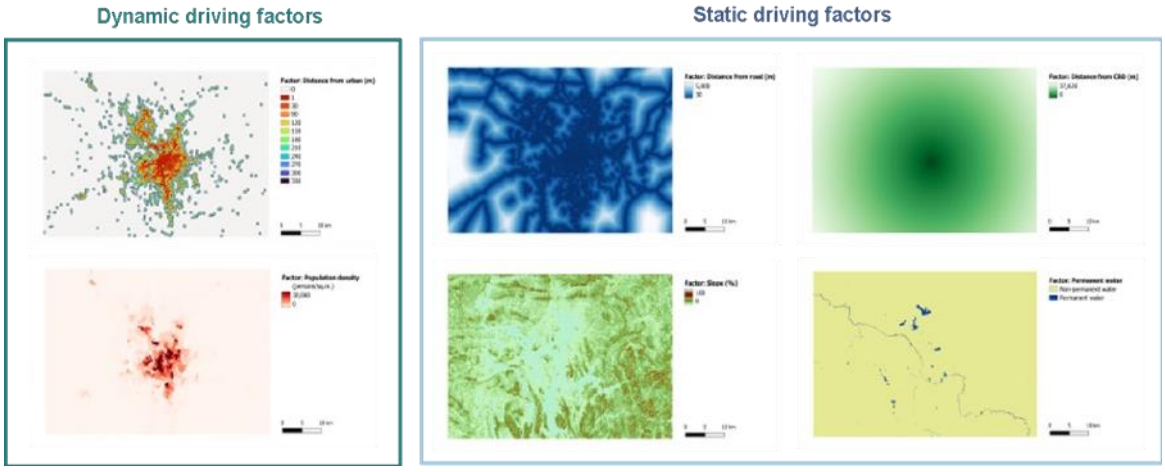
Source: JICA Study Team

Figure 5-10 Checking the Reproducibility of Analysis Results in Urban Areas

[Analyses of future urban area expansion]

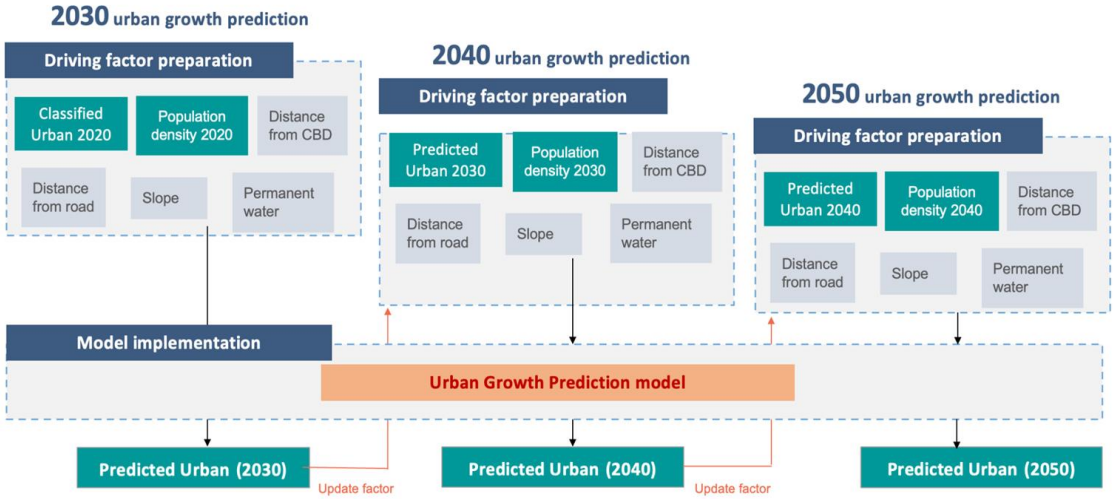
The future expansion of the urban area is estimated based on a large-scale model analysis of land use pattern using computer simulation and using satellite images as input data (Figure 5-11 and Figure 5-12). The following parameters that affect urban area formation are used:

- Population density: Population density will increase in the future.
- Distance from city center: Urbanization will occur from nearest points.
- Distance from roads: Near areas of roads will be urbanized first.
- Slope: Steep slope areas are less likely to be urbanized.
- Water systems (rivers, wetlands): Rivers and wetlands are difficult to be urbanized.



Source: JICA Study Team

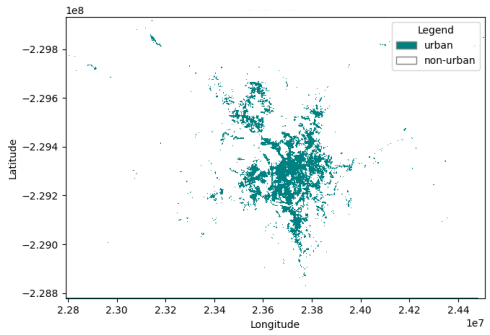
Figure 5-11 Images of Parameters Used in the Analysis



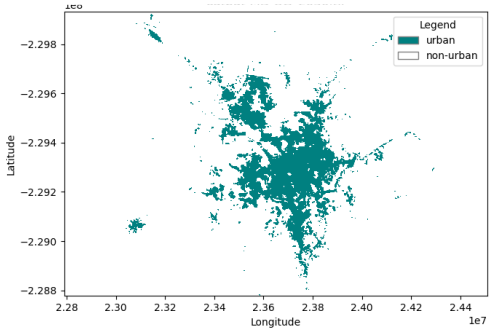
Source: JICA Study Team

Figure 5-12 Flowchart of Future Urban Area Projection

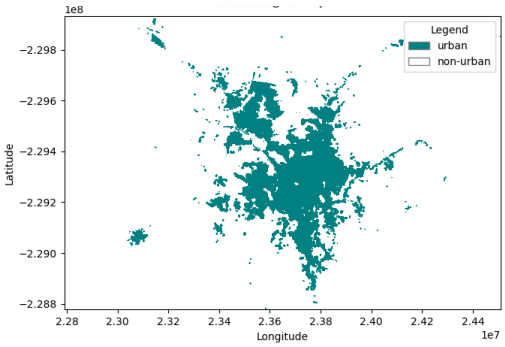
[Analysis result of future urban area expansion]



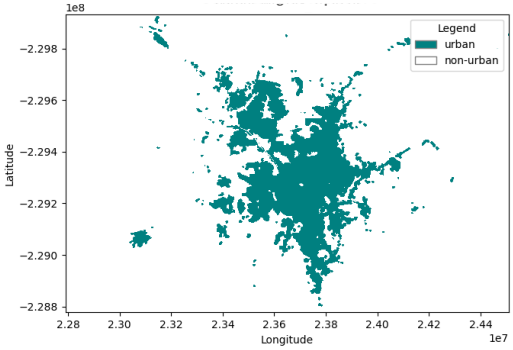
Year of 2020



Year of 2030 (Short-term)



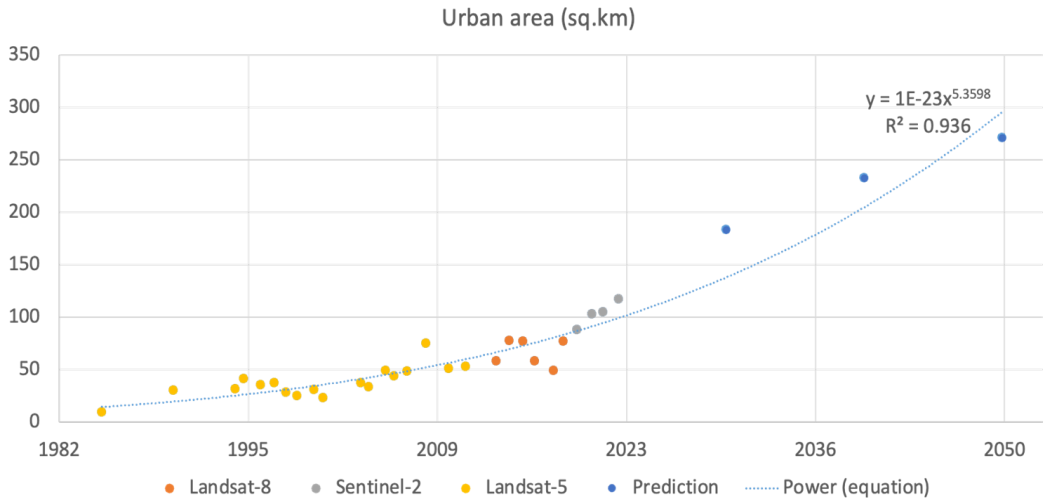
Year of 2040 (Medium-term)



Year of 2050 (Long-term)

Source: JICA Study Team

Figure 5-13 Results of Future Urban Area Projection (Short, Medium, and Long-term)



Source: JICA Study Team

Figure 5-14 Model Reproducibility and Short-term, Medium-Term and Long-term Urban Growth Forecasting Results

Table 5-8 Projection Result (Future Urban Area and Increase Rate)

Year	Area (sq.km.)	Increase Rate (%)
2010	50.94	-
2020	98.31	48.18
2030 (Short-term)	183.33	46.38
2040 (Medium-term)	232.82	21.26
2050 (Long-term)	270.99	14.09

Source: JICA Study Team

[Utilization of the Analysis Results of Future Urban Area Expansion]

The result of previous analysis has ensured the reproducibility of the current situation (urbanization) through satellite image analysis over time which confirmed the accuracy of the model. Based on that model, the results of future urban expansion are as follows (Figure 5-17 and Table 5-8) :

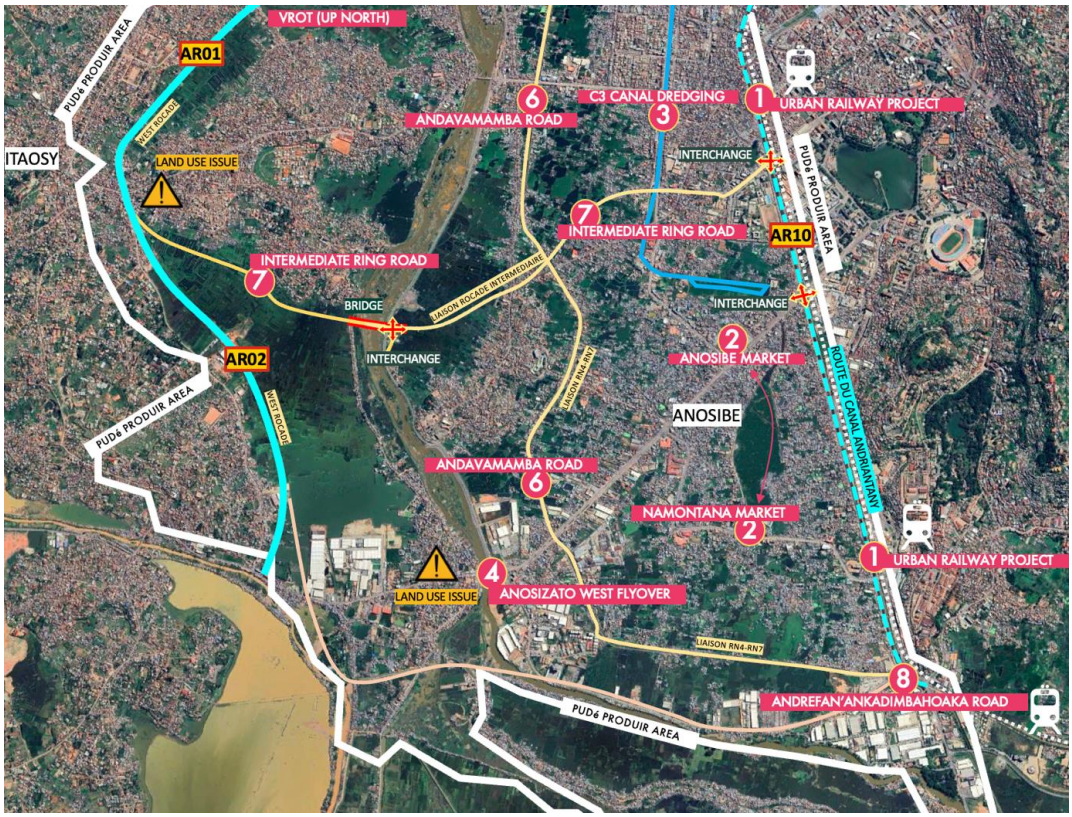
- In the future, the urbanized area is expected to expand about 1.9 times in the short-term, about 2.4 times in the medium-term, and about 2.8 times in the long-term.
- The result above will be further reviewed and analyze the status of urbanization along the candidate seven (7) road projects and population distribution. These results will be used as basic data for forecasting future traffic demand.

5.7 Necessities and Issues of the Seven Road Projects in Urban Development

5.7.1. A-R-01 and A-R-02 Road Projects

A-R-01 and A-R-02 road projects, which are in the western section of the Intermediate Ring Road, are listed in the PUDé PRODUIR and will contribute to promotion of the PRODUIR development. Locations of the PRODUIR area, the A-R-01 and A-R-02 road projects are shown in Figure 5-15.

A-R-01 will also promote the Itaosy area development as it connects VROT to the western region of Antananarivo. However, land acquisition will be a major concern in the central Itaosy area where A-R-01 and A-R-02 intersect. Land acquisition for a section of approximately 470 m may be required. The Itaosy area is a dense urban area; therefore, it is desirable not only to consider land purchase but also to plan a redevelopment project for the entire area.



Source: PUDi TaToM, 2019, PUDé PRODUIR, JICA study team, 2023

Figure 5-15 Locations of PRODUIR PUDé Area, A-R-01 and A-R-02

The A-R-02 project will require a large-scale construction of waterway because it will pass through flooded areas and paddy fields. It is also essential to take measures to prevent illegal occupation of wetlands and illegal construction after the project is completed. The connection with RN1 will cause traffic congestion due to the influx of traffic from the Anosizat intersection. To reduce these risks, Projects 7 and 8 shown in Figure 5-15 are considered effective.

In the Itaosy Area, traffic demand will increase in the future. Therefore, A-R-01 and A-R-02 projects should incorporate, if possible, some dedicated lanes for bus or some bus stops similar to the ones on the eastern section of the Intermediate Ring Road (Figure 5-16).

Source: PUDé PADARNE, 2023

Figure 5-16 Bus Stops on the Eastern Section of the Intermediate Ring Road

5.7.2. A-R-03 and A-R-04 Road Projects

The PUDé of Ankorondrano has the potential to become a sub-center district with a residential population of approximately 46,000 people and 30,000 jobs. Almost half of the land is wetlands or paddy fields, so road planning must take into account the risk of flooding.

In planning the A-R-03 and A-R-04 projects, road routes and its structures should be planned in coordination with the road network, drainage, and land use planning. For the A-R-03 project, land use and drainage are assumed to be the main issues for the project. In addition, it is also desirable to consider planning service roads for land use and residential accessibility.

It appears that the A-R-04 project will intersect with the cable car project that is currently under construction. The cable car project is expected to be 25 to 28 m high, and this needs to be fully taken into account in planning longitudinal profile of the roads. Four (4) alignment alternatives for A-R-03 were supposed to be considered in the EIB-supported F/S study. Thus, it is recommended that multiple alternatives be considered to select the most appropriate one in the JICA F/S study as well.

A-R-03 and A-R-04 will serve multiple roles such as serving as an arterial road connecting the new city of Tanamasoandro to the Antananarivo metropolitan area, by providing access to the Ankorondrano sub-center, improving east-west access to the metropolitan area, and connecting to VROT. In this road planning, it is necessary to take into account the traffic demand generated by the Ankorondrano development and the connection to VROT.

5.7.3. A-R-05 and A-R-06 Road Projects

The A-R-05 and A-R-06 projects will form the outer ring road and play an important role in the urban development envisioned along the road. The main issues of these projects are topographical constraints and cost (Figure 5-17).

The Ambodifasina and Ivato area may become cities with 100,000 inhabitants by the development.

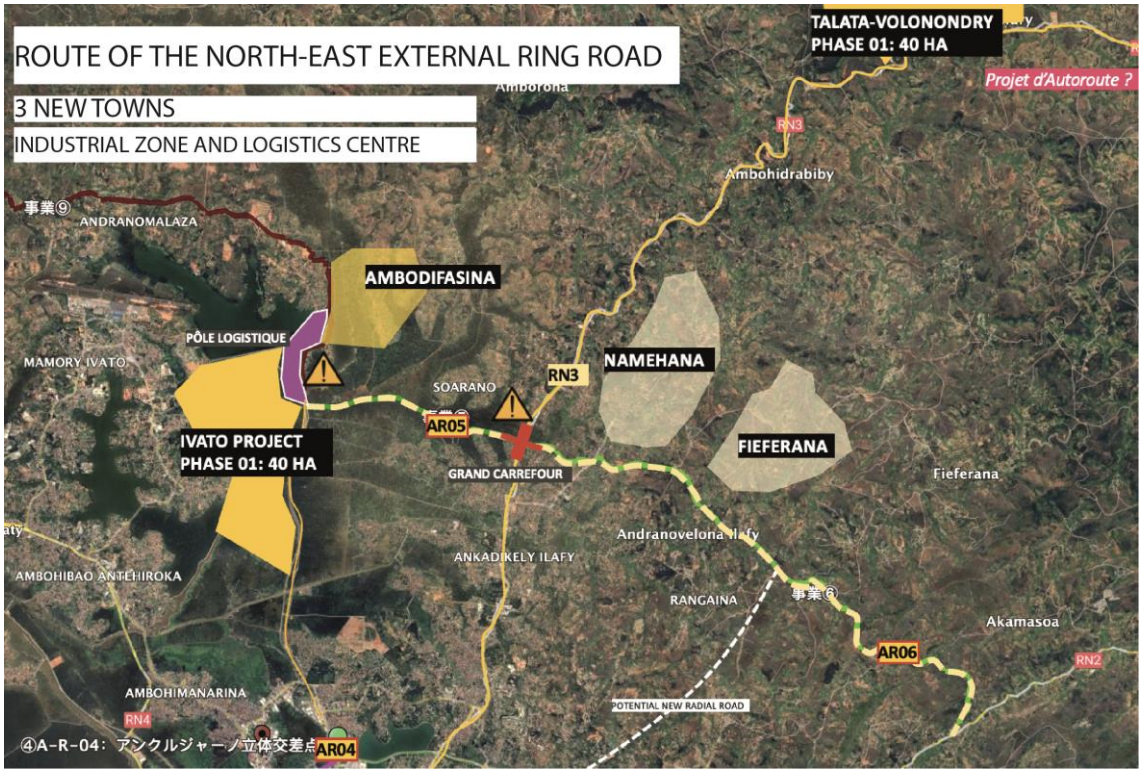
There is a plan to establish a logistic center between the two areas. However, it is still in the conceptual stage and lacked details.

The TaToM Master Plan proposes construction of industrial districts along the outer ring road. MATSF has a development concept for two industrial districts, Namehana and Fieferana, but no concrete action yet has been taken.

SENVH has a concept of residential area development with the area of 40 ha in Talata-Volonondry along RN 3 in the northeastern part of the urban area.

A radial road connecting the eastern section of the Intermediate Ring Road with the outer ring road (A-R-06) is proposed in the PADARNE PUDé study.

This urban development along A-R-05 and A-R-06 will include industrial activities, logistics hubs, and dry ports. Therefore, it is important to construct roads with adequate road widths and truck parking. The recent transport master plan study indicates A-R-05 and A-R-06 as possible routes for Bus Rapid Transit (BRT).



Source: PUDi TaToM, 2019, SENVH, JICA study team, 2023

Figure 5-17 Urban Development Prospects around A-R-05 and A-R-06 Projects

5.7.4. A-R-10 Road Project

The A-R-10 project, which will utilize the space of the Andriantany Canal, is the most significant project in terms of improving the urban environment. The space is one of the few remaining ones

in the city center for development of transportation infrastructure. Thus, the A-R-10 project could become a major artery for north-south commuter traffic (Figure 5-18).

The current canal is poor in terms of sanitation due to the dumping of waste materials. In addition, there are many sections along the canal where slums have formed. The A-R-10 project may serve as an opportunity to renew the canal to give it a new lease of life.

According to the F/S conducted by the MTP about 10 years ago, at-grade carriageways were planned with 4-6 lanes in this project. However, for effective use of the space, an elevated road viaduct should be considered. It may be possible to consider constructing roads with 4 lanes plus 2 lanes dedicated to BRT on the viaduct.

Urban rail projects are being implemented at ground level. It is also essential to secure a space for railways so that a heavy rail transit (HRT) system for efficient transport and logistic system development can be introduced throughout the city in the future.

As the axis along the canal is flat, it would be possible to build the first continuous bicycle lane of Antananarivo.

Source: JICA study team, 2023

Figure 5-18 A-R-10 Route and Useful Images from Other Countries as Reference for Possible Development

CHAPTER 6 Present Status and Prospects of Road Traffic in the Antananarivo Metropolitan Area

6.1 Road Infrastructure Status

6.1.1. Road Network Status

The main road network in Antananarivo metropolitan area is mainly formed by National Highways. These national highways are formed in a radial pattern from the intersection in front of Soarano Station at the kilometer zero post (Figure 6-1 and Table 6-1). There are five highways within the urban area: National Route 1 ("RN1") crossing in a southwesterly direction, RN2 in an easterly direction connecting the port of Toamasina, RN3 in a northerly direction, and RN7 in a southerly direction toward Antsirabe. As for radial roads, two airport access roads have been developed in recent years. As for major roads that function as ring roads, the Tokyo Bypass (connecting RN2 and RN7), which was developed through JICA grant aid, and the Intermediate Ring Road (commonly known as Rocade d'Iarivo), which was developed by finance of EIB, EU and AFD was opened in 2021.

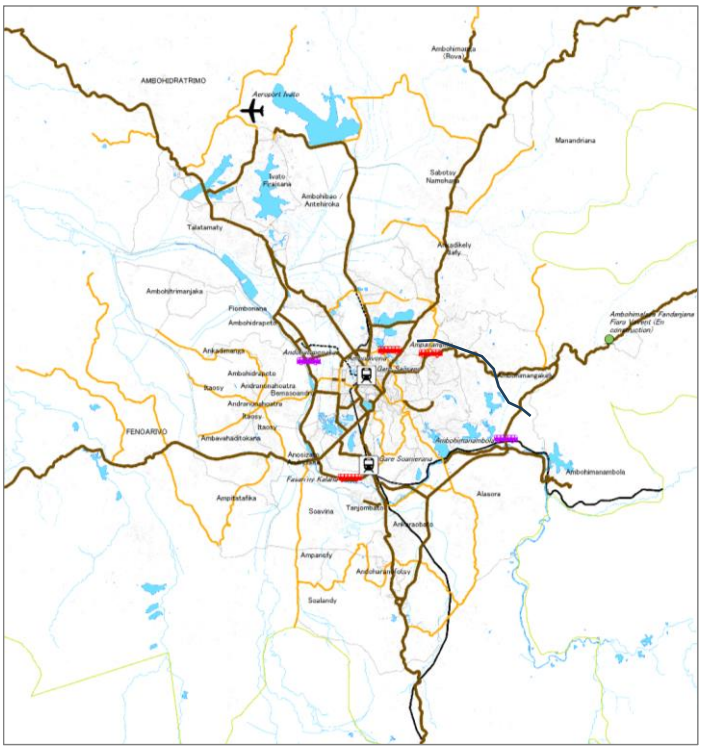


Figure 6-1 Road network of the Antananarivo Metropolitan Area

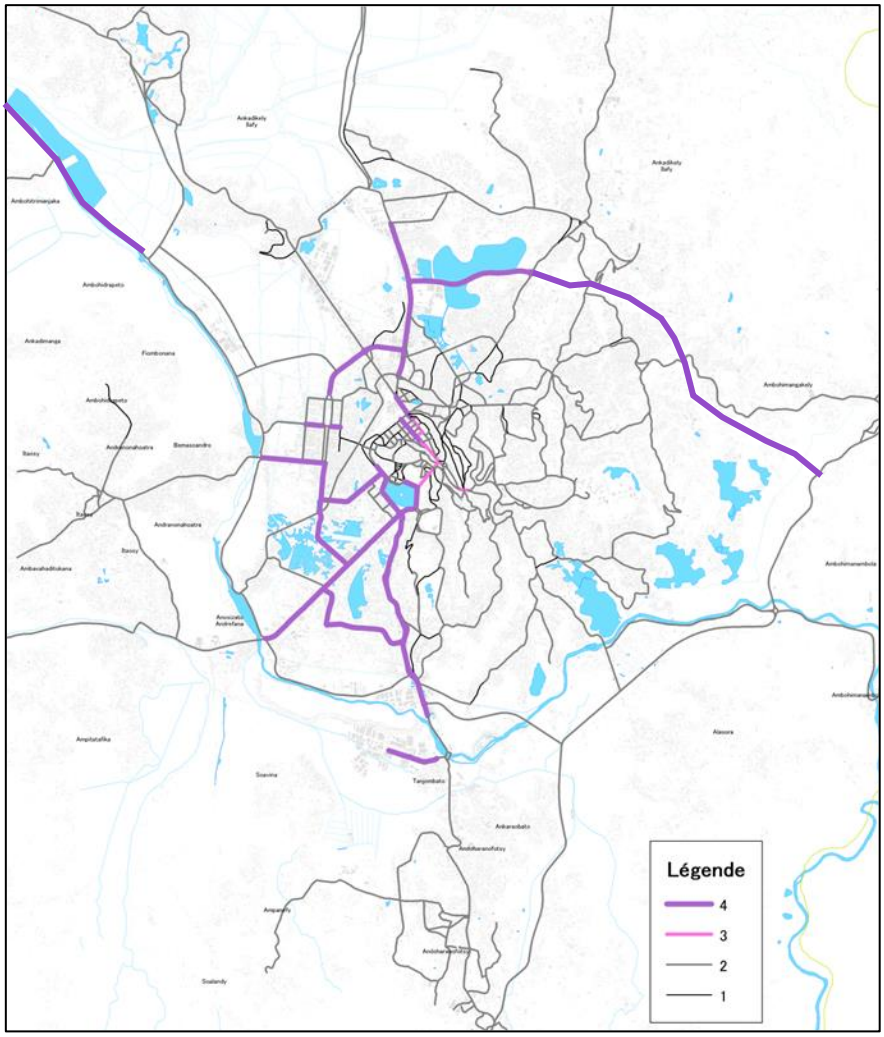
Table 6-1 Road Extension by Road Classification

Road Classification	Extension
National Highway	236 km (50%)
Primary Road	156 km (33%)
Secondary Road	81 km (17%)
Total	473 km (100%)

Source: JICA Study Team

6.1.2. Road Network by Number of Lanes

Antananarivo metropolitan area, with a population of around 3 million, has only 39 kilometers of multilane roads. Only about 8% of the arterial roads in the metropolitan area are multilane (Figure 6-2 and Table 6-2). The multilane roads constructed in the last five (5) years are the airport access road along Ikopa river and Rocade d'Iarivo, which was realized by AFD and other donors.



Source: JICA Study Team

Figure 6-2 Status of Number of Lane in the Antananarivo Metropolitan Area

Table 6-2 Percentage of Lanes Number

Number of lanes	Extension	Number of lanes	Extension
Four-lane	39 km (8%)	Two lanes	372km (79%)
Three lanes	3km (<1%)	Single lane	59km (12%)
Total	473km (100%)		

Source: JICA Study Team

6.1.3. Roadway Configuration

The roadway configuration of the national road, the backbone of the Antananarivo metropolitan area, had many narrow sections and a width configuration that was not suitable for smooth road traffic (Table 6-3). The new arterial roads built with donor support since 2015 show improvements, including road widths that can accommodate increasing automobile traffic and the installation of bus bays (Table 6-4).

Table 6-3 Examples of Roadway Configuration of National Road

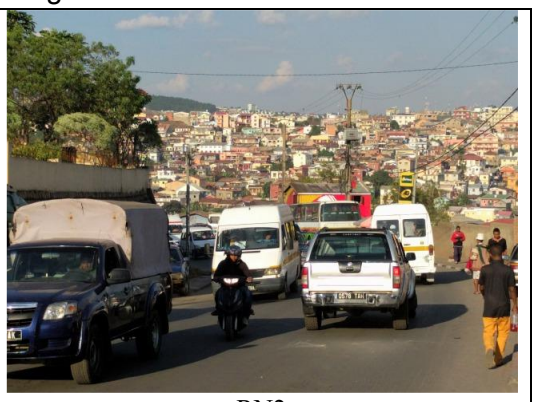
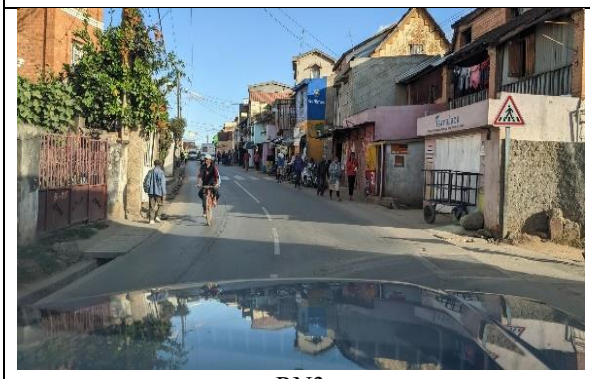
 RN1	 RN2
 RN3	 RN4

Table 6-4 Examples of Roadway Configuration of New Roads

 Rocade d'Iarivo	 Airport Access Road by China Support

Source: JICA Study Team

6.2 Current Status of Public Transportation System

6.2.1. Current Status of Minibus (Taxi-Bé)

The present public transportation system in Antananarivo is mainly Taxi-Bé with about 20 seats and Taxi. Buses called Taxi-Brousse operate between cities (Figure 6-3).

The system of Taxi-Bé is divided into urban line and suburban line, which are two separate networks. Urban lines operate in the areas surrounding CUA, and licenses are issued by CUA. On the other hand, Suburban lines connect the surrounding municipalities to the city. These licenses are administered by ATT under the MTM.

These lines are operated exclusively by private operators called cooperatives. According to the CUA, the supervising agency, the urban line consists of 80 routes and is operated by about 70 cooperatives. The service basically operates from 5:00 am to 8:00 pm, Monday through Saturday, and until 9:00 pm on some routes. There is no nighttime service. Fares are fixed, with a flat fare of 600 Ar for Taxi-Bé in urban areas.

There are 43 suburban routes. Although CUA and ATT manage Taxi-Bé routes and private operators, they do not have data on passenger demand or passenger demand by route and are not able to manage demand.

Although there are no regulations regarding the spacing of bus stops, bus stops are actually located on the roads at intervals of around 250 meters. There are about 10 bus terminals within the urban area that serve as transfer points, but there are no so-called bus terminals in the city.

On the other hand, two bus terminals for Taxi-Brousse intercity buses have been established in the metropolitan area, one of which, Maki Bus Terminal, is located in the vicinity of the A-R-02 project under the study. Another bus terminal, Fisandratana Station, is located along the Tokyo Bypass, but it is not in operation because no operating company has been selected.

Table 6-5 Images of Taxi-Bé

Source: JICA Study Team

Figure 6-3 Route Map of Taxi-Bé

6.2.2. Status of Urban Railroad

As for railroad, there are four (4) tracks radiating from the Soarano station in the center of the city. The track to Toamasina in the southern part of the urban area is functioning. The northern track, the section to LP company oil storage depot in Ankorondrano area, is functioning for the transport of fuel products from the port of Toamasina. In any case, these railroads are currently used only for freight transport and do not function as urban public transport for passenger traffic.

6.3 Current Status of Road Traffic

6.3.1. Traffic Volume

To understand the current traffic volumes of the road network, various surveys were conducted.

[Data used in the analysis]

- Purpose of the study: To determine the current traffic volume and traffic characteristics of major roads. It will also be used as basic data for traffic demand forecasting for the entire urban area.
- Survey station: 50 sites (including cord-line /screen-line in metropolitan areas)
- Survey items: 6 vehicle types (bicycle, motorcycle, Car, Taxi-Be, light truck, large truck)
- Survey date and time: Weekday 1-day survey (10 sites: 24 hours, 40 sites: 12 hours)
- Survey Method: Manual count by surveyor, supplemented by application of AI image analysis.
- Comparative data: 2017 observations (survey results within the TaToM Master Plan)

[Major Analysis Results and Implications for the Evaluation of 7 Road Projects]

Table 6-6 Traffic Survey Results and Implications for Evaluation of 7 Road Projects

Traffic Survey Results	Implications for Project Evaluation
Traffic volume is generally heavy on the main roads within a 5-kilometer radius of the city center. The Ankorondrano area has more than 30,000 vehicles/day, and RN1 and RN7 have more than 30,000 vehicles/day. On the other hand, traffic volume on RN2 and RN3 in the suburban area is approximately 10,000 vehicles/day (Figure 6-4).	High traffic volume on the roads parallel to the Intermediate Ring Road and the north-south trunk road suggests that there is a high need for such road projects.
Traffic volumes above the traffic capacity were observed in the urban centers. In particular, RN1 (Anosizato) and RN7 (Tanjobato) in the Ikopa River crossing area observed more than twice the road traffic capacity).	
Traffic volumes at all survey sites were 1.1 to 1.3 times higher than the 2017 survey results (Figure 6-5).	Future demand projections are needed to account for the approximately 1.1 to 1.2 times faster traffic growth on the current roadway associated with the seven projects.
Freight vehicle traffic on city center roads is low. To begin with, there are few cargo vehicles between the Port of Toamasina and the urban area, and there are restrictions on the flow of cargo vehicles into the city center (Table 6-8).	Need to consider the medium- to long-term impact of the expansion of the Port of Toamasina on cargo volume growth in the metropolitan area and effective utilization of the 7 road projects.
There are roads where the percentage of motorcycles and minibuses (Taxi-Be) exceeds 40% and 25%, respectively (Table 6-7).	Need to consider the necessity for bike lanes, bus lanes and bus bays in road design. Impact on future transportation demand from conversion to automobiles due to rising incomes.
Peak ratio from the suburbs to the city center are at 7:00/8:00 AM (24-hour peak ratio in the 9% range) and at 16:00/17:00 PM (peak ratio in the 8% range). The downtown area remains in the 7% range throughout the day (Figure 6-8).	Peak ratio tends to be higher than in Japan and other countries, and peak hours and peak ratios need to be considered as conditions for intersection design.

Source: JICA Study Team

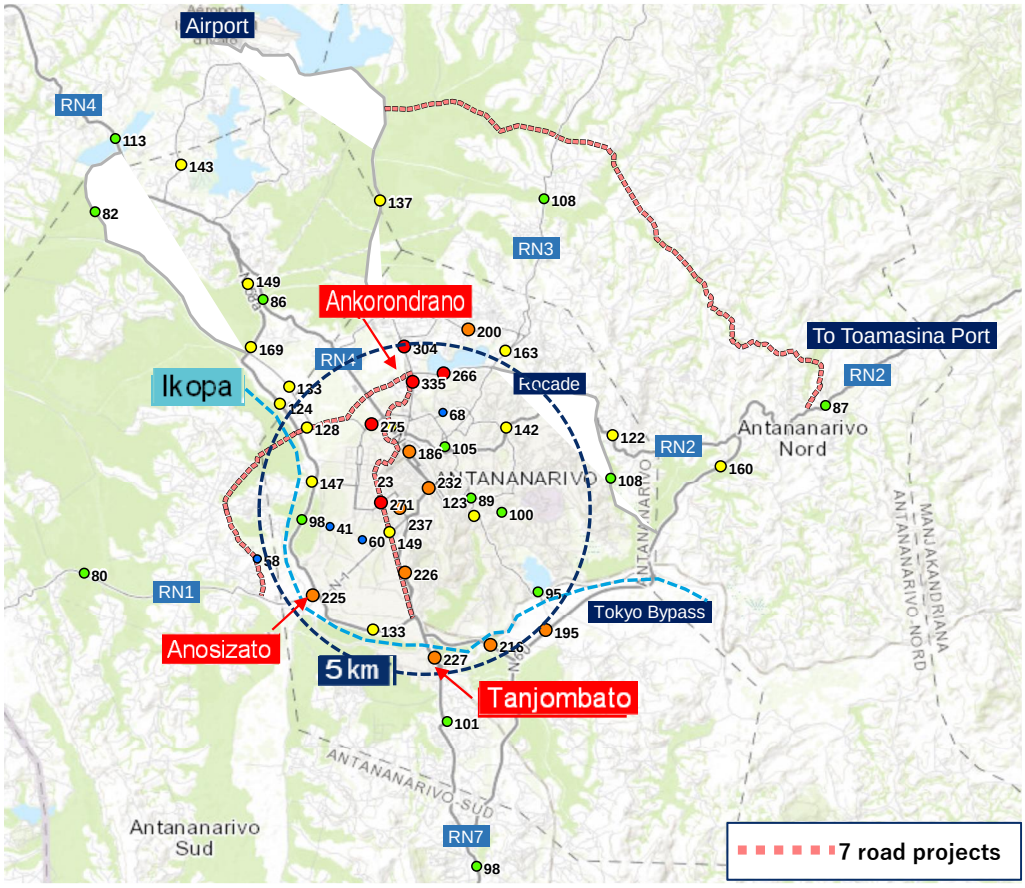


Figure 6-4 Average Daily Traffic Volume (100 vehicles/day)

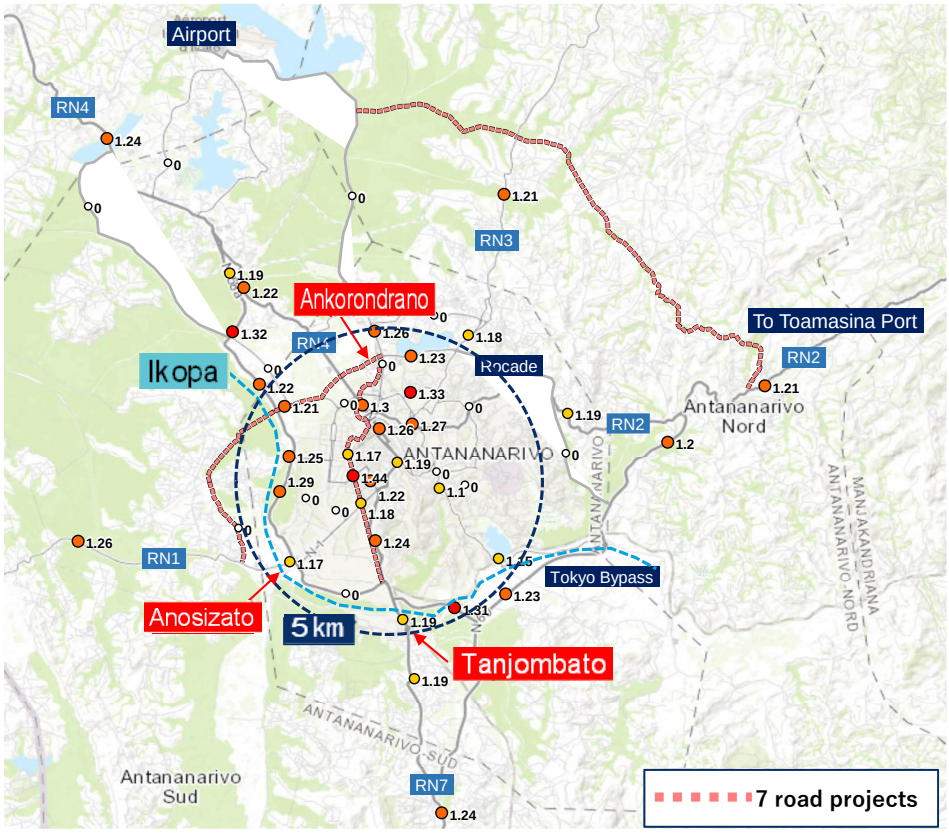


Figure 6-5 Comparison of 2023 Surveys Results with 2017 Survey Results (2023 results divided by 2017 results)

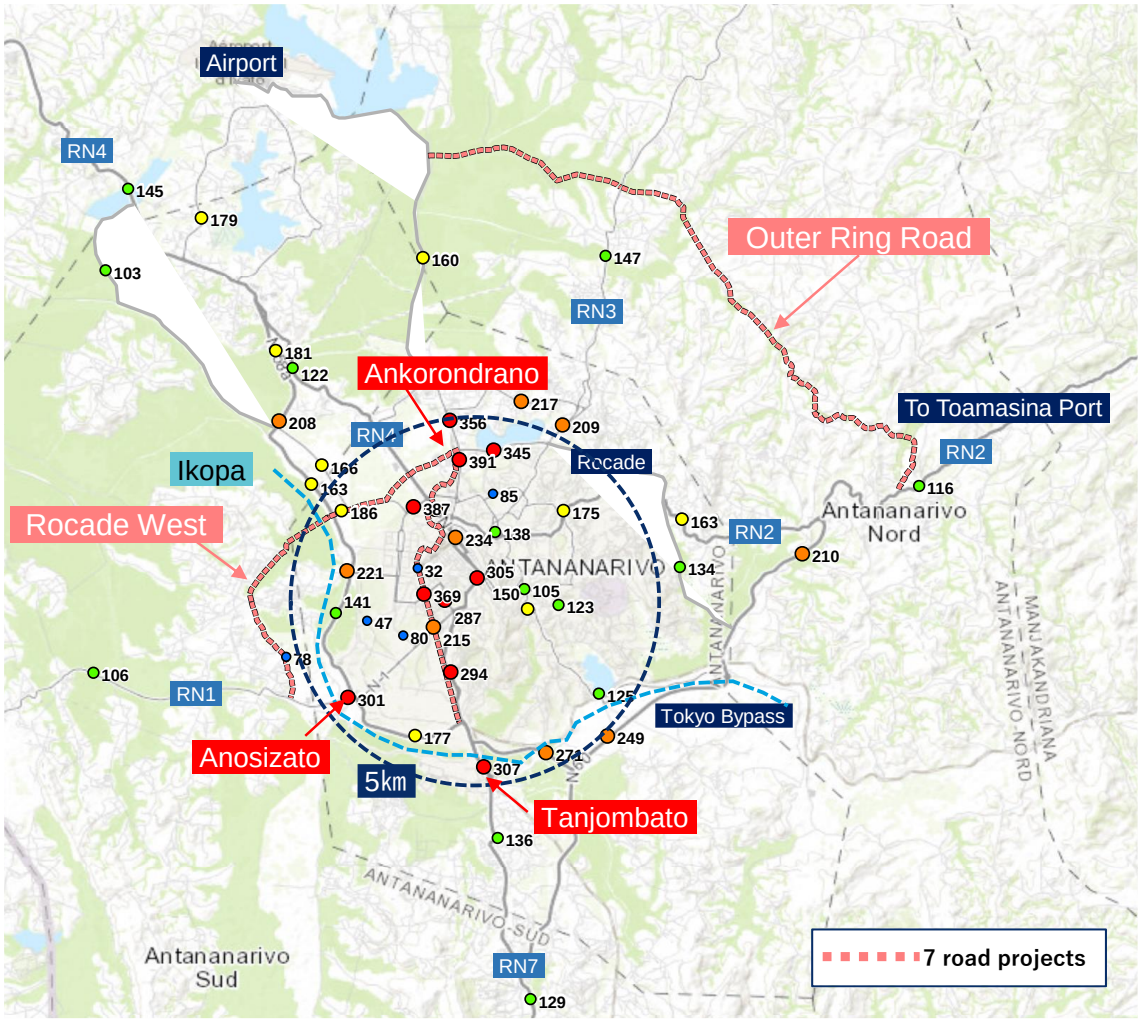


Figure 6-6 Average Daily Traffic Volume (100 PCU/day)

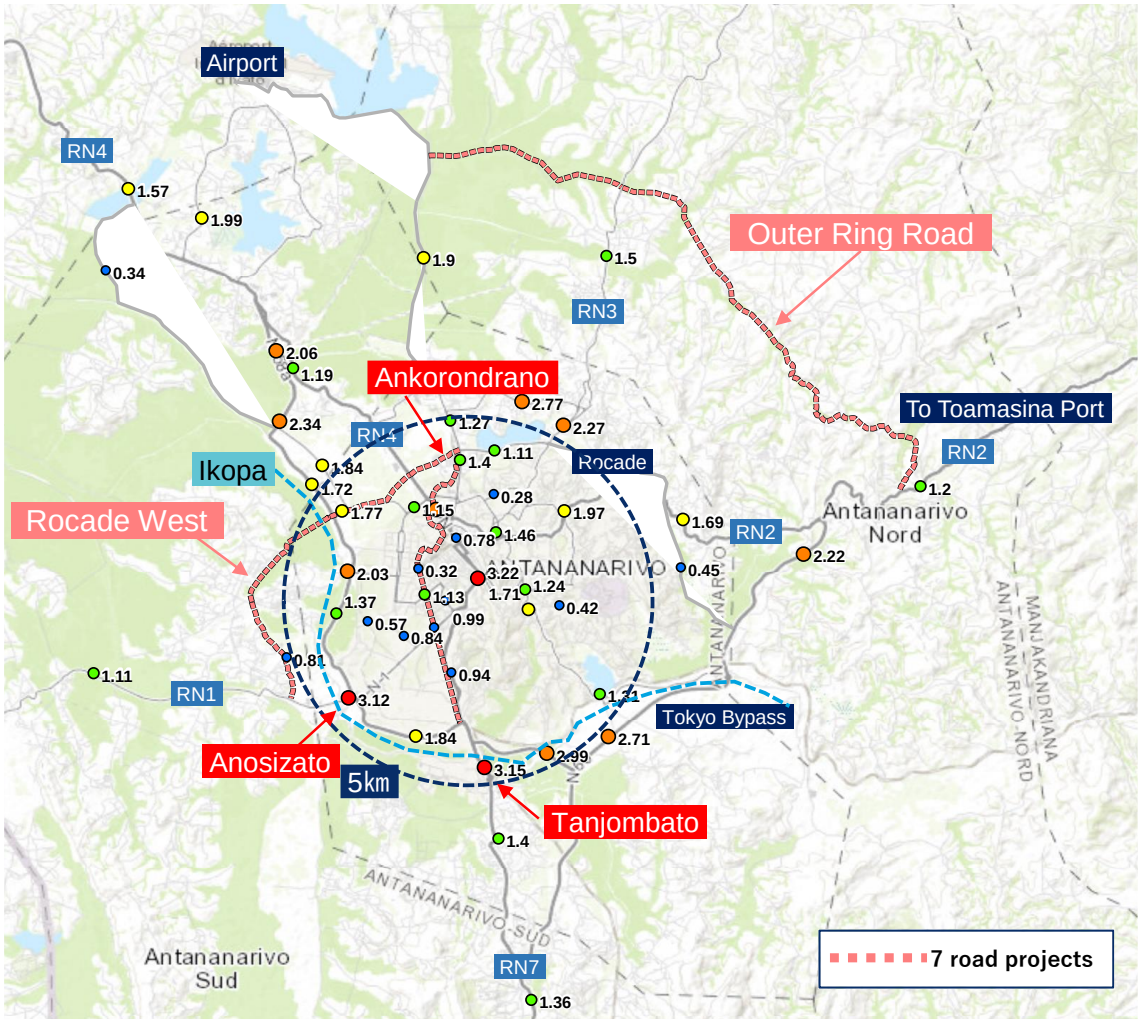


Figure 6-7 Ratio of Daily Traffic Volume to Road Traffic Capacity

Table 6-7 Composition of Vehicle Types (including motorcycles)

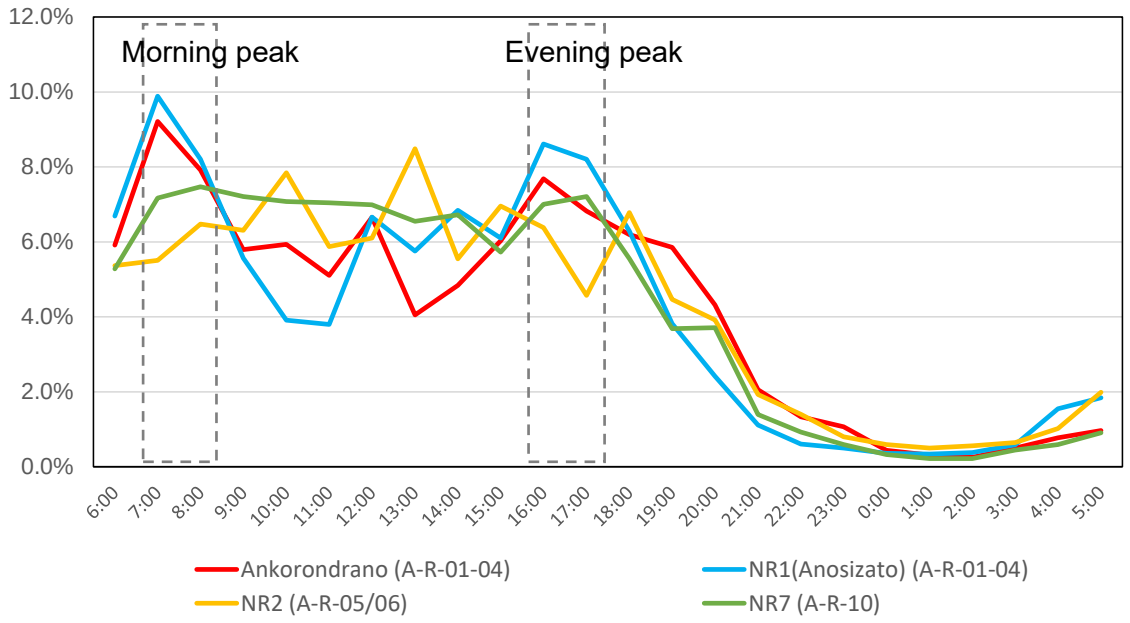
Survey Road	project	Motorcycle	Passenger Car	Mini Bus (Taxi-Be)	Light Truck	Truck	Total
Ankorondrano	A-R-01-04	21%	55%	20%	3%	1%	100%
NR4	A-R-01-04	39%	33%	26%	2%	1%	100%
Europe Road	A-R-01-04	43%	47%	7%	3%	0%	100%
Maki Stadium	A-R-01-04	46%	44%	7%	2%	1%	100%
Itaosy Bridge	A-R-01-04	49%	31%	17%	2%	1%	100%
NR1(Anosizato)	A-R-01-04	36%	32%	26%	4%	2%	100%
Itaosy Road	A-R-01-04	36%	36%	21%	4%	3%	100%
Rocade	A-R-01-04 / 05/06	34%	55%	7%	4%	1%	100%
NR2	A-R-05/06	20%	33%	26%	8%	13%	100%
NR3	A-R-05/06	38%	31%	25%	4%	1%	100%
NR7	A-R-10	35%	39%	23%	2%	1%	100%

Source: JICA Study Team

Table 6-8 Composition of Vehicle Types (excluding motorcycles)

Survey Road	project	Motorcycle	Passenger Car	Mini Bus (Taxi-Be)	Light Truck	Truck	Total
Ankorondrano	A-R-01-04	-	69%	26%	3%	1%	100%
NR4	A-R-01-04	-	54%	42%	3%	1%	100%
Europe Road	A-R-01-04	-	82%	12%	5%	1%	100%
Maki Stadium	A-R-01-04	-	81%	13%	4%	1%	100%
Itaosy Bridge	A-R-01-04	-	62%	33%	3%	1%	100%
NR1(Anosizato)	A-R-01-04	-	50%	41%	6%	3%	100%
Itaosy Road	A-R-01-04	-	56%	33%	5%	5%	100%
Rocade	A-R-01-04 / 05/06	-	83%	10%	6%	2%	100%
NR2	A-R-05/06	-	41%	33%	10%	16%	100%
NR3	A-R-05/06	-	51%	40%	7%	2%	100%
NR7	A-R-10	-	60%	35%	4%	2%	100%

Source: JICA Study Team



Note: Related projects: A-R-01-04: Intermediate Ring Road, A-R-05/06: Outer Ring Road, A-R-10: North-South Trunk Road (utilizing canals)

Source: JICA Study Team

Figure 6-8 Percentage of Hourly Traffic Volume on Major Roads

Table 6-9 Hourly Traffic Volume Percentage on Major Roads

Survey Road	Ankorondrano	NR1(Anosizato)	NR2	NR7
project	(A-R-01-04)	(A-R-01-04)	(A-R-05/06)	(A-R-10)
6:00	5.9%	6.7%	5.4%	5.3%
7:00	9.2%	9.9%	5.5%	7.2%
8:00	7.9%	8.2%	6.5%	7.5%
9:00	5.8%	5.6%	6.3%	7.2%
10:00	5.9%	3.9%	7.8%	7.1%
11:00	5.1%	3.8%	5.9%	7.0%
12:00	6.7%	6.7%	6.1%	7.0%
13:00	4.1%	5.8%	8.5%	6.5%
14:00	4.8%	6.8%	5.5%	6.7%
15:00	6.0%	6.1%	7.0%	5.7%
16:00	7.7%	8.6%	6.4%	7.0%
17:00	6.8%	8.2%	4.6%	7.2%
18:00	6.2%	6.3%	6.8%	5.6%
19:00	5.9%	3.8%	4.5%	3.7%
20:00	4.3%	2.4%	3.9%	3.7%
21:00	2.1%	1.1%	1.9%	1.4%
22:00	1.3%	0.6%	1.4%	0.9%
23:00	1.1%	0.5%	0.8%	0.6%
0:00	0.4%	0.4%	0.6%	0.3%
1:00	0.3%	0.3%	0.5%	0.2%
2:00	0.2%	0.4%	0.6%	0.2%
3:00	0.5%	0.6%	0.6%	0.4%
4:00	0.8%	1.5%	1.0%	0.6%
5:00	1.0%	1.8%	2.0%	0.9%
Total	100%	100%	100%	100%

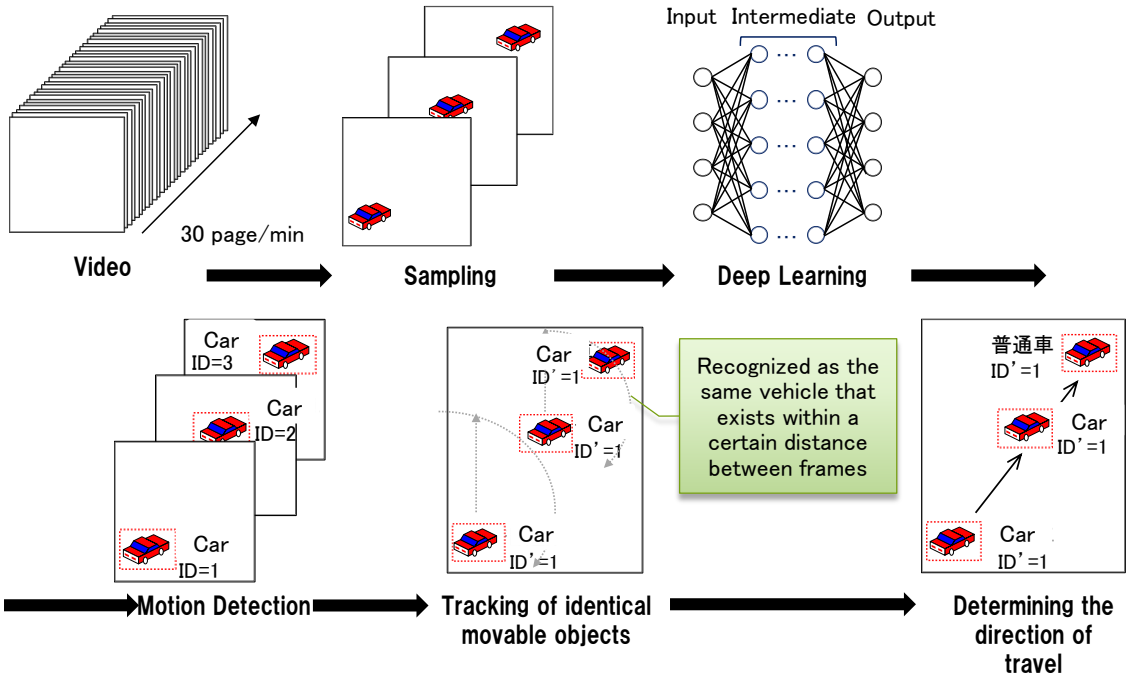
Note)Figure 6-8 Back Data. The color scheme is an automatic color scheme based on the percentage of the mean value to aid in intuitive understanding of large and small.
Source: JICA Study Team

[Supplementary Explanation: Correction of Traffic Count Survey Results Using AI Image Analysis]

In Madagascar, there has been little experience in conducting traffic volume surveys, and there are no local personnel with experience in planning and managing traffic surveys. Under the guidance of the JICA Study Team, this survey was based on manual counts, but with the complementary use of AI image analysis. This process was done as an attempt to correct the results of the traffic survey and use them as the final values of the traffic volume survey results. The analysis was conducted at various locations including on roads in urban areas and roads on sub-urban, and an analysis accuracy of 85% to 95% was confirmed. The following is an overview of the creation of traffic volume survey models using AI technology.

[AI technology-based mobile object detection and tracking process]

- Extract a set number of frames per second from the CCTV image (Figure 6-9).
- Detect moving objects from extracted images using deep learning (deep learning).
- Identify and track the same moving object between image frames.

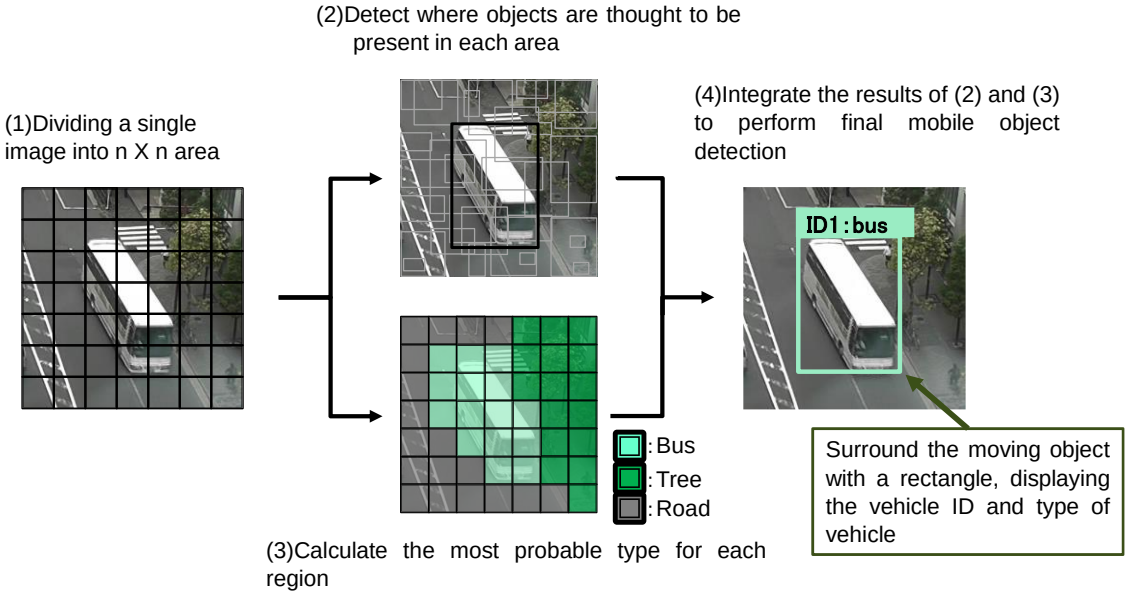


Source: JICA Study Team

Figure 6-9 Moving Object Detection and Tracking Process Using AI Technology

[Methods of detection of moving objects]

- The system automatically detects moving objects in the image by utilizing "CNN (Convolutional Neural Network)", a type of deep learning (Figure 6-10 and Figure 6-11).
- In this study, MSCOCO (Microsoft Common Objects in Context) was used as the object detection model. YOLOv3 was also used as the object detection algorithm.



Source: JICA Study Team

Figure 6-10 Detection Methods for Moving Objects Using AI Technology

Source: JICA Study Team

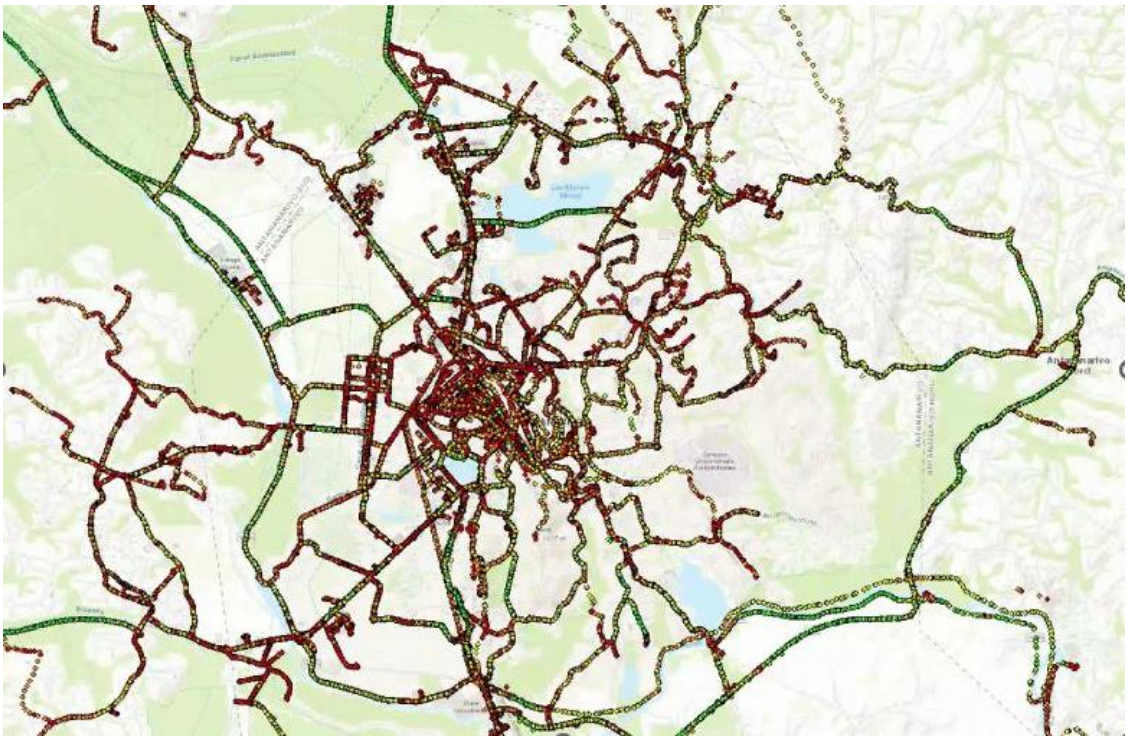
Figure 6-11 Image of Traffic Volume Counting by AI Analysis

6.3.2. Travel Speeds and Congestion Conditions

[Data used in the analysis]

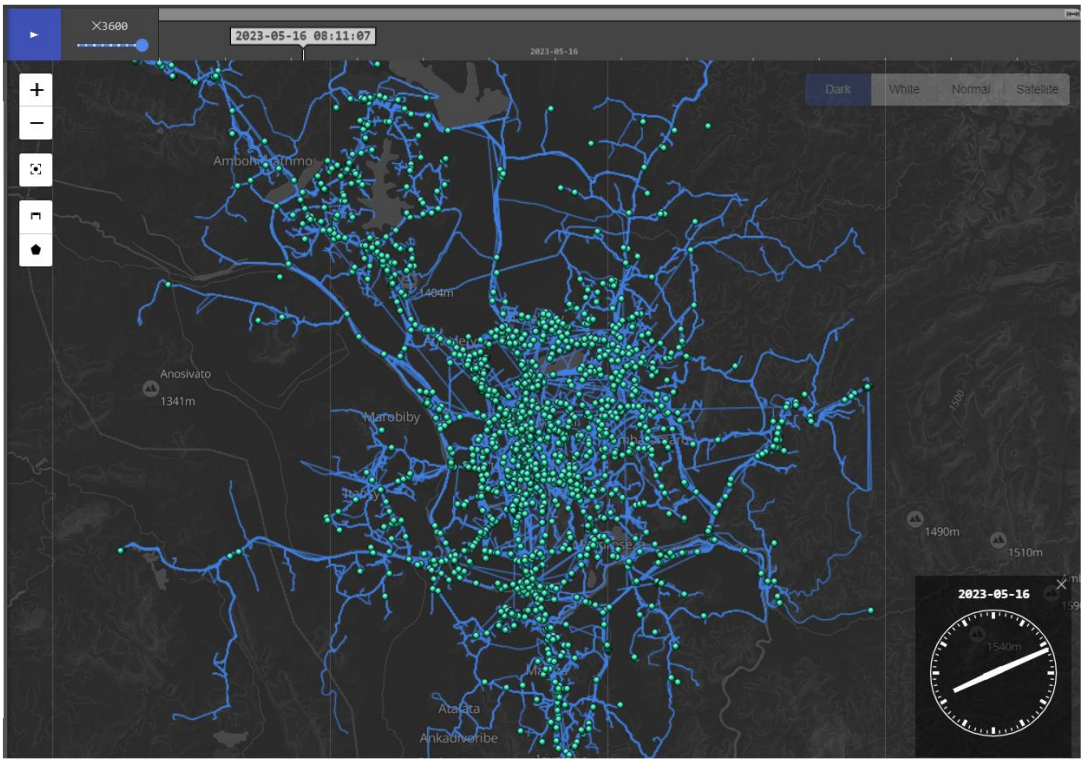
- Purpose of the study: To analyze major traffic bottleneck locations within the urban area and to provide basic data for studying the need for 7 road projects.
- Survey location: Major roads in the metropolitan area
- Survey item: Travel speeds of motorcycles, passenger cars, and buses
- Survey date: May 2023 Data by Time of Day
- Survey method: Probe data of about 3,000 vehicles owned by local private companies (Figure 6-12 and Figure 6-13)

*Note:Data acquisition methods and details, as well as raw data, are not disclosed due to confidentiality obligations with the private companies concerned.



Source: JICA study team processing based on data obtained. The dots in the figure indicate vehicle trajectory and travel speed (red: low speed, green: high speed).

Figure 6-12 Example of Probe Data for Travel Speed Analysis



Source: Video prepared by JICA study team based on data obtained.

Figure 6-13 Probe Data Visualization

[Major Analysis Results and Implications for the 7 Road Project]

Table 6-10 Travel Speed Analysis Results and Implications for Project Evaluation

Travel Speed Analysis Results	Implications for Road Project Evaluation
During the weekday daytime, the average speed is less than 20 km/h, forcing the drivers to travel at low speeds. In the urban area as a whole, the evening peak is the slowest (Table 6-11, Figure 6-14, Figure 6-15).	The development of arterial roads inside the urban area is urgently needed.
Traffic at urban centers are forced to run at low speeds. Traffic congestion in the Ikopa River crossing (Itoasy and Anosizato) and Ankorondrano areas during commuting hours is significant, with traffic jam lengths of more than 2 km observed.	There is significant congestion on the section of the Ikopa River parallel to the Intermediate Ring Road, suggesting the need to extend the Intermediate Ring Road.
According to rough estimates, economic loss due to traffic congestion in the Antananarivo metropolitan area are as follows: • Congestion loss time: 8 million hours/year. • Economic losses due to traffic congestion: 375 billion Ar/year (83 million USD).	Investments in road infrastructure on the scale of JICA Yen loan project are considered necessary to reduce economic losses due to traffic congestion.

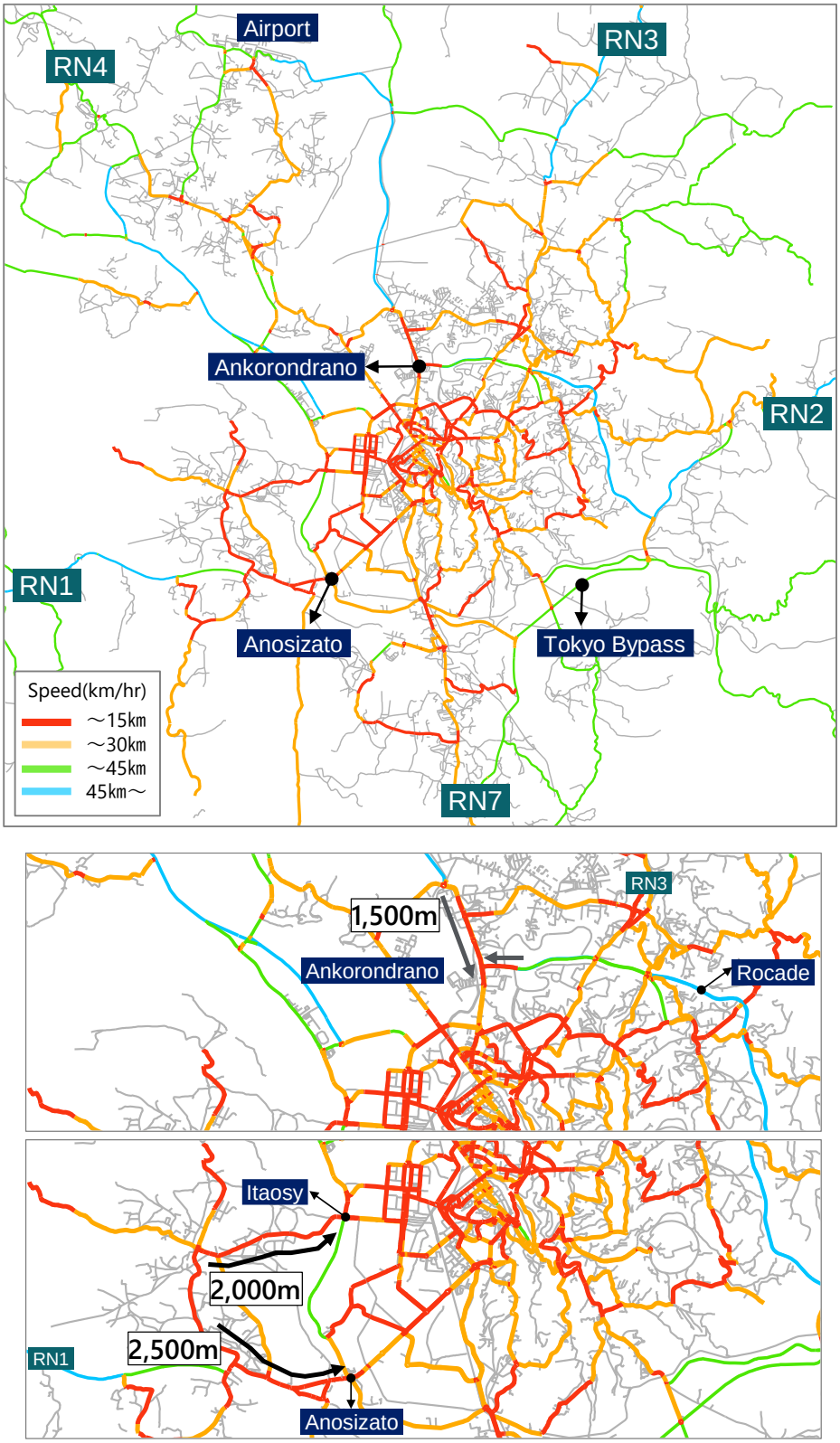
Source: JICA Study Team

Table 6-11 Travel Speeds by Time of Day, May 2023

Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Weekday	Weekend	Total
6:00	21.4	20.2	20.0	19.5	20.0	23.0	26.7	20.2	24.9	21.6
7:00	19.5	16.8	16.7	16.9	16.8	21.5	25.5	17.3	23.5	19.1
8:00	18.8	16.2	16.3	16.4	16.0	20.6	24.3	16.7	22.4	18.3
9:00	18.8	16.5	16.2	16.3	15.8	19.8	23.8	16.8	21.8	18.2
10:00	19.0	16.8	16.5	16.3	15.9	19.3	24.3	16.9	21.8	18.3
11:00	19.3	17.0	16.7	16.6	16.1	19.4	24.7	17.1	22.1	18.5
12:00	19.9	17.5	16.6	17.2	16.6	20.0	25.2	17.6	22.6	19.0
13:00	20.6	18.0	17.3	17.7	17.3	20.5	25.7	18.2	23.1	19.6
14:00	20.2	17.7	17.1	17.2	16.7	20.6	25.4	17.8	23.0	19.3
15:00	19.7	17.0	16.8	16.9	16.3	20.3	25.4	17.3	22.9	18.9
16:00	18.8	16.1	16.1	15.9	15.7	20.5	24.9	16.5	22.7	18.3
17:00	18.0	15.2	15.0	14.7	14.8	19.9	23.8	15.5	21.9	17.3
18:00	18.8	15.9	15.8	15.8	15.3	20.5	23.2	16.3	21.8	17.9
19:00	23.3	22.1	21.4	20.2	19.3	24.1	28.3	21.3	26.2	22.7
20:00	24.9	25.1	28.6	26.8	23.8	29.9	34.1	25.9	32.0	27.6

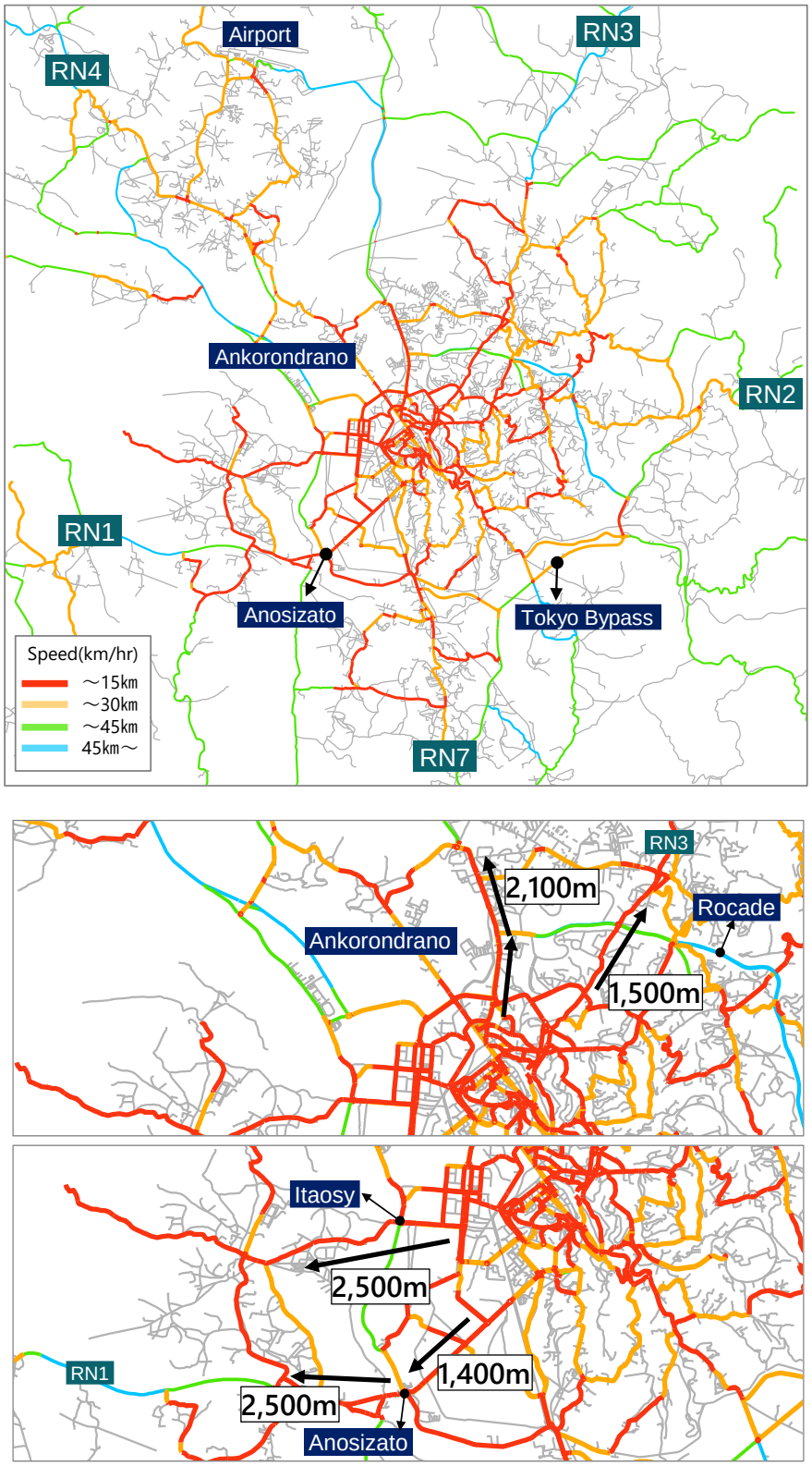
Note: The color scheme is an automatic color scheme based on the percentage of the average value to aid in intuitive understanding of large and small.

Source: JICA Study Team



Source: JICA Study Team; May 2023 average.

Figure 6-14 Morning Peak Hour Travel Speeds and Congestion Lengths at Key Locations



Source: JICA Study Team; May 2023 average.

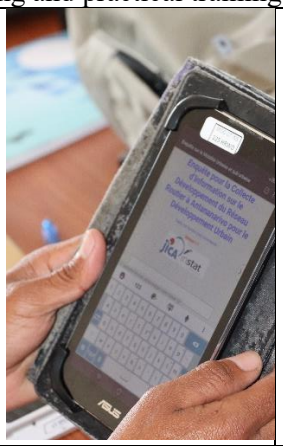
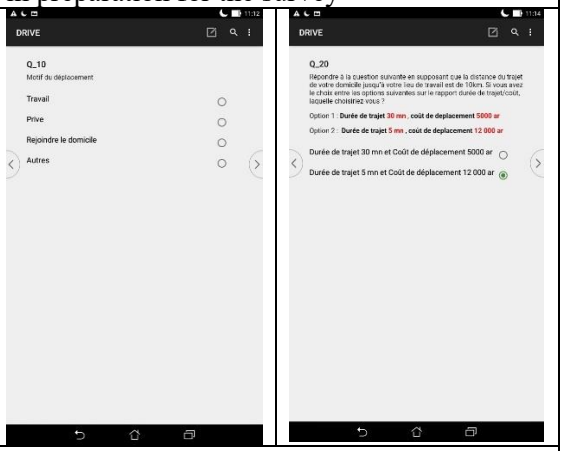
Figure 6-15 Evening Peak Hour Travel Speeds and Congestion Lengths at Key Locations

6.3.3. Traffic Characteristics

[Data used in the analysis]

- Purpose: An urban transportation mobility survey was conducted to analyze the transportation behavior of car and Taxi-Bé (minibus) users within the urban area and to understand the transportation characteristics of the Antananarivo metropolitan area. The data will be used as a basis for understanding current conditions and predicting future traffic demand.
- Scope of study: entire metropolitan area, major Taxi-Bé routes
- Survey items: origin and destination, number of trips, distance and time traveled, number of passengers, and general information.
- Survey date: July-August 2023
- Survey method: Questionnaire survey of road users (using tablet terminals as shown in Table 6-12). The survey was planned and conducted in collaboration with a local government agency, with the aim of transferring technology.
- Sample size: Private car users (2,000 samples), Taxi-Bé users (500 samples)

Table 6-12 Urban Mobility Survey Practice/Use of Tablet Devices

<table>
<tr><td colspan="2">  </td><td colspan="2">  </td></tr>
<tr><td colspan="4">Briefing and practical training in preparation for the survey</td></tr>
<tr><td colspan="2"> 
  </td><td colspan="2">  </td></tr>
<tr><td colspan="2">Hands-on training in tablet terminal operation</td><td colspan="2">Questionnaire screen</td></tr>
</table>

Source: JICA Study Team

[Major analysis results and implications for the evaluation of the seven projects]

Table 6-13 Summary of Urban Mobility Survey Results

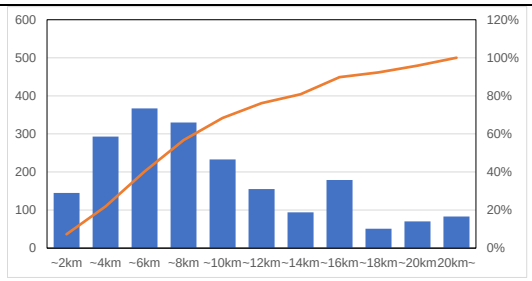
	Private car users	Taxi-Bé users	Comparison
Number of Trip	2.25 times/day	2.13 times/day	Private cars are 0.12 trips (6%) more common.
Commuting distance	9.1 km	7.4 km	Private cars are 1.7 km (23%) longer.
Commuting time	55.7 min.	83.6 min (total) 9.5 minutes (access) 11.2 min (waiting time) 53.9 minutes (ride time) 8.9 min (egress)	Private cars are 28 minutes (33%) shorter.
Movement speed	9.8 km/hr	5.3 km/hr	Private cars are 1.9 km/hr (35%) faster
Trip Purpose	Commuting/work: 86%. Personal affairs: 14%.	Commuting/work: 96%. Personal affairs: 4%.	10% higher percentage of trips for personal affairs in private vehicles
Average number of passengers	1.56 persons	-	-

Source: JICA Study Team

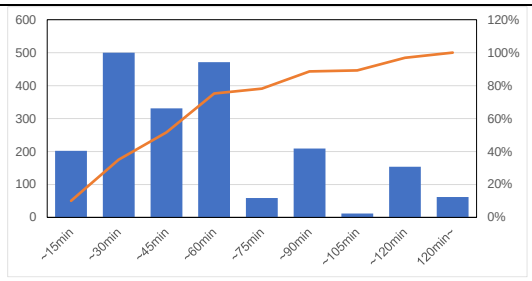
Table 6-14 Urban Mobility Survey Analysis and Implications for Project Evaluation

Urban Mobility Survey Analysis Results	Implications for Business Evaluation
The number of trips per day (net) is 2.52 for private car use and 2.17 for Taxi- Bé use (Table 6-13).	Suggests that the shift to private cars may result in more trips.
Higher income levels correlate with number of trips (Figure 6-16).	Higher incomes may contribute to higher traffic volumes.
Average commuting time by private car is about 60 minutes and 75 minutes for Taxi-Bé (Figure 6-17, Figure 6-18)	Commuting times could further increase if the city becomes more suburbanized.
The movement of people shows a high concentration in the CUA and traffic flow within the CUA, but there is also a considerable amount of traffic flow across the city center (Figure 6-19).	

Source: JICA Study Team



Commuting distance by private car (km)
Average 9.1 km

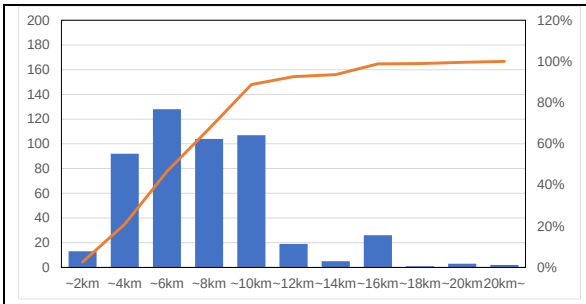


Commuting time by private car (minutes)
Average 56 min.

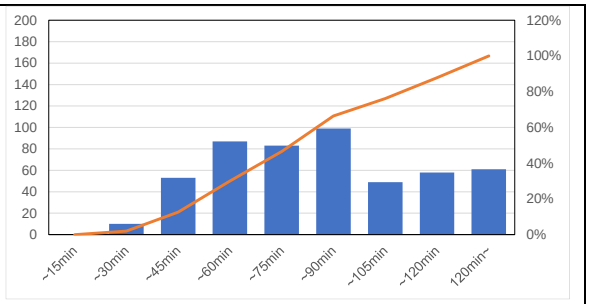
N=2,000

Source: JICA Study Team

Figure 6-16 Commuting Distance and Commuting Time by Private Vehicle



Commuting distance using Taxi-Bé (km)
Average 7.4 km

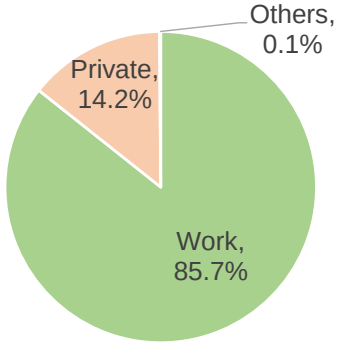


Commuting time using Taxi-Bé (minutes)
Average 84 minutes

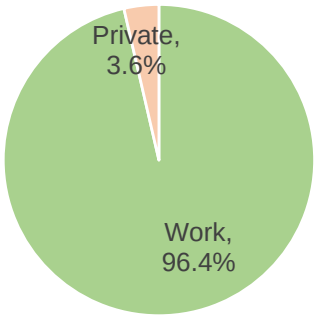
N=500

Source: JICA Study Team

Figure 6-17 Commuting Distance and Commuting Time by Taxi-Bé



Private car use (N=2,000)



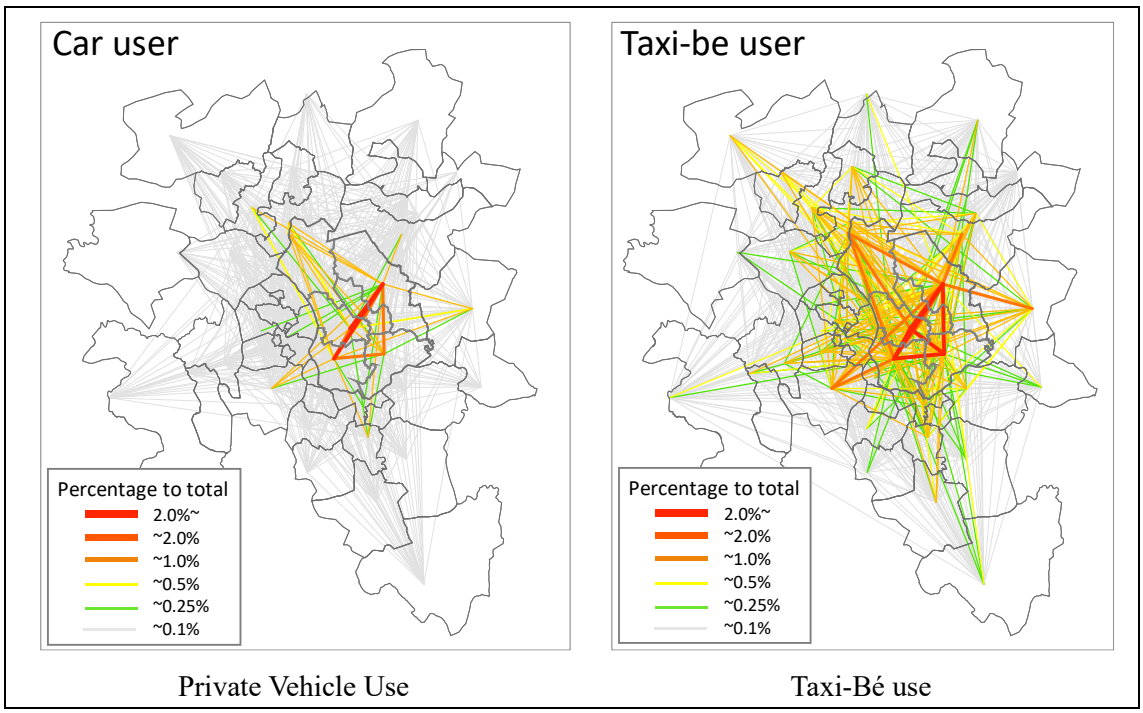
Taxi-Bé use (N=500)

*Excluding the purpose of returning home, which is the final trip.

Source: JICA Study Team

Figure 6-18 Comparison of Trip Purposes for Private Car and Taxi-Bé Use

Traffic flow was created from the current OD table based on urban mobility research and consideration.



Source: JICA Study Team

Figure 6-19 Traffic Flow by Private Car and Taxi-Bé

6.4 Status of Urban Logistics

6.4.1. Characteristics of Urban Logistics

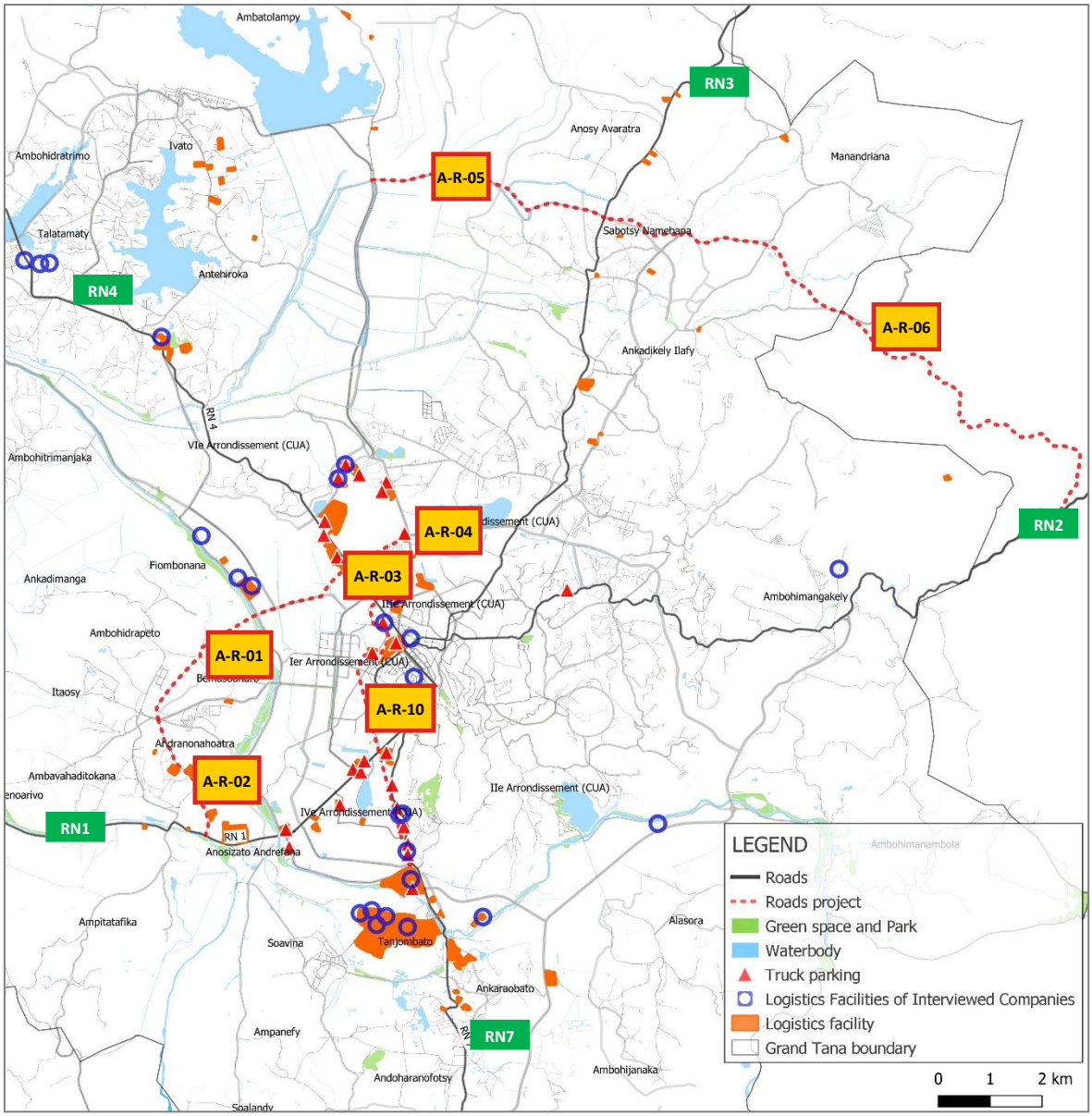
In general, the following characterized urban logistics:

- Frequent trips and just-in-time delivery (must be speedy) due to availability of menus by internet.
- Use of small trucks for maneuverability in a congested road network and to respond to frequent trips.
- Installation of several freight depots in the city for freight consolidation.
- Some degree of cooperation among logistics players (e.g. sharing of distribution facility).
- Consciousness to green logistics (less impact on environment like use of EV trucks).

Logistics system in the city of Antananarivo, and in the country in general, is still in developing stage. The distribution system which is one of the components of the Logistics system is rather simple where a single company is practicing the hub and spoke distribution model and point-to-point distribution model (see below sub-section for discussion of the two models). Collaboration and cooperation among the logistics actors are not yet a common practice (e.g. sharing of distribution platforms).

6.4.2. Location of Logistics Facilities in Antananarivo

In this report, logistics facility refers to factories, warehouses, distribution centers, container terminal, and other facilities of a company which attract high volume of truck traffic. As seen in the figure below, there is a very high concentration of logistics facilities at the core of Antananarivo. In particular, locations of these high concentrations of logistics facilities include: Ankorondrano (close to A-R-03 and A-R-04) especially along the RN4; Ambodivona and Antohomadinika (along the A-R-10); Tanjobato (RN7), Itoasy (A-R-02, RN1). Similarly, there is notable presence of logistics facilities (textile industry) along the RN3 (Ankadikely Ilafy, Sabotsy Namehana, Anosy Avaratra) indicating the importance of A-R-06 to logistics operation.



Source: JICA Study Team based on the results of the interview survey

Figure 6-20 Location of Logistics Facilities in Antananarivo

6.4.3. Distribution Model of the Interviewed Companies

Based on the interview with logistics companies, two types of distribution model are still being practiced in the country.

a. Hub and spoke

This (hub and spoke) distribution model is illustrated in Figure 6-22. This works in this way:

- **Toamasina to Antananarivo**: freights coming from Toamasina Port is brought to the warehouses of these companies located in the core of the city for consolidation before brought to final destination (recipient of the freight). Since the location of these warehouses is inside the city, these generate large number of truck traffic which significantly contribute to traffic congestion.
- **Antananarivo to Toamasina**: freights for export are also consolidated at the warehouses inside Antananarivo before these freights are brought to Toamasina Port. Freight as far as coming from Anshirabe are consolidated in these warehouses hence significant truck traffic is generated inside the city of Antananarivo.

As part of efforts to achieve systematic urban expansion, it is important to give weight to the idea that there is a need to relocate these logistics facilities at the outskirts of Antananarivo to free the core of the city from large volumes of truck traffic. This idea is generally supported by the interviewed companies on the condition that good road network is provided and some incentives are offered (e.g. tax break).

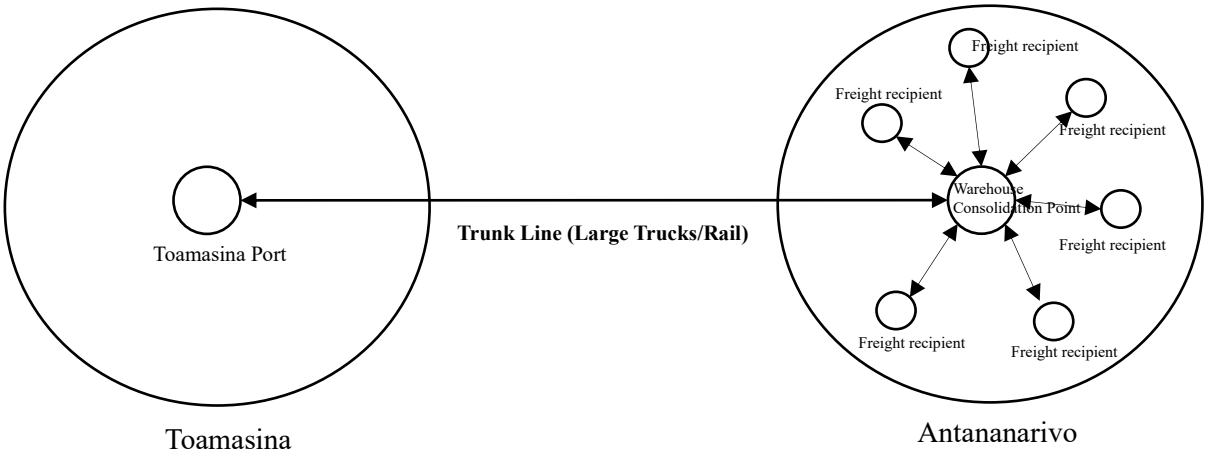


Figure 6-21 Consolidation Point of the Hub and Spoke Distribution Model by the Companies is located in the core of Antananarivo

b. Point-to-point

Container trucks directly deliver their cargoes to client warehouses and/or shopping malls, located in Antananarivo (Figure 6-22). One of the reasons for the practice of direct distribution method (point-to-point) is due to lack of Logistics Platform where consolidation could be done by the transporters.

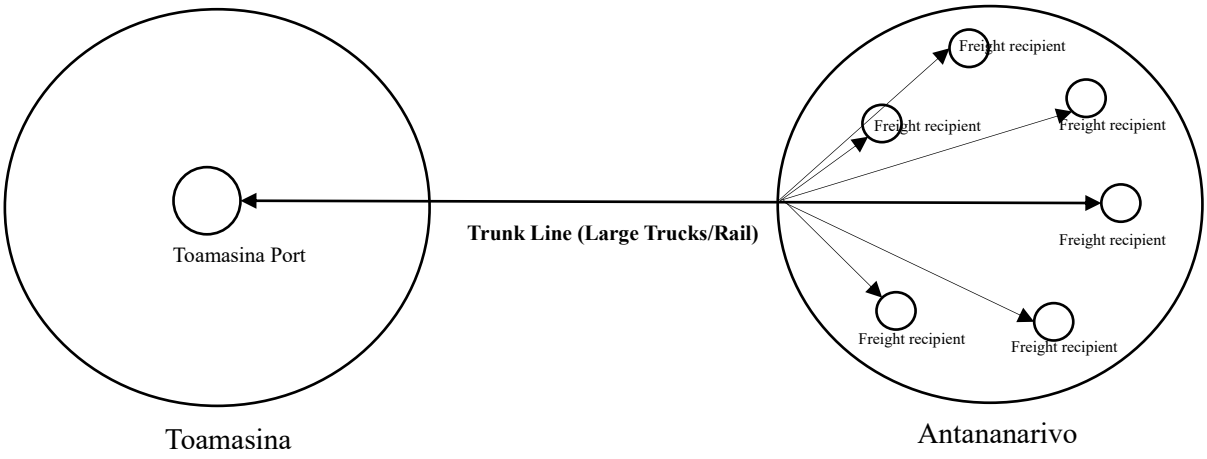


Figure 6-22 Point-to-point Distribution Model by the Companies in Antananarivo

6.4.4. Immediate Use of the 7 Road Projects

In order to confirm the usefulness of the seven (7) candidate road projects in logistics operation, an interview with logistics companies were carried out. At first, the current routes of trucks and corresponding problems in these routes were identified as illustrated in "purple color" in the figure below. The most common problems raised by these companies are: traffic congestion, missing links in the network, narrow roads for truck traffic, poor road surface condition, among others.

When the seven (7) candidate road projects were shown to these companies using a large map, they identified various routes they could use in distributing their products as indicated by "red color" routes in the map (Figure 6-23). The most common comment expressed by these companies is that if these roads are constructed, they could avoid the congested city center hence their delivery would be faster. Similarly, they could receive their raw materials faster which come from the west side of the country because their trucks could avoid the congested section of RN1 which made possible by the A-R-02, A-R-01, A-R-03, A-R-04. The new routes identified by these companies are presented in Figure 6-23.

Current truck routes

Trucks have to pass through the city center which is very congested.

Future truck routes (if 7 roads are constructed)

According to interviewed companies, they can avoid the congested city center if the 7 roads are constructed and this will brin savings in operation & maintenance costs.

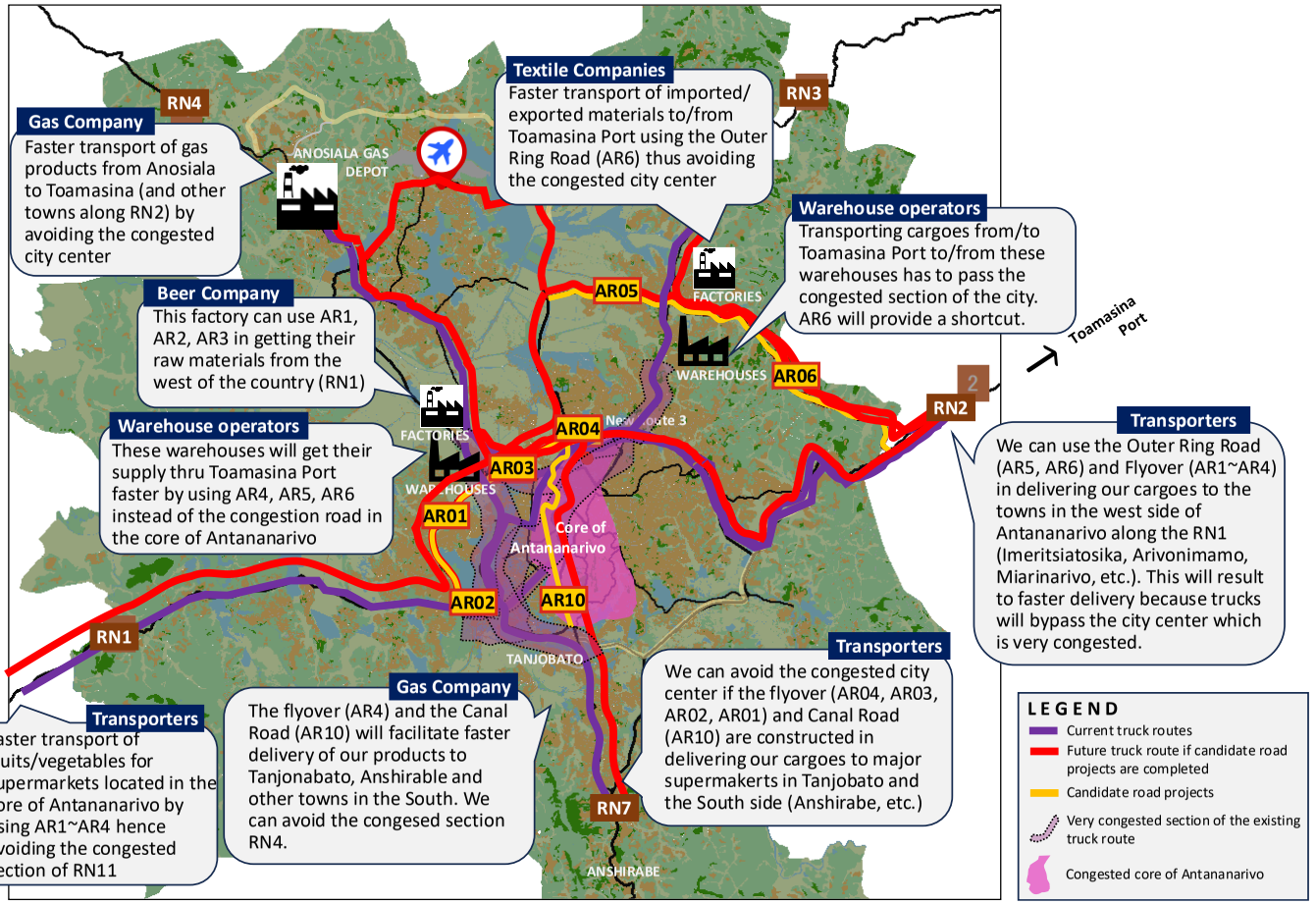


Figure 6-23 Opinions from Logistics Companies on How They Will Use the 7 Road Projects

6.4.5. Candidate Sites for Logistics Platforms in Antananarivo

According to the information received from the government side, the initial site for the multimodal platform was located in Amoronakona, roughly 6.5km away from the city center (Figure 6-24). The identified site will be accessible both by the rail and road transport. However, there was a difficulty of securing the required land due to resistance of landowner to sell hence the government has to look for alternative sites.

As a consequence, the site in Androndrakely was chosen as alternative site, roughly 4km away from the city center. The size of this new site is 6 hectares and has an estimated construction cost of US$ 10.25 Million. Currently, the government is looking for partner to fund the project. L'avant-projet sommaire (APS) (preliminary study) has been completed which was the basis of the USD 10.25 Million construction cost. No consultation with potential company users was made yet. However, MADARAIL (in charge for O&M of this platform once constructed) has an agreement with Logistique Petroliere (a major oil company) that they will use this facility once completed. Accordingly, the possibility of opening the platform to other clients will be studied later.

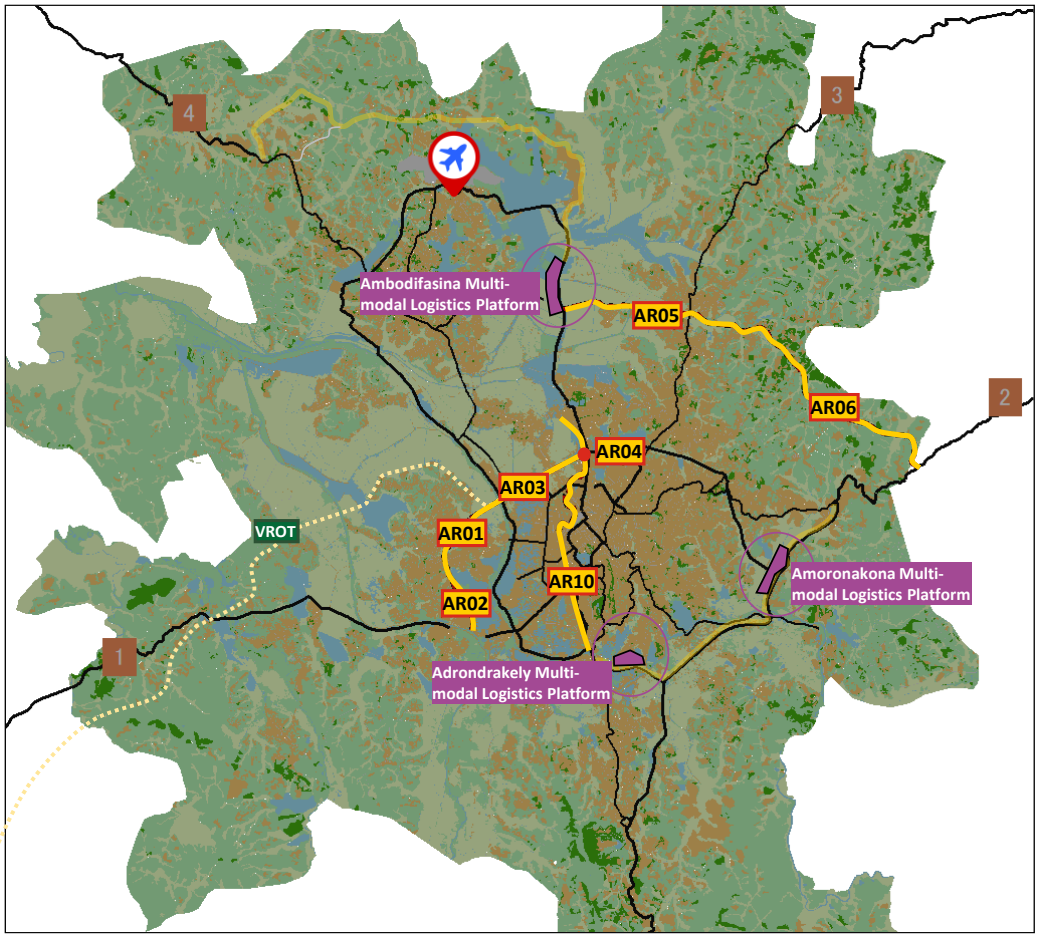


Figure 6-24 Candidate Sites of Logistics Platform

The third location which was identified by the PUDé initiated by AFD is located in Ambodifasina. As the master plan is still under formulation, there is insufficient available information. From the perspective of logistics (Table 6-15), it appears that the Amoronakona is better positioned for the following reasons:

- First, it has reasonable distance from the city center hence trucks will be kept away from the city center.
- Second, it can be served both by road and rail transportation (although alternative site in Androndrakely is also served by both).
- Third, it is closer to RN2 which is the main road connecting Antananarivo to Toamasina Port hence trucks could access the platform easily without using other roads.
- Fourth, it is closer to Tokyo Bypass and Rocade hence freight delivery to the city center can be facilities by these roads.

Table 6-15 Characteristics of the three (3) sites

Items		Amoronakona (Original site)	Androndrakely (Alternative site)	Ambodifasina (Proposed by PUDé initiated by AFD)
a. Distance from city center		6.5 km	4.0 km	10.0 km
b. Access to multi-modal transport		Road & Rail	Road & Rail	Only road
c. Road Network supporting the facility	Access to port	(RN2 + 3km portion of Tokyo Bypass) • Good	(RN2 + Tokyo Bypass + RN63) • Relatively good	(Local road) • Good access to Airport using local road • Difficult access to Toamasina port (but will be addressed if A-R-05 and A-R-06 are constructed)
	Access to city center	Rocade d'Ilarivo (4-lane) • Traffic flow is good	RN7 (4-lane) • Congested road	Local road • Traffic flow is relatively good
d. Available land		60 hectares	6 hectares	Not known yet
e. Land Class		Marsh	Marsh	Marsh
f. Land issue		Landowner is not selling the needed land	Land is already secured	Not known yet
g. Surrounding areas				

6.4.6. Opinions from the Interviewed Companies on the Logistics Platform

Logistics Platform is an important facility to organize the freight distribution in the city center. In essence, the idea is to deliver the same number of freight but in less number of trucks through freight consolidation. Reducing the number of trucks in the network brought various benefits such

as reduction of level of traffic congestion, less source of harmful gases, less space for truck parking (hence the space could be used for other purposes), less vibration experienced by the residents among others.

For the above reasons, the interviewed companies were asked about their opinion if they support the idea of establishing logistics platform. Likewise, their ideas were sought on the location of three (3) candidate platforms. In general, most of them are in agreement that logistics platform is needed in Antananarivo to organize the freight distribution in the city. However, they argued that the location should be studied well to consider various needs of the facility (e.g. good road and rail connection, wide available space, away from the city center, etc.) to ensure its success. Table 6-16 summarizes the opinions of the interviewed logistics companies.

Table 6-16 Opinions from the Logistics Companies on the importance of Logistics Platform

	Comments by Interviewed Companies on the Importance of Logistics Platform and its location
Companies Responses	**Do you think Logistics Distribution Platform is important?** • Yes, Logistics Platform is very important. This will greatly improve traffic circulation in the city since large trucks will end their trips here (outside of the city). **Androndrakely Logistics Platform** • They think this location is too close to the city center. The high number of trucks attracted by the facility will create serious traffic congestion. • Other feels that both Androndrakely and Amoronakona are very close to the city and will become a buildup area (hence congested) in 5 years or so. The location should be moved away farther say at the junction of RN2 and Outer Ring Road. **Amoronakona Logistics Platform** • They feel this is more suitable due to its notable distance from the city center and good road and rail accessibility. • Amorokona is good because it will facilitate trucks serving RN2 and RN7. This platform will mostly serve cargoes for export and import. **Ambodifasina Logistics Platform** • They think that the Ambodifasina is a good place for logistics platform which could serve trucks serving RN1, RN4, RN3 (assuming Outer Ring Road is constructed: A-R-05, A-R-06). • The proposal to have a logistics platform in Ambodifasina is sound. This can be used to store export products of the country passes through the air such as lychee fruits, sea products, among others.

6.4.7. Proposed Urban Logistics System in Antananarivo

Distribution system's efficiency largely relies on the completeness of the road network. A good road network has a series of ring roads and radial roads to allow various options to access the core of the city. Therefore, complete formation of the road network is a pre-requisite for the creation of an efficient logistics system in Antananarivo.

As seen in Figure 6-25, the plan is to transform the current direct delivery system where container

trucks approach the core of the city hence significantly contributing to traffic congestion to consolidated delivery system using the Logistics Center/Platform. In essence, two major infrastructures are needed: (a) ring roads and radial roads and (b) Logistics center/platform.

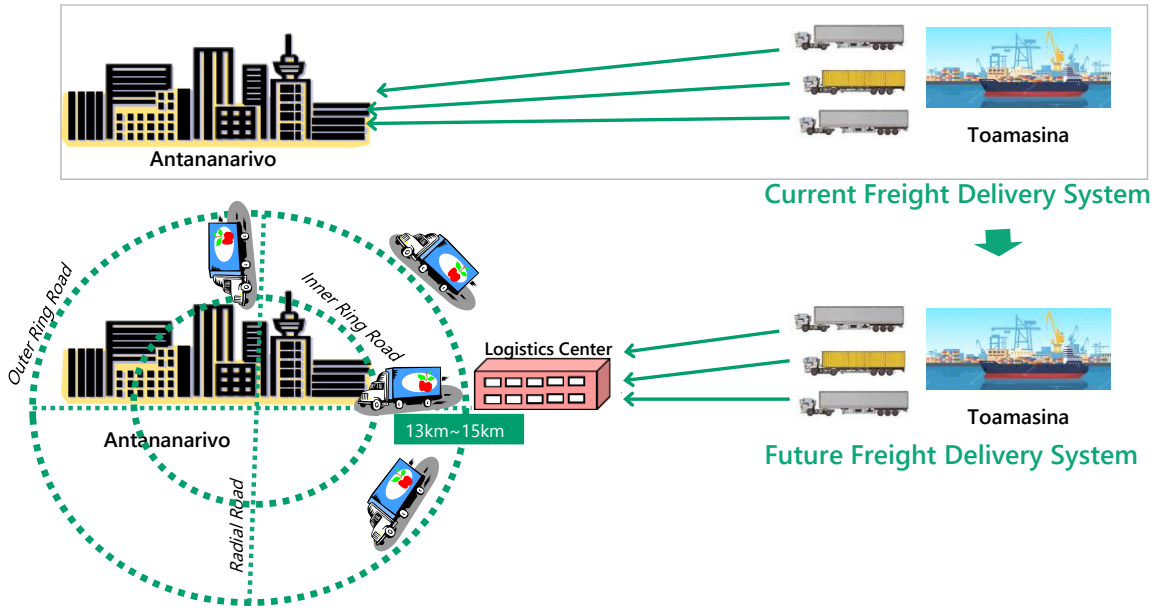


Figure 6-25 Current and Future Freight Delivery System in Antananarivo

6.4.8. Contribution of the Seven (7) Roads in the realization of efficient Logistics System in Antananarivo

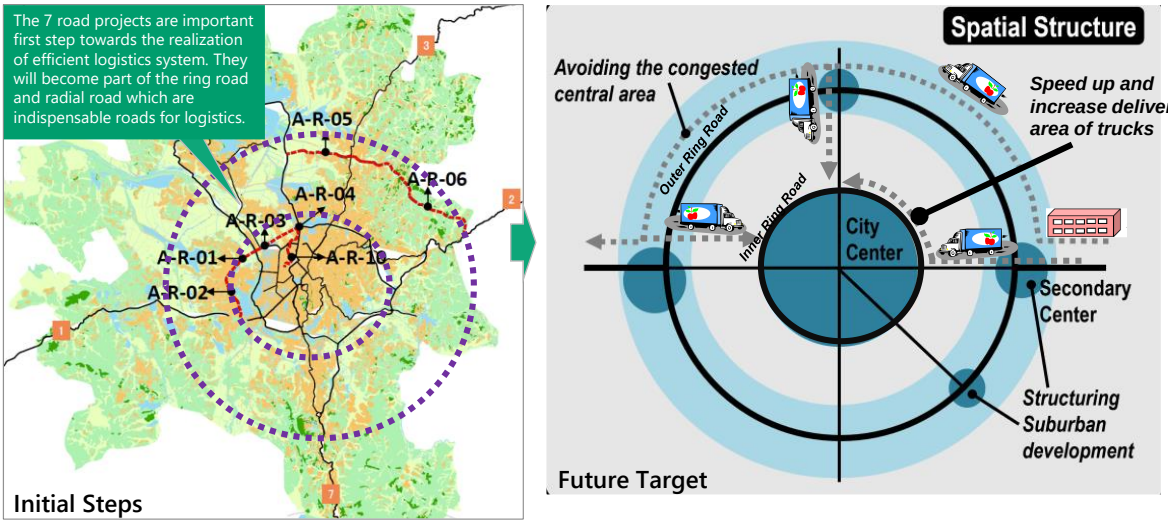
As discussed earlier, a series of ring roads and radial roads have to be constructed to complete the formation of the road network of Antananarivo. Well-formed road network allows traffics including truck traffic to circulate in good order because there is completeness of the network where missing links are absent.

As seen in Figure 6-26, the seven (7) road projects are main components of the future road network to realize efficient logistics system in Antananarivo. Rod projects A01~A04 will form part of the inner ring road which would allow trucks to bypass the congested city core. Road projects A-R-05 and A-R-06 will be part of the outer ring road which would support systematic expansion of the city. A-R-10 on the other hand will become one of the many radial roads connecting the inner ring road to the core of the city which is important to complete the delivery of freight in the city center. In short, the seven projects are all important component of the envisioned future logistics system (Table 6-17).

Table 6-17 Role of Each Road Project in the Logistics Functions

Road Project	Role in the network formation and logistics function
A-R-02	Part of the inner ring road (to allow trucks to bypass congested city core)
A-R-01	Part of the inner ring road (to allow trucks to bypass congested city core)
A-R-03	Part of the inner ring road (to allow trucks to bypass congested city core)
A-R-04	Part of the inner ring road (to allow trucks to bypass congested city core)
A-R-05	Part of the outer ring road (to allow trucks to bypass congested city core and to allow the city to

Road Project	Role in the network formation and logistics function
	expand systematically)
A-R-06	Part of the outer ring road (to allow trucks to bypass congested city core and to allow the city to expand systematically)
A-R-10	Part of the radial road (to bring freight to the core of the city)



Source: (Right figure) Modified from "The Geography of Transport Systems (5th Edition)", Jean-Paul Rodrigue (2020), New York: Routledge, 456 pages. ISBN 978-0-367-36463-2

Figure 6-26 Needed Projects to realized Proposed Urban Logistics System

6.4.9. Achievement of Efficient Logistics System

When the road network formation of Antananarivo is completed and support logistics facilities are installed (e.g. Logistics center/platform), the following are expected major benefits:

- Reduction of Transportation Cost
- Reduction of Commodity Price
- Contribution to urban development by triggering relocation of logistics facilities from city center to suburb
- Contribution to enhancement of urban environment/configuration of Antananarivo through reduction of the number of large trucks in the city center

6.5 Future Traffic Demand Forecast

6.5.1. Basic Idea of Work

This study presents a rough projection of future traffic demand based on available data that has been obtained to date. Although this is a rough study, the relative short-term, medium- term, and long-term future traffic demand for the seven roadway projects shall be compared to determine the priority and relevance of the seven projects. The steps of the study are as follows.

- Estimation of population and economic framework,
- Estimation of urban area expansion and population distribution obtained from urban

expansion model analysis,

- Analysis of major urban development perspective,
- Estimation of a model for the growth of automobile traffic for the entire metropolitan area
- Traffic flow data (OD: Origin Destination data) based on interim report data from the Urban Mobility Survey and traffic probe data
- Road network obtained from traffic condition survey (road network creation work for traffic analysis)
- Traffic volume allocation (future traffic volume estimation)

6.5.2. Population and Economic Framework

The population and economic frames in the Antananarivo metropolitan area used to project future transportation demand shall be as follows.

Table 6-18 Population Framework for Forecasting Future Transportation Demand

Antananarivo Metropolitan Area	2018	2023	2028	2033	2043	2053
	Census	Base	After 5 years	Short term	Mid-term	Long-term
Population (thousands)	2,521	2,971	3,476	4,200	5,216	6,089
Growth Rate	3.31% (M.Yen)	3.34% (in %)	3.19% (3.19%)	3.11% (3.11%)	2.11% (2.11%)	1.11% (1.11%)

Source: Estimated based on data from INSTAT (Statistics Bureau) and other sources.

Table 6-19 Economic Framework for Forecasting Future Transportation Demand

Antananarivo Metropolitan Area	2018	2023	2028	2033	2043	2053
	Census	Base	After 5 years	After 10 years short term	20 years later medium-term	30 years later long term
Gross national product (M.USD)	6,104	7,422	9,669	12,504	21,636	39,246
Growth rate	-	4.0% (4.0%)	4.0% (4.0%)	4.0% (4.0%)	5.5% (5.5%)	6.0% (1.0)
GRDP per Capita (USD)	2,421	2,498	2,782	3,087	4,148	6,445

Source: Estimated based on data from INSTAT (Statistics Bureau) and other sources.

6.5.3. Estimation of Traffic Trends and Growth Models for the Antananarivo Metropolitan Area

The vehicle-kilometers traveled on major roads for the past four years, 2004, 2010, 2017, and 2023, when available, were estimated and analyzed for trends in traffic volume increases and decreases (Table 6-20). To estimate future traffic volumes, a linear model was estimated with population and metropolitan area GRDP as explanatory variables (Table 6-21). The results of the analysis indicated that traffic volumes for the entire metropolitan area would be 2.3 times in 20 years and 3.7 times in 30 years (Figure 6-27).

Table 6-20 Traffic Volume Trends on Major Roads (Vehicle Kilometers)

Road	2004	2010	2017	Year 2023
	PUDi2004	Survey by MTP	TaToM	Survey in the study
RN2 (Suburban)	7,000	8,500	12,300	17,318
RN3	14,000	15,044	16,670	21,534
RN4 Bypass	8,500	10,974	13,434	16,867
RN7	5,500	7,445	8,805	11,339
Arterial roads	7,500	9,780	12,481	15,218
Total	42,500	51,743	63,690	82,275

Source: Each survey in the table

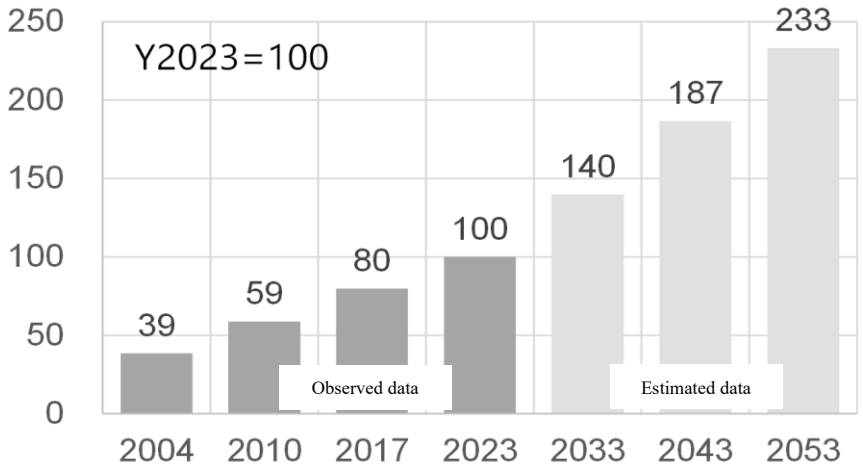
Table 6-21 Population and GRDP of the Antananarivo Metropolitan Area

Indicator	2004	2010	2017	Year 2023
Population (thousands)	1,574	1,926	2,438	2,971
GRDP (million USD)	1,808	3,923	5,757	7,422
GDP per Capita (USD)	1,149	2,037	2,362	2,498

Source: Estimated based on data from INSTAT, World Bank, etc.

Table 6-22 Parameter Estimation Results

Explanatory variable	Coefficient	t-value	multiple correlation coefficient	coefficient of determination
Population (thousands)	17.84	3.13	0.99	0.99
GRDP (million USD)	7.30	2.89		



Source: JICA Study Team

Figure 6-27 Future Traffic Volume Estimation Results

6.5.4. Perspective of Urban Development Plan

The following are major urban development plans that are expected to promote development in the future (Table 6-23). The scale and layout of these plans are taken into account as the planned traffic volume in the future traffic demand forecast.

Table 6-23 Planned Traffic Volume from New Urban Development

Project	Summary	Business Scale	Planned Population/Employment
(1) Tana Masoandro New Town Project	Administrative Function Relocation/ mixed development	1,020 ha	224,000 persons 200,000 Employment
(2) Talata- Volonondry New Town Project	Neighborhood Development	62 ha	23,000 people
(3) PRODUIR	Neighborhood Development	2,000 ha	150,000 people
(4) PUDé Ankorondrano	New City Center Development Plan	668 ha	46,300 persons
(5) PUDé Ampitatafika	Development complex along RN1	360 ha	No plan
6) PUDé PADARNE	Compound development along the Intermediate Ring Road	26 ha	+ 8,350 + 5,570 Employment
(7) PUDé Bypass	Bypass roadside mixed-use development	1,016 Ha	No plan
(8) PUDé Ambodifasina	Compound development along the airport access road	under review	100,000

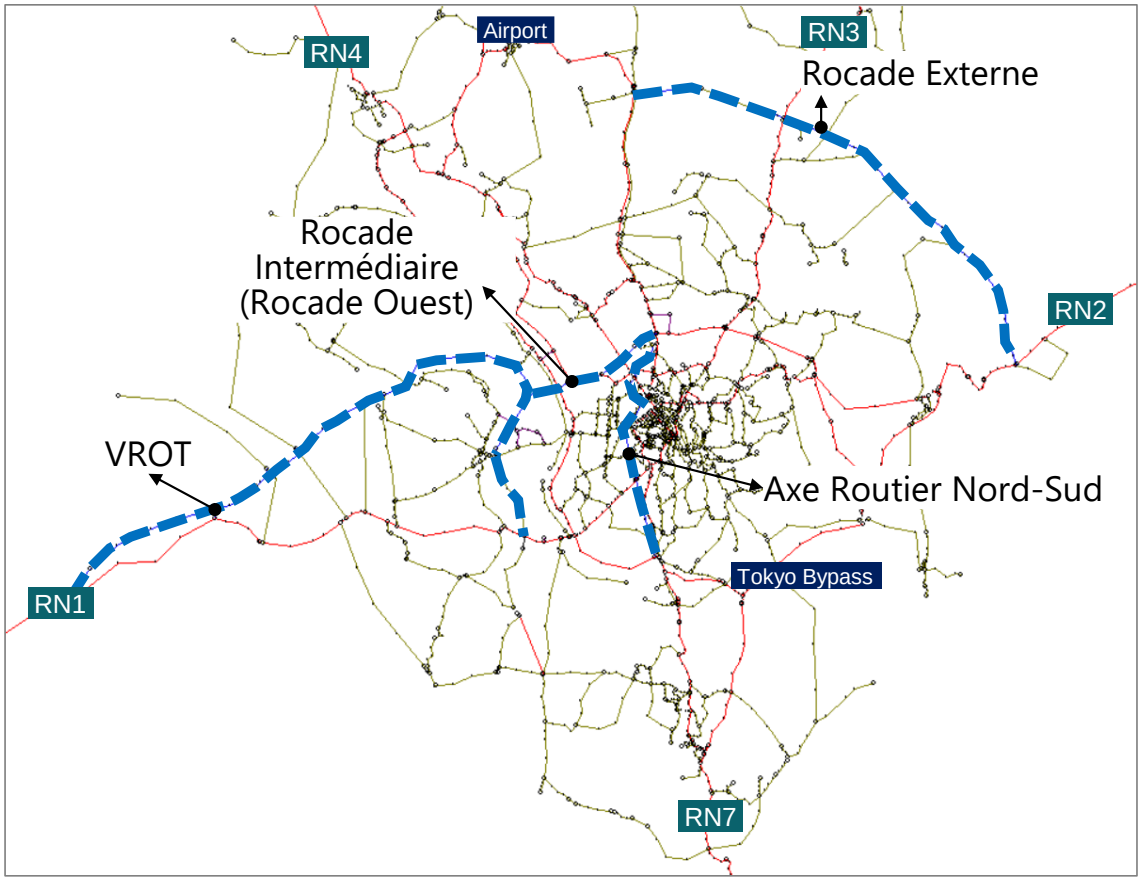
Source: JICA Study Team

6.5.5. Future Road Traffic Demand Forecast

The following data were used to estimate future traffic as

[Basic conditions]

- Estimated years: short term (2033), medium term (2043), long-Term (2053)
- Scope of road network: Scope includes entire metropolitan area
- Road network: current network + 7 priority projects + VROT, etc
- Number of OD zones: 84 zones (generally in communes),
- Traffic volume estimation method: In this report, the traffic volume distribution method (user balanced distribution) is used for the calculation as a summary report.



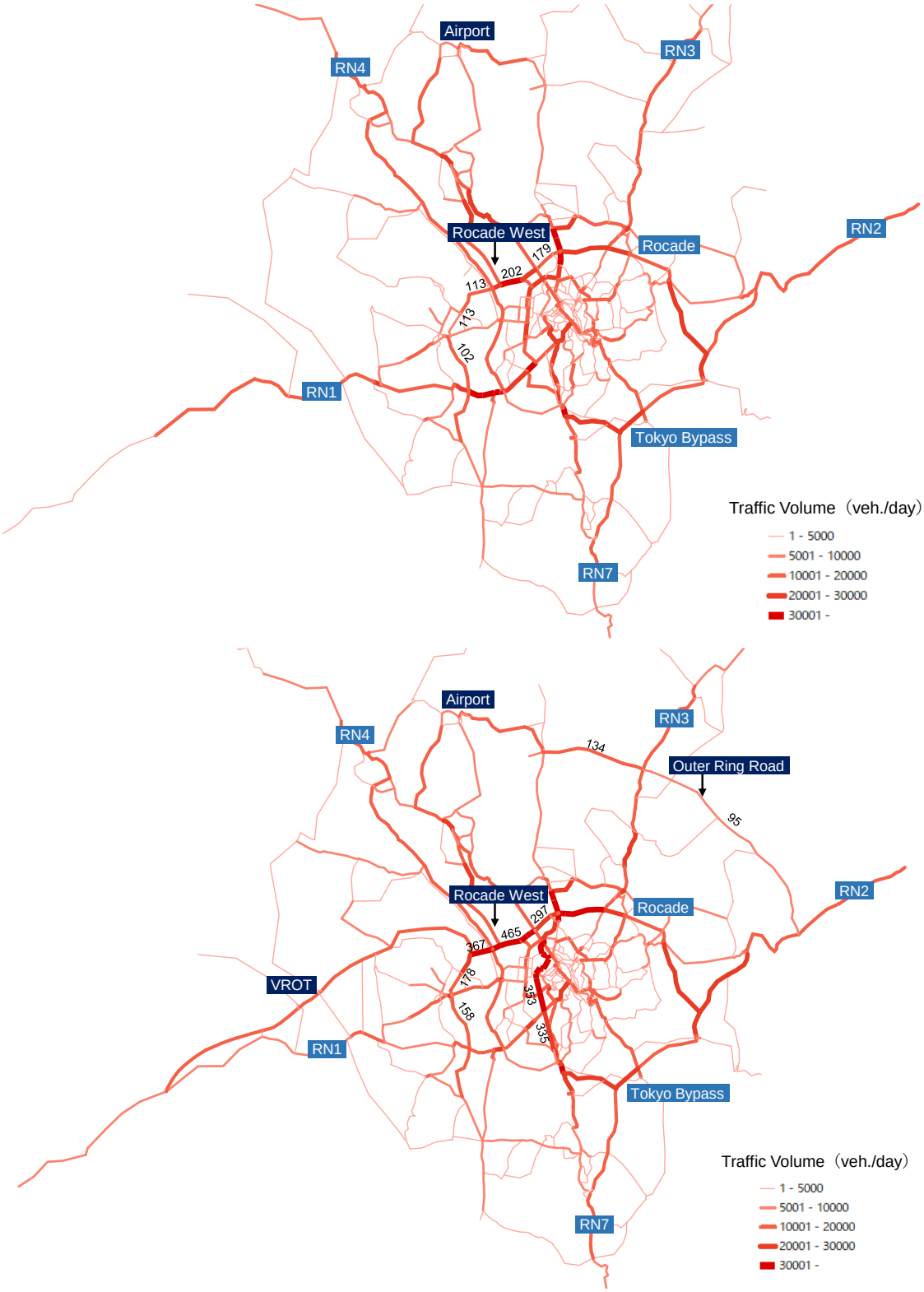
Source: JICA Study Team

Figure 6-28 Road Network and Zoning Used for Traffic Volume Distribution (2043)

[Traffic volume distribution results]

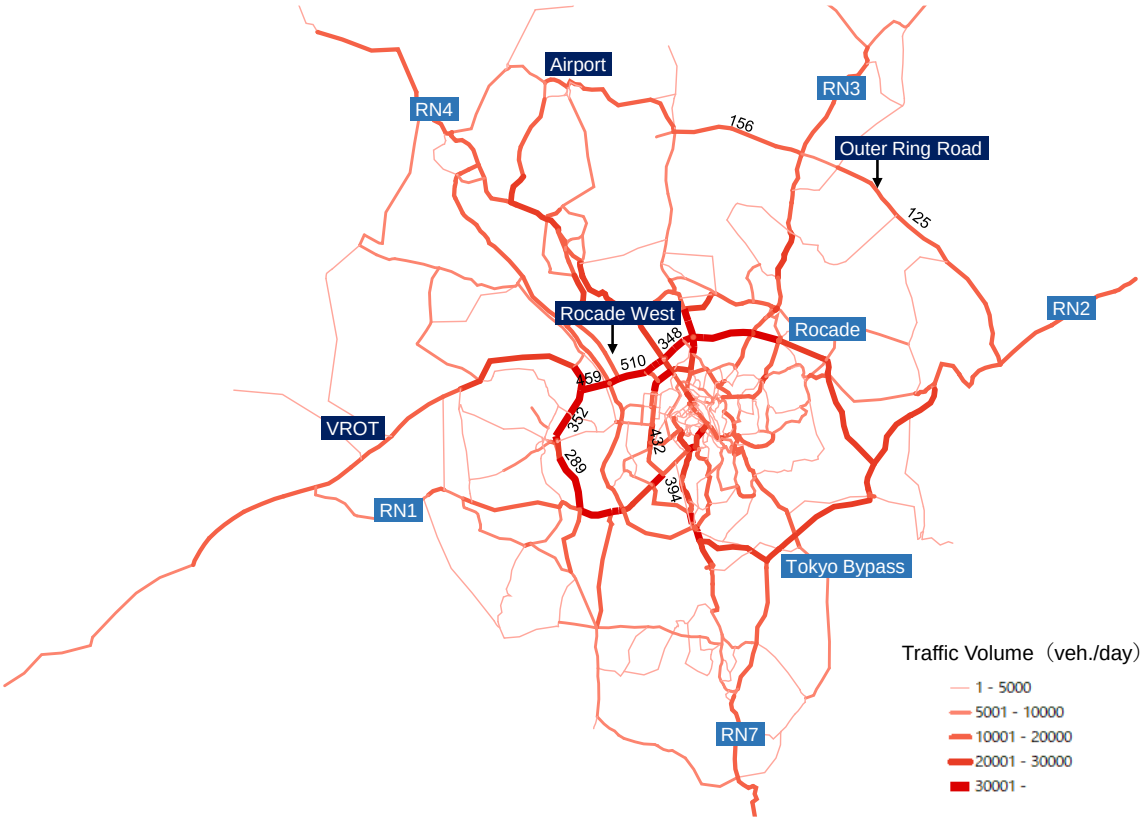
- It is assumed that the Intermediate Ring Road will have a high ring road function with a traffic volume of approximately 20,000 vehicles/day or more from the time it is put into service (short-term: 10 years). On the other hand, the Outer Ring Road is expected to have a traffic volume of approximately 10,000 vehicles/day in the mid-term (20 years) or later, when land use will be developed in the Outer Ring Road (Table 6-24).

- The north-south trunk road was calculated as an upper and lower multi-level structure, resulting in a short-term result of over 30,000 vehicles/day and a medium-term result of over 60,000 vehicles/day (Table 6-24).



Source: JICA Study Team

Figure 6-29 Result of Traffic Demand Forecast
(Upper:Short-Term 2033, Under:Medium-Term2043)



Source: JICA Study Team

Figure 6-30 Result of Traffic Demand Forecast (Long-Term 2053)

Table 6-24 Future Traffic Volumes for the Seven Projects (Weighted average)

Road	Section	Project	Short (2033)	Medium (2043)	Long (2053)
Intermediate Ring Road	Ankorondrano～Maki	A-R-03/04	24,200	35,800	39,200
	Maki～VROT	A-R-01/03	11,300	36,700	45.900
	VROT～Itaosy～RN1	A-R-01/02	10,100	17,300	29,400
Outer Ring Road	Airport Access～RN3	A-R-05	-	13,400	15,600
	RN3～RN2	A-R-06	-	8,600	11,200
North-South Trunk Road	Ankorondrano～RN1	A-R-10	-	31,700	39,000
	RN1～Tanjobato		-	24,000	30,100

Source: JICA Study Team

6.6 Analysis of Development Effects of Road Projects

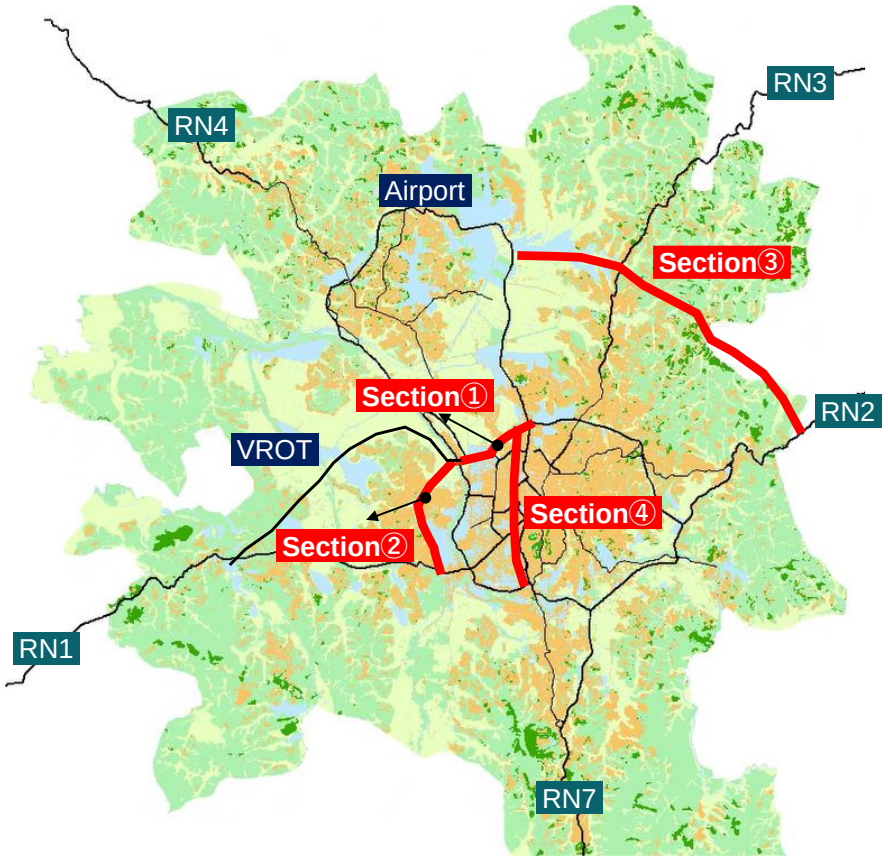
6.6.1. Target Sections of Development Effect Analysis

The target sections for analysis of development effects are shown in Table 6-25 and Figure 6-31.

Table 6-25 Target Sections for Evaluation

Road	Section	Length (km)	Target road projects
Intermediate Ring Road	Section 1 (Ankorondrano – VROT)	4.3 km	A-R-01/A-R-03/ A-R-04
	Section 2 (VROT - RN1)	4.7 km	A-R-01/ A-R-02
Outer Ring Road	Section 3 (Airport Access - RN3 - R2)	17.0 km	A-R-01
North-South Trunk Road	Section 4 (Ankorondrano – Tanjobato)	7.5 km	A-R-02

Source: JICA Study Team



Source: JICA Study Team

Figure 6-31 Target Sections for Evaluation of Development Effects

6.6.2. Evaluation Indicators and Calculation Methods

Five (5) indicators were used to gauge the development impact of the target sections. These five indicators shown in Table 6-26 are under three development effects namely: traffic congestion reduction effect, economic effect, and environmental impact effect. Each indicator was calculated based on the difference between the presence (with) and absence (without) of the relevant section, using the results of the traffic demand forecast (Year 2043).

Table 6-26 Evaluation Indicators

Development Effect	Indicator
Traffic congestion reduction effect	Travel time reduction (hours/year)
Economic effect	Travel time reduction benefits (USD/year)
	Running cost reduction benefit (USD/year)
Environmental improvement effects	NOx (ton/day)
	CO2 (ton-c/day)

Source: JICA Study Team

6.6.3. Evaluation Results

All the evaluation sections exhibit positive development effects as shown in Table 6-27. However, the Ankorondrano to VROT section (Section 1) of the central ring road has the highest effect in terms of traffic congestion reduction effect, economic effect and environmental improvement effect. Even if the development effects are divided into per kilometer as presented in Table 6-28 and illustrated in Figure 6-32, the Section 1 still possesses the highest development effect and followed by Section 4.

Table 6-27 Result of Evaluation Effects

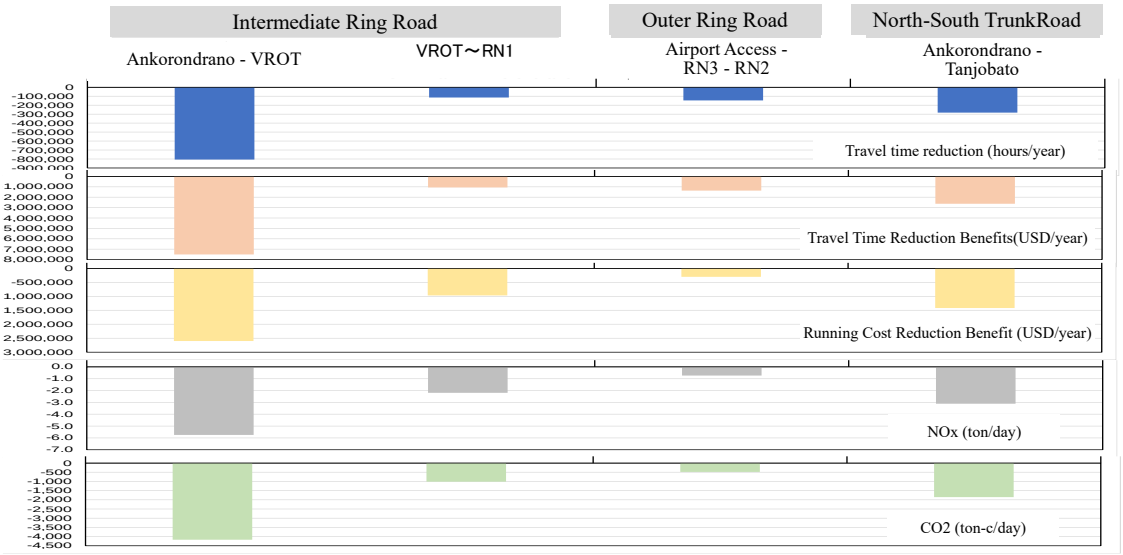
Developmental Effect	Indicator	Intermediate Ring Road		Outer Ring Road	North-South Trunk Road
		Section 1 (Ankorondrano – VROT)	Section 2 (VROT - RN1)	Section 3 (Airport Access - RN3 - RN2)	Section 4 (Ankorondrano - Tanjobato)
Traffic congestion reduction effect	Travel time reduction (hours/year)	-3,468,576	-537,960	-2,489,640	-2,120,592
Economic effect	Travel Time Reduction Benefit (USD/year)	32,283,814	5,007,148	23,172,419	19,737,674
	Running cost reduction benefit (USD/year)	11,178,869	4,541,471	5,095,878	10,640,772
Environmental improvement effect	NOx (ton/day)	-24,725	-10,302	-12,488	-23,341
	CO2 (ton-c/day)	-17,931	-4,759	-8,185	-13,879

Source: JICA Study Team

Table 6-28 Results of Evaluation Effects (per km)

Developmental Effect	Indicator	Intermediate Ring Road		Outer Ring Road	North-South Trunk Road
		Section 1 (Ankorondrano – VROT)	Section 2 (VROT - RN1)	Section 3 (Airport Access - RN3 - RN2)	Section 4 (Ankorondrano - Tanjobato)
Traffic congestion reduction effect	Travel time reduction (hours/year)	-806,646	-114,460	-146,449	-282,746
Economic effect	Travel time reduction benefit (USD/ year)	7,507,864	1,065,351	1,363,083	2,631,690
	Running cost reduction benefit (USD/year)	2,599,737	966,270	299,758	1,418,770
Environmental improvement effect	NOx (ton/day)	-5,750	-2,192	-735	-3,112
	CO2 (ton-c/day)	-4,170	-1,013	-481	-1,851

Source: JICA Study Team



Source: JICA Study Team

Figure 6-32 Illustration of Evaluation Effects per km

6.6.4. Other Development Effects

Other development effects of the four (4) sections were assessed using qualitative analysis taking into account their contribution in enhancing traffic function. Some of the evaluation items can be analyzed quantitatively, but since there are clear differences in the character of the four (4) sections in this study, it was decided to limit the evaluation into qualitative. The assumed year in assessing traffic function is set to the Medium Term (Year 2043).

In the future, all the road segments are expected to play an important role in enhancing transportation in the urban area. It is evaluated that the Intermediate Ring Road (Sections 1 and 2), located in an area that is expected to be urbanized in the short to medium term, is expected to

perform a variety of road functions. In particular, the development effect of the Ankorondrano - VROT section can be considered to be high as shown in Table 6-29. However, in order to realize its functions, consideration should be given to traffic function (fast moving vehicles) over access function (no limit and any vehicle can use it although some are very slow moving hence it affect the function of the road; and many access roads connected to it).

Table 6-29 Evaluation from the Viewpoint of Traffic Function Performance

Developmental Effect	Intermediate Ring Road		Outer Ring Road	North-South Trunk Road
	Section 1 (Ankorondrano – VROT)	Section 2 (VROT - RN1)	Section 3 (Airport Access - RN3 - RN2)	Section 4 (Ankorondrano - Tanjobato)
Contribution in facilitating the introduction of core Public Transport (BRT)	✓✓✓ High contribution	✓✓✓ High contribution	✓ Low contribution due to the fact that the location is in suburban area.	✓✓✓ High contribution
Promote relocation and consolidation of logistics facilities to suburban areas	✓✓ Medium: Logistics facilities around Ankorondrano might be tempted to build logistics facilities outside the city due to improved access to the city core	—	✓✓✓ High: It will trigger development of logistics industry in the area just like what occurred at Tokyo Bypass. This was confirmed during interview with logistics actors	—
Reduction in the number of vehicles passing through the city center	✓✓✓ High: The function of the intermediate ring road is demonstrated.	✓✓ Medium: The function of the intermediate ring road is performed, but part of the road passes within the existing urban area.	✓✓ Medium: In the assumed year, the outer ring road will only partially form a network, and its function will be limited.	—
Improved access to central and sub-centers of Antananarivo	✓✓✓ High: VROT - Intermediate Ring Road will be connected to improve access between the new city and the existing city center.	✓✓ Medium: Improved access between Itaosy district and existing downtown area	—	✓✓✓ High: Improved access between Ankorondrano - City center - Tanjobato
Improved accessibility to areas with inconvenient transportation	✓✓✓ High: Improved access to area beyond RN4	✓✓✓ High: Improved access to Itaosy district	✓✓✓ High: Function as a core road in undeveloped areas	—
Secure emergency transportation routes	✓✓✓ High: Due to high density surroundings which necessitate good emergency routes during calamities	✓✓✓ High: Due to high density surroundings which necessitate good emergency routes during calamities	✓✓ Medium: Due to low density in the area (suburb are)	✓✓✓ High: Due to high density surroundings which necessitate good emergency routes during calamities

Source: JICA Study Team Legend: ✓=Low, ✓✓=Medium, ✓✓✓=High

6.6.5. Overall Evaluation from Road Traffic Function

A comprehensive evaluation was conducted based on the future traffic demand, quantitative development effects, and road traffic functions assessed up to the previous section. Although the weight of each item is not considered, it can be concluded that the development effect of the Ankorondrano to VROT section of the intermediate ring road is high. And from the perspective of road traffic function, it has a high development effects over the others.

Table 6-30 Evaluation from the Perspective of Road Traffic Function

Developmental effect		Intermediate Ring Road		Outer Ring Road	North-South Trunk Road
		Ankorondrano- - VROT	VROT - RN1	Airport Access - RN3- -RN2	Ankorondrano ～Tanjobato
Future traffic demand	Medium-term traffic （2043）	✓✓✓	✓✓	✓	✓✓✓
Traffic congestion reduction effect	Travel time reduction (hours/year)	✓✓✓	✓	✓	✓✓
Economic effect	Travel time reduction benefits (USD/year)	✓✓✓	✓	✓	✓✓
	Running cost reduction benefit (USD/year)	✓✓✓	✓	✓	✓✓
Environmental improvement effects	NOx (ton/day)	✓✓✓	✓	✓	✓✓
	CO2 (ton-c/day)	✓✓✓	✓	✓	✓✓
Road traffic functions	Creation of space for the introduction of core Public Transport (BRT)	✓✓✓	✓✓✓	✓	✓✓✓
	Promote relocation and consolidation of logistics facilities to suburban areas	✓✓	—	✓✓✓	—
	Reduction in the flow of passing vehicles into the city center	✓✓✓	✓✓	✓✓	—
	Improving access to the city center and sub-center areas	✓✓✓	✓✓	—	✓✓✓
	Improved accessibility in areas with inconvenient transportation	✓✓✓	✓✓✓	✓✓✓	—
	Secure emergency transportation routes	✓✓✓	✓✓✓	✓✓	✓✓✓
Comprehensive evaluation		✓✓✓	✓✓	✓	✓✓

Source: JICA Study Team Legend: ✓=Low, ✓✓=Medium, ✓✓✓=High