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# **Development of a Road Transport Sustainability Plan for Namibia**

## **Final Report**

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Prepared by the Texas A&M Transportation Institute

Prepared for the Roads Authority of Namibia

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## **ACKNOWLEDGMENTS**

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## **BACKGROUND AND INTRODUCTION**

The Texas A&M Transportation Institute (TTI), a research agency that is a part of The Texas A&M University System, was contracted by the Roads Authority (RA) of Namibia to facilitate the development of a Road Transport Sustainability Plan. The sustainability plan will assist Namibia in addressing a broad range of transportation issues in a strategic manner. The goals of the project included the following:

- Train the staff of Namibia's Technology Transfer Centre (T2) and key members of the Road Authority on transportation, sustainability, and planning-related topics;
- Develop a Sustainability Plan for Namibia's Road Transport Sector that incorporates the goals of the National Development Plan of Namibia and the needs of key stakeholders; and
- Put Namibia in a leadership position with regard to the development and implementation of sustainable transportation plans.

This project included a literature review investigating existing transportation plans and broad development plans for Namibia, as well as training for T2 Centre staff by TTI on key topics, including those related to transport and sustainability.

Following this, a workshop facilitated by TTI staff was held in Windhoek, Namibia with key stakeholders to explain the project and approach, to solicit goals, objectives, and possible performance measures from the participants. TTI staff then used the background research and output from the workshop to develop a draft sustainability plan, which was presented to stakeholders for comment.

This report provides a summary of work performed in this project, including background research and other activities conducted. The Sustainability Plan developed as part of this project is submitted as a separate document.

## PROJECT KICK-OFF ACTIVITIES

The project was officially kicked-off in November 2013 with a 10-day visit from three Roads Authority staff members (who also have joint appointments with the T2 Centre) to the TTI offices in College Station, Texas, and Austin, Texas. The purpose of the trip was to train the T2 staff on transportation, sustainability, and planning-related topics. The trip was an opportunity for the T2 staff to learn about TTI's ongoing research and identify areas that could be applied and implemented in Namibia.

The agenda for this visit was developed by TTI based on input from Roads Authority/T2 staff regarding subjects of interest. The agenda included meetings and training with a wide range of TTI and Texas A&M University researchers showcasing research projects, products, and services. Some visits also included interaction with Texas Department of Transportation (TxDOT) staff. These meetings provided insight and knowledge that the T2 staff can disseminate to the Roads Authority staff through their resource centre. The meetings, presentations, and study tours conducted during the visit are listed below, along with names of the relevant technical experts:

- Overview of TTI and Research Capabilities with TTI's Director (Dennis Christiansen) and Planning and Environment Executive Associate Director (Katie Turnbull);
- Briefing on Sustainability and Environmental Research (Joe Zietsman);
- Tour of TTI's Environmental Laboratories (Jeremy Johnson and Jett McFalls);
- Tour of TTI Library Facilities ( Hong Yu);
- Tour of Texas A&M University Libraries (Sandy Tucker);
- Tour of McNew Lab, Materials and Pavement Division (Stephen Sebesta);
- Crash Testing Informational (Dean Alberson);
- Safety Research in the USA (Karen Dixon);
- Pedestrian Treatments (Kay Fitzpatrick);
- Pavement Research (Jon Epps);
- Planning and Traffic Engineering (Reza Farzaneh);
- Weigh-in-Motion and Traffic Data Collection (Bill Knowles and Catherine Wolff, TxDOT); and
- Public-Private Partnerships, Tolling, and Innovative Finance (Jolanda Prozzi, TTI and Dieter Billek, TxDOT).

### **Sustainability Workshop and Training**

In conjunction with the visit, TTI's Environment and Air Quality Division staff conducted a two-day workshop focused on providing sustainability training to T2 staff. TTI developed customised training materials for the Roads Authority and covered the following topics in the training:

- 1) sustainability and sustainable transportation;
- 2) strategic planning;
- 3) performance measurement;
- 4) transportation and the environment;
- 5) the *Guidebook for Sustainability Performance Measurement for Transportation Agencies* developed by TTI; and
- 6) FHWA's INVEST tool.

As part of this training workshop, specific needs and an approach to the development of the Road Transport Sustainability Plan were also discussed in order to enable the TTI staff to prepare appropriately for the plan development, including the stakeholder workshop. The preparations for the sustainability plan development, including relevant activities conducted during the sustainability training sessions, are discussed in the next chapter.

## **PREPARATION FOR SUSTAINABILITY PLAN DEVELOPMENT**

### **Overview**

As mentioned in the previous chapter, the preparations for the sustainability plan development were initiated as part of the sustainability training sessions conducted in November 2013. The overall approach to the development of a sustainability plan is based on the *Guidebook for Sustainability Performance Measurement for Transportation Agencies* that was developed by TTI as part of a research project under the National Cooperative Highway Research Program (NCHRP).

Additionally, a literature review was also performed by the TTI team (see Appendix A) to gather background information and understand the overall context in which the sustainability plan is being developed.

T2 staff received training on how to develop performance measures, goals, and objectives for a Namibian context. The T2 staff then participated in an exercise to develop a sustainability mission statement for the Roads Authority of Namibia and to identify key needs for Namibia's road transport sector.

In a process facilitated by TTI, the T2 staff noted challenges and key transport sector needs relevant to Namibia, and then outlined a sustainability statement and developed a sustainability plan outline for a Namibian context. T2 staff formulated a set of goals for the sustainability plan that highlight the key needs for Namibia.

The staff then used an Excel®-based spreadsheet tool that is part of the *Guidebook for Sustainability Performance Measurement for Transportation Agencies* (NCHRP Guidebook) to select key objectives and performance measures that are relevant to Namibia. This list of objectives and measures (see Appendix B) can serve as a compendium of possible options for participants at the workshop in Windhoek to use as a starting point for selecting objectives and performance measures. Finally, the T2 and TTI staff discussed the format for the stakeholder workshop in Windhoek and developed a preliminary plan and list of potential invitees.

The remainder of this chapter summarises the outcome of the sustainability workshop and training, including an assessment of the transportation needs in Namibia, the sustainability statement developed, and the preparations made for the stakeholder workshop.

### **Assessment of Namibia's Road Transport Sector Needs and Related Issues**

During the training sessions, T2 staff provided an overview of the political, social, and economic outlook in Namibia, which led to discussions on Namibia's broad needs for its transport sector. The T2 staff identified needs that could be included in the sustainability plan. These broad needs and overall context were considered when the staff worked on developing broad goals for the transport sector and described below:

- *Accessibility*: Improve access in rural areas so that communities have access to basic services such as schools, clinics, and jobs. There is also the possibility of building more roads/broadening network connectivity by using alternative materials to build cheaper roads. Another issue faced in Namibia is the development of rural communities along roads, which sometimes hinder mobility. The roadway network needs to be preserved for mobility.
- *Equity*: Improve distribution of resources between the northern and southern regions of Namibia. The northern region has not received as much development resources compared to the southern trading hubs.
- *Technological Innovation*: Advancing technology innovation with stabilisers. There is an interest to understand how to use, test, and verify them. There is a large market to make use of these products in Namibia.
- *Safety*: Improve safety for pedestrians and on the roadways.
  - Gravel roads can be treacherous and some drivers are unaware how to drive on these types of roads.
  - Borrow pits near the roadway left after construction cause a safety hazard.
  - Effectively use existing data and/or improve data collecting methods on roadway accidents through a road safety study. The current data do not show locations of accidents and more quality data are needed.
  - Improve pedestrian safety in urban areas. Currently there are no bike lanes or sidewalks in the centre of Windhoek.
- *Multimodal*: Focus on multimodal needs specifically railways and roadways.
  - Recently passed new legislation to ensure that heavy loads on roadways adequately pay for damage caused to roadways.
  - Railways are inefficient, slow, and not well-connected.
- *Innovative Financing*: Examine multiple financing opportunities
  - Toll roads may be difficult to enforce and are not feasible – ‘shadow tolling’ or other concepts may be more applicable.
  - Public-Private Partnerships could provide an opportunity for improvement of weigh bridge operations. Currently, weigh stations close at night and trucks can avoid paying by traveling at night. Also, the weigh bridges are often out of the way of major corridors.
  - Improve pricing of construction products, for example, determine baseline pricing/quotes.
  - Bribery is sometimes an issue when it comes to financing and road construction.
- *Traffic Congestion*: Focus on congested areas that occur in Windhoek. Congestion also occurs in the northern region because limited access to popular travel/holiday destinations.
- *Funding and Legislation*: Roads Authority Act stipulates that funds should only be spent on roads that are economically feasible. Funds collected by Roads Authority from permits/licenses/cross border fees are given to the Road Fund Administration (RFA).

- Fuel tax/levies (by a private company) are not increased often and are a fixed percentage. Fluctuating fuel prices (closely tied with South Africa) impacts the fuel taxes collected
- Each division request funds from RFA, and they decide budget (which is on a 5-year rolling basis).
- *Environmental Issues*: Environmental concern focused on health and climate change.
  - Environmental Act stipulates that roads have to look at environmental impacts (especially wetlands and endangered species).
  - Assistance is needed in case of flooding/extreme weather. The Ministry of Environment is focusing on CO<sub>2</sub> emissions, as climate change poses threat of increased drought and flooding in rural areas.
  - Flooding causes erosion, and there is an interest in erosion control near roadways.
- *Economic Development*:
  - Job creation is an important aspect of economic development. Roadway projects are required to employ a percentage from the local area.
  - Equitable distribution of benefits is also a concern; Namibia has one of the highest inequality rates (based on the Gini coefficient).

### **Sustainability Statement and Sustainability Plan Outline**

The Sustainability Statement developed by T2 staff during the workshop is as follows:

*The Road Authority strives to achieve sustainability by providing a safe and efficient national road network, which supports economic growth and ensures access for all while preserving the environment for current and future generations.*

TTI and T2 staff first discussed a draft outline for the sustainability plan.

#### *Sustainability Plan Outline*

##### 1) Introduction:

- Describes the purpose, approach, and context of the plan and the importance and motivation behind it.
- Describes how the sustainability plan relates to Namibia's National Development Plan.
- Outlines how key stakeholders are involved in the development of the plan through the stakeholder workshop.

- 2) Sustainability in Namibia:
  - Describes Namibia's current approach to sustainability (overall, in all sectors) and outlines how the sustainability plan relates to Namibia's transport sector.
- 3) Sustainability Approach for Road Transport:
  - Defines sustainability in transport context and describes the sustainability statement developed for the Roads Authority.
  - Outlines the key needs/opportunities for Namibia's transport sector.
  - Defines the goals of the sustainability plan that are developed during the stakeholder workshop with input from participants.
  - Outlines the relevant objectives and performance measures for each goal.
- 4) Application of the Sustainability Plan:
  - Describes how the plan can be applied in Namibia, for example, through a scorecard to track goals or through established benchmarks that need to be met on a yearly basis.
- 5) Implementation:
  - Outlines how the sustainability plan will be implemented through a phased approach, based on input from T2 staff and other stakeholders.

### **Transport Sustainability Goals for Namibia**

During training in College Station, the T2 staff reviewed the goals developed in the NCHRP guidebook and reviewed the transportation needs identified previously, in order to develop sustainability goals for a Namibia context. T2 staff identified the following as possible goals/sub-goals for the Namibian sustainability plan.

- I. Safety.
  - a. Reduce road accidents (vehicles, animals, pedestrians, during construction).
  - b. Consider pedestrians and animals during planning phase.
  - c. Promote HIV/AIDS awareness along transportation corridors (during construction and operation).
- II. Economic Viability.
  - a. Efficient use of funds (avoiding bribes, address priorities, be consistent with the master plan).
  - b. Innovative financing.
- III. Accessibility/Equity.
  - a. Improve access to basic services (health, schools).
  - b. Improve economic opportunities (access to markets).
  - c. Promote multimodal transportation.
  - d. Promote equitable development/construction/maintenance of roads between Northern and Southern regions.

- IV. Ecosystems.
  - a. Preservation of natural environment.
  - b. Develop product standards to preserve natural resources.
- V. Resource/Material Consumption.
  - a. Promote use of alternative materials/innovative products to construct roads.
- VI. System Efficiency.
  - a. Promote multimodal transportation (freight).
  - b. Implement strategic planning of weigh bridge operations and enforcement of overload control.

### **Preparation for Stakeholder Workshop in Windhoek**

The workshop was planned to occur during the inauguration of the T2 centre. A half-day workshop in the afternoon following the inauguration was planned, followed by a full-day session the next day. It was planned that the TTI team would then work with T2 staff to draft a plan to be circulated for final comment and feedback.

During the training session with T2 staff, a list of potential workshop participant/stakeholders was developed. T2 staff discussed important transportation stakeholder groups that would provide valuable insight and input into the sustainability plan. Below is a list of organisations identified as potential participants:

- The Roads Authority: including representation from each division, high-level executives, regional engineers, and the Roads Board;
- City of Windhoek;
- Polytechnic of Namibia;
- University of Namibia;
- Ministry of Works and Transport;
- Ministry of Environment and Tourism;
- National Road Safety Council;
- Motor Vehicle Accident Fund;
- Road Fund Administration;
- Namibian Police (NAMPOL);
- Association of Southern African National Road Agencies (ASANRA);
- National Planning Commission;
- Walvis Bay Corridor Group; and
- Trans-Kalahari Corridor Group.

The TTI team worked with T2 staff to finalise the schedule, agenda, and invitees for the stakeholder workshop. The outcome of the workshop, plan development, and concluding remarks are provided in the following chapter.

## CONCLUDING REMARKS

Based on the background material and preliminary activities discussed in this report, a stakeholder workshop session was held March 3–4, 2014. The finalised agenda for this workshop, held in Windhoek in Namibia, was as follows:

### **Part 1: Monday, March 3**

- 2.00 p.m.–2.10 p.m. Welcome and Introductions
- 2.10 p.m.–2.40 p.m. Overview of TTI
- 2.40 p.m.–3. 10 p.m. Overview of Project
- 3.10 p.m.–3.40 p.m. Workshop Outline and Introduction to Key Concepts
- 3.40 p.m.–4.20 p.m. Facilitated Discussion of Key Needs and Issues
- 4.20 p.m.–4.30 p.m. Closure

### **Part 2: Tuesday, March 4**

- 9.00 a.m.–9.15 a.m. Introduction
- 9.15 a.m.–9.45 a.m. Report Back on Needs and Associated Goals
- 9.45 a.m.–10.30 a.m. Development of a Sustainability Statement
- 10.30 a.m.–10.45 a.m. Break
- 10.45 a.m.–12.15 p.m. Breakout Sessions – Prioritising Goals and Identifying Actions
- 12.15 p.m. – 12.30 p.m. Briefing for Afternoon Session
- 12.30 p.m.–2.00 p.m. Lunch
- 2.00 p.m.–2.15 p.m. Presentation of Goals and Actions
- 2.15 p.m.–3.15 p.m. Group Discussion to Identify Measures
- 3.15 p.m.–3.30 p.m. Break
- 3.30 p.m.–4.15 p.m. Group Discussion on Application of Plan
- 4.15 p.m.–4.30 p.m. Wrap-Up

The workshop enabled the development of a draft sustainability plan, which was circulated to the stakeholder group for further feedback and comments. The finalised version of the sustainability plan, which includes recommendations for implementation and key actions, is submitted as a separate document accompanying this report.

## APPENDIX A – LITERATURE REVIEW

*Note – this literature review was originally submitted to the Roads Authority as a Task 1 deliverable for use as background information in development of the sustainability plan. A slightly modified version is included in this Appendix, incorporating comments received on the original draft.*

### Introduction to Sustainability and Sustainable Transportation

The most common definition of sustainable development is ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs.’ Sustainability can be understood as the end state achieved through the process of sustainable development. It is generally discussed in the context of balancing environmental, economic, and social aspects (which are often termed as the dimensions or pillars of sustainability), as shown in Figure 1.

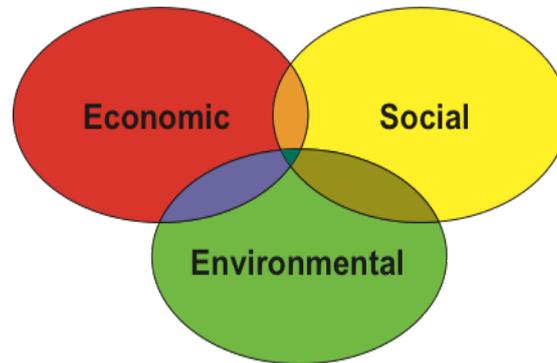


Figure 1. Sustainability Dimensions.

The TTI team has previously developed a guidebook titled *Sustainability Performance Measurement for Transportation Agencies* as part of the National Cooperative Highway Research Program in the United States. In this work, the principles of sustainability were further elaborated as follows:

*Sustainability entails meeting human needs for the present and future, while:*

- *preserving and restoring environmental and ecological systems;*
- *fostering community health and vitality;*
- *promoting economic development and prosperity; and*
- *ensuring equity between and among population groups and over generations.<sup>1</sup>*

<sup>1</sup> National Cooperative Highway Research Program. A Guidebook for Sustainability Performance Measurement for Transportation Agencies. NCHRP Report 708. 2011.

These principles of sustainability not only reflect the three dimensions (economic, social, and environmental) but also incorporate equity and human needs. Figure 2 shows a visual illustration of the sustainability principles and emphasises the role of equity in reinforcing the other dimensions of sustainability.

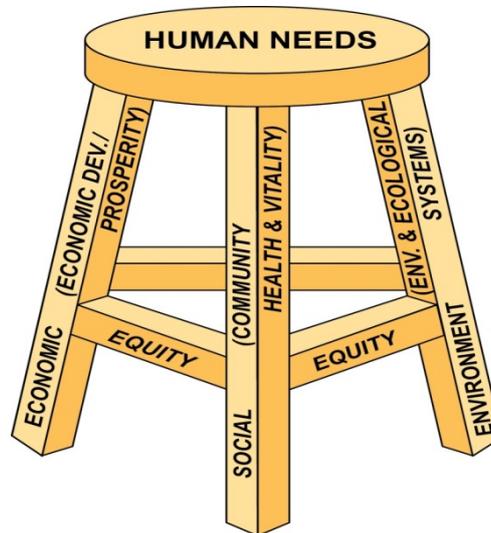


Figure 2. Illustration of Sustainability Principles.

Sustainable transportation can be understood as the expression of sustainable development in the transport sector. For example, sustainable transportation may be defined as the provision of safe, effective, and efficient access and mobility into the future while considering economic, social, and environmental needs.

Sustainable transportation has become increasingly important in recent years and has emerged as a major global issue. It was highlighted by the recent United Nations Conference on sustainable development (Rio +20), where multi-lateral development banks pledged \$175 billion for sustainable transportation projects. By developing a sustainable transportation plan and addressing the issue of sustainability in the transport sector, Namibia can not only position itself to address a broad range of transportation issues in a strategic manner, but also take advantage of international funding opportunities for sustainable transportation projects, and emerge as a leader in Africa with regard to sustainable transportation.

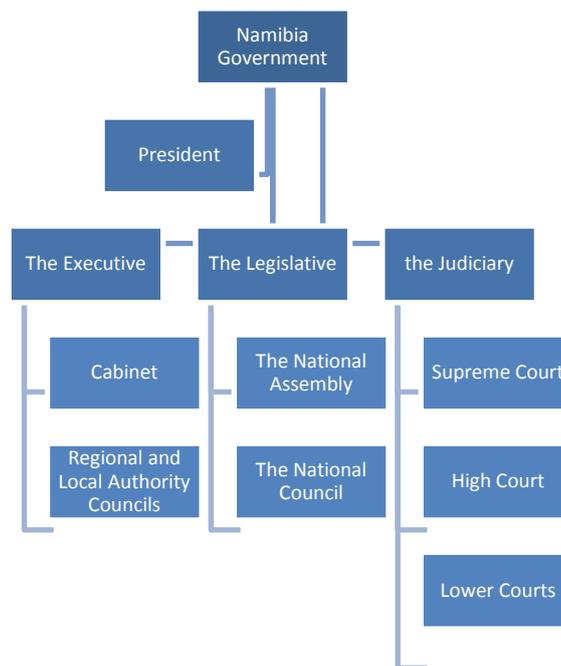
### Overview of Namibia's Transport System

Namibia's position along the coast and location in Southern Africa provides key transportation links for interior landlocked African countries. Namibia's transport system links several Southern African countries including three landlocked countries (Botswana, Zimbabwe, and Zambia). Namibia serves as a key trade route for moving goods from ports throughout Southern Africa. Namibia's transport sector including freight and its ports serves as a vital resource for moving goods throughout the continent.

According to Namibia's Fourth National Development Plan, Namibia's infrastructure is in good condition including the national transportation infrastructure, electricity distribution lines, dams, telecommunications, and mobile communication infrastructure. However, Namibia faces challenges in maintaining and improving infrastructure as its infrastructure revenue levels are not at the level of finance needed for growth and maintenance needs.<sup>2</sup> Namibia's transport sector faces other hurdles such as a growing population, high accident numbers, limited extent of network, and limited transportation planning.<sup>3</sup>

### Transport Stakeholders

There are several stakeholders involved in the transport sector including government ministries, government agencies, regional and local government, legislative and judiciary, and state-owned enterprises, such as Roads Authority (RA), Road Fund Administration (RFA), and Roads Contractor Company (RCC).<sup>4</sup> The Namibian government has three branches: executive, legislative, and judiciary with the president presiding over all branches, shown in Figure 3.<sup>4</sup>



**Figure 3. Namibia Government Structure.**

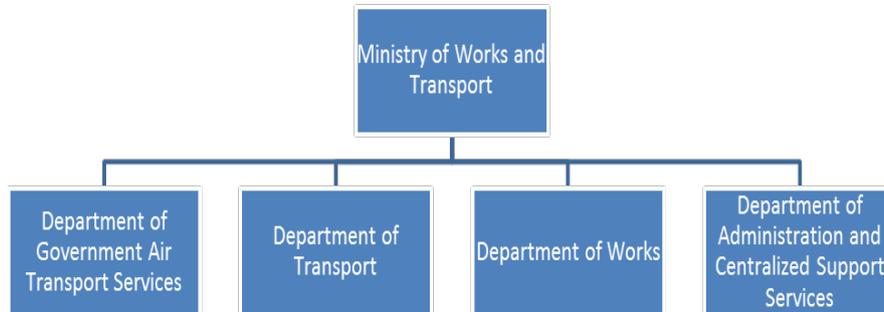
Within the executive cabinet are Government Ministries, which are responsible for various government services. The Namibia Ministry of Works and Transport's mission is to 'provide world class, innovative, sustainable, and accessible support to motor

<sup>2</sup> Namibia's Fourth National Development Plan.

<sup>3</sup> Sustainable Urban Transport Master Plan for Windhoek, Background and Objective, at: <http://movewindhoek.com.na/content/background-and-objective>.

<sup>4</sup> Government of Namibia, at: <http://www.gov.na/en/gov-links>.

vehicle accident victims, and to contribute to accident prevention with passionate employees, business partners, and enabling technologies.’<sup>5</sup> The Ministry of Works and Transport is comprised of four departments, shown in Figure 4.



**Figure 4. Ministry of Works and Transport Departments.**

Source: Adapted from <http://209.88.21.36/opencms/opencms/grnnet/MWTC/Departments/>

In 1999, three State-Owned Enterprises (the Roads Authority, Road Fund Administration, and Roads Contractor Company) were established to assist the Ministry of Works and Transport in carrying out functions relating to the control of the national road network.

The Ministry of Environment and Tourism is another important stakeholder relevant for this project. The main functions of the Ministry include:

- promoting sustainable development;
- protecting biological diversity;
- improving environmental awareness;
- encouraging democratic environmental planning and management; and
- involving Namibia in regional and global environmental issues, programs, and treaties.<sup>6</sup>

Since the sustainability plan developed under this project will address many of these functions, the Ministry of Environment and Tourism could be an important stakeholder in implementing various goals and objectives that are developed during the stakeholder workshop.

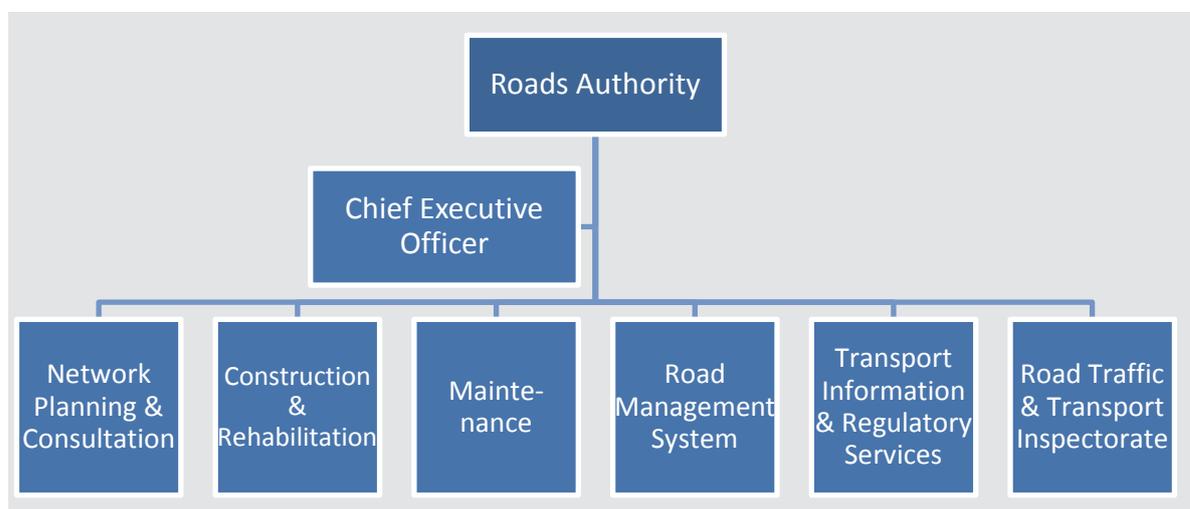
<sup>5</sup> Ministry of Works and Transport, at: <http://209.88.21.36/opencms/opencms/grnnet/MWTC/entities.html>.

<sup>6</sup> Ministry of Environment and Tourism. <http://www.met.gov.na/Directorates/EnviroAffairs/Pages/DEAMainPage.aspx>.

### Roads Authority

The Roads Authority Act of 1999 established the Roads Authority and gave the newly created organisation the responsibility of managing of the national road network such as the planning, construction, and maintenance of all national roads.<sup>7</sup>

The Roads Authority's core function is to construct and maintain Namibia's road sector through the growth and expansion of the road network and infrastructure. The Roads Authority is divided into six technical divisions, shown in Figure 5, as well as various other sections that provide the Authority with administrative support.<sup>8</sup> The Roads Authority mission is 'to manage a safe and efficient national road network to support economic growth' and the vision is 'to be a sustainable road sector that is ahead of national and regional socio-economic needs in pursuit of Namibia's Vision 2030.'<sup>9</sup>



**Figure 5. Roads Authority Organisation Chart.**

The Roads Authority and the Road Fund Administration use a Road Management System (RMS), which is an integrated management framework for the management of the road network. The development of the RMS was included in the Roads Authority Act of 1999. The purpose of the RMS is to identify needs, quantify needs, prioritise needs; and assist in planning and management of the road network.<sup>10</sup> Many road management sub-systems are included in Namibia's RMS such as the road referencing system, information management and control system, traffic surveillance system, maintenance management system, and geographical information system as well as many others.

<sup>7</sup> Roads Authority Act. 1999.

<sup>8</sup> Roads Authority, Safe Roads to Prosperity, About, at: <http://www.gov.na/en/gov-links>

<sup>9</sup> Roads Authority.

[http://www.ra.org.na/index.php?option=com\\_content&view=article&id=2&Itemid=3](http://www.ra.org.na/index.php?option=com_content&view=article&id=2&Itemid=3).

<sup>10</sup> Sustainable Asset Management- Namibia Road Sector.

### *Roads Authority Strategic Plan, 2012–2015*

The Roads Authority has periodically developed strategic plans with objectives for each division within the organisation. The strategic plan for 2008–2010 included a three-year timeframe with strategic goals, strategies, measurable outputs, and action plans; the first strategic goal was to provide a safe, sustainable, and efficient management of the national road network and directly relates to the purpose of the research project.<sup>11</sup>

To develop the strategic plan for 2012–2015, the Roads Authority used a balanced scorecard strategic planning methodology. This strategic plan outlines a framework for the Roads Authority to focus on 13 strategic objectives within two themes: Governance and Leadership, and Manage the Road Network. Some of the strategic objectives listed in the plan that could be relevant to the sustainability plan include those related to assuring a safe road network, managing traffic and transportation operations, and managing road infrastructure. Furthermore, the strategic plan outlines an analysis on the strengths, weaknesses, opportunities, and threats of the organisation. Within the threats section, environmental damage and climatic conditions are listed, which also have relevance to the sustainability plan being developed in this project.

### *Road Fund Administration*

The Road Fund Administration is responsible for managing the funding of transportation projects and programs through a road user charging system and a road fund. The Road Fund Administration allocates funds to projects that sustain and improve the national road network and major urban arterials. It also funds projects that maintain urban roads, traffic information, safety, research, and law enforcement.<sup>12</sup> Types of road user charges include:

- vehicle registration and annual license fees for vehicles registered in Namibia;
- fuel taxes for travel on public roads;
- entry fees on foreign registered vehicles;
- abnormal load fees;
- mass distance charges based on traveling distance, mass and dimensions and vehicle configuration; and,
- fines for damage to roads.<sup>13</sup>

### *Roads Contractor Company*

The Roads Contractor Company's responsibilities include constructing and maintaining any of the roads. Construction work includes building, bridges, dams, tunnels, canals, reservoirs, and railway infrastructure. The road maintenance includes the construction of gravel, bitumen, and salt roads, and improvement on paved

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<sup>11</sup> Roads Authority Strategic Plan, 2008–2010.

<sup>12</sup> Road Fund Administration. <http://www.rfanam.com.na/index.html>.

<sup>13</sup> Sustainable Asset Management- Namibia Road Sector.

roads.<sup>14</sup> Figure 6 shows the relationship between the three state-owned enterprises, as outlined in the Namibia Road Sector Sustainable Asset Management document. While the figure provides a useful overview of relationship between the three entities, it does not provide the full picture in terms of projects funded through channels other than road user charges (such as GRN funds).

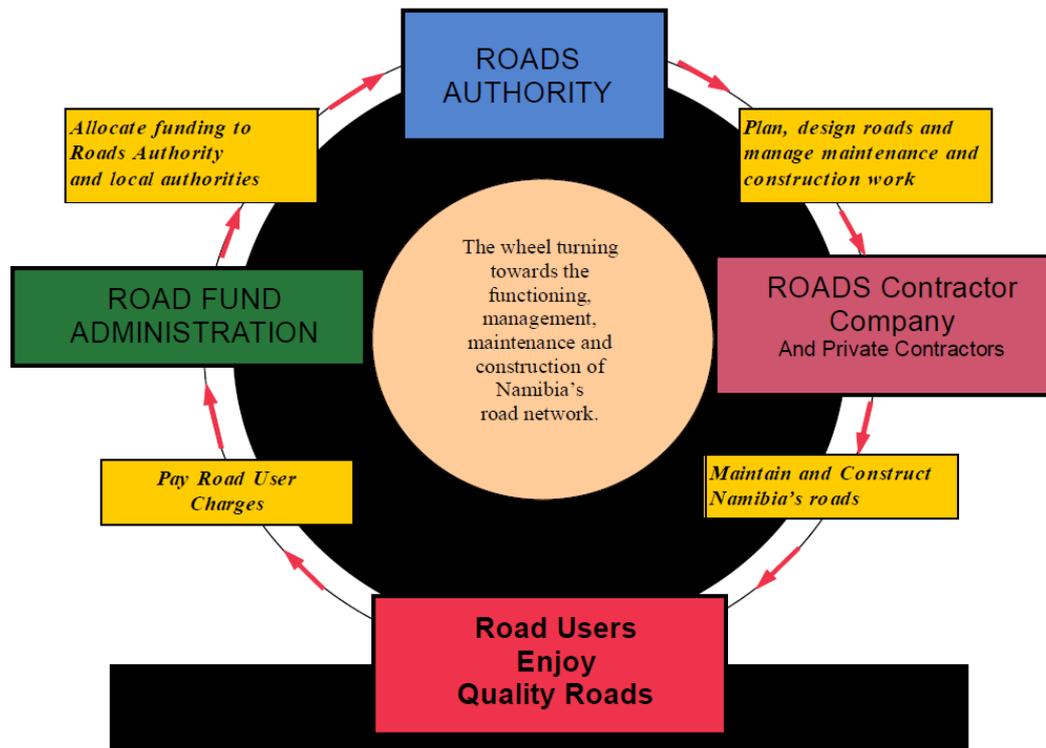


Figure 6. Entities of Namibia's Road Sector.

Source: Sustainable Asset Management- Namibia Road Sector.

### Namibia's Fourth National Development Plan

The Namibian Fourth National Development Plan for 2012–2017 outlines the government's development goals for the next 5 years. The development plan outlines the three main goals: faster and sustainable economic growth, the creation of employment opportunities, and enhanced income equality. The development plan highlights the role of infrastructure as a basic enabler to the country's economic development. The plan highlights the sector's challenges and proposed strategies to address them, outlined in Table 1. The outlined strategies are high-level economic infrastructure approaches intended to assist the country of 'becoming the most competitive tourist destination in sub-Saharan Africa and increase the manufacturing sector's contribution to GDP.'<sup>15</sup> The Development Plan notes the Ministry of Works and Tourism is the main stakeholder responsible for implementing these strategies as

<sup>14</sup> Roads Contractor Company. <http://www.rcc.com.na/>.

<sup>15</sup> Namibia's Fourth National Development Plan 2012/2013–2016/2017. NDP\_4. July 2012.

well as the Ministry of Agriculture, Water and Forestry; Ministry of Regional and Local Government, Housing and Development; and Ministry of Information, Communication and Technology.

**Table 1. Summary of Public Infrastructure Challenges and Proposed Responses**

<b>Challenge</b>	<b>Implication if challenge is not addressed</b>	<b>Strategy to address challenge</b>
Underinvestment in core infrastructure	Reduced international competitiveness	Invest further in core infrastructure
The Port of Walvis Bay continues to operate near its full capacity	Reduced efficiency may impact on the case put forward to develop Namibia as a logistics hub	Expand the port in good time
The core rail network is old and dilapidated	Safety and reliability of rail transport are compromised, which will also affect industry	Fix the core rail network
Road maintenance has been neglected	Safety and reliability of road transport are compromised, which will also affect industry	Restore the balance between expansion of new roads versus maintenance
Current airport infrastructure is not sufficient to support aviation expansion as well as of other modes of transport	Reduce the Walvis Bay's ability to perform at full capacity and compromise synergy between air transport and other modes of transport	Expand airport infrastructures to support development of other modes of transport
Dependency on imported electricity continues	Industry will be negatively affected by power shortages	Establish base load capacity requirement and address the demand side during the NDP4 cycle
Scarcity of water resources in Namibia limit industrialisation in the country	Industrialisation will not achieve its full potential	Ensure water security by 2017 and address demand issues by establishing additional infrastructure
The majority of Namibians have no access to affordable formal housing	Impacts negatively on social cohesion and social conduct	Increase efforts to provide affordable housing to all
Inadequate ICT infrastructure	Impacts negatively on business efficiencies	Maintain and improve existing ICT infrastructure, with a focus on rural penetration

*Source: The Fourth National Development Plan, July 2012.*

The sustainability plan would also be relevant to address some of the challenges outlined in another basic enabler mentioned, institutional environment. This enabler is primarily focused on the governance, general business environment, and institutions; however, the development plan mentions a high priority on environmental management and that the priority is important to promote economic development. The plan lists a focus on land degradation, deforestation, unsustainable use of coastal and marine resources, and vulnerability to climate change.

The development plan outlined strategic goals and priorities for long-term development by 2030, shown in Figure 7. The sustainability plan developed for this project could help address goals for the strategic areas of public infrastructure and institutional environment. The above sections outlined these strategic areas' specific challenges, which can be incorporated into the sustainability plan's goals and objectives. For example, an objective maintaining roads in a sustainable manner could help address the public infrastructure challenge of maintaining the safety and conditions of current roads.

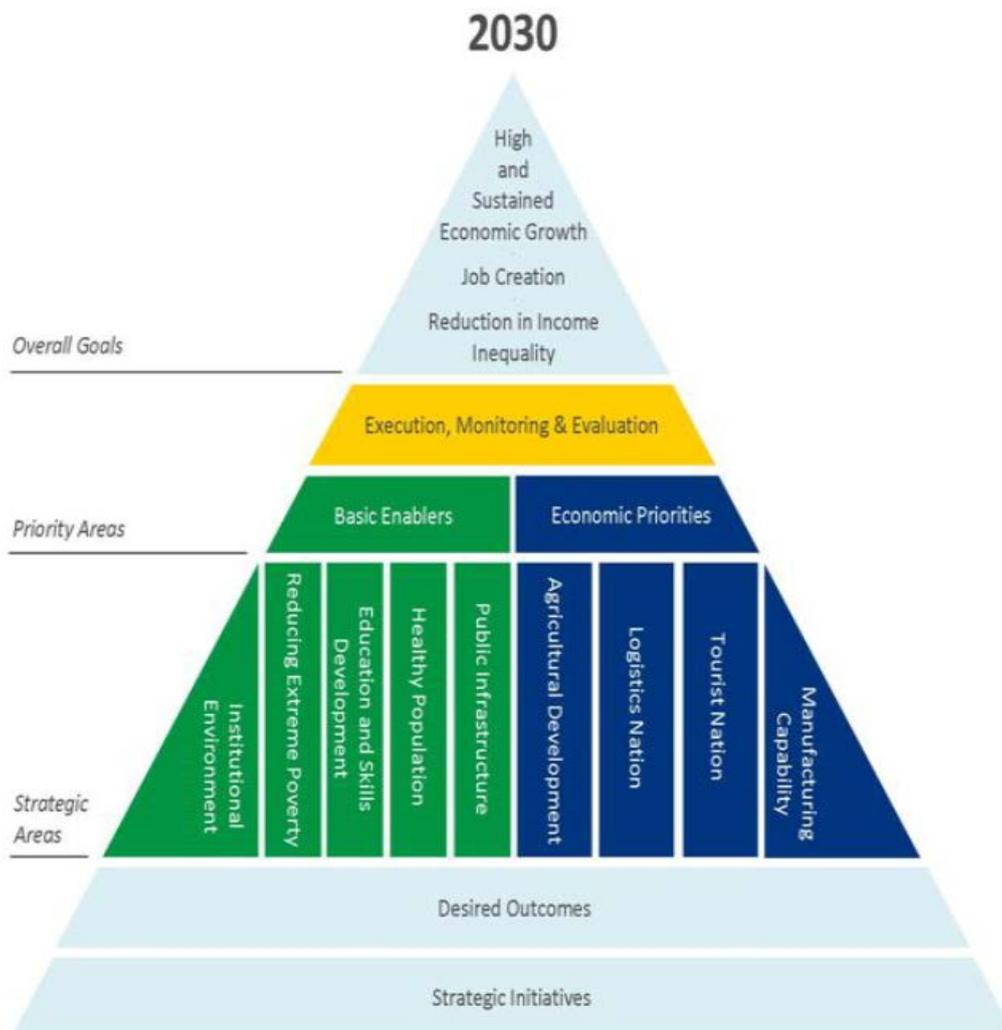


Figure 7. Namibia's Long-Term Development Goals.

## Overview of Namibia's Existing Transportation Plans

This section of the literature review outlines the key transportation plans that are of relevance for the sustainability plan being developed in this project. The documents reviewed in this section include the Integrated Transport Master Plan for Namibia, the COOKE Roads Master Plan, the Medium to Long Term Roads Master Plan (MLTRMP) for Namibia, and the Sustainable Urban Transport Master Plan for Windhoek. Each of these plans is described briefly below.

### *Integrated Transport Master Plan for Namibia*

To address some of the future challenges the transport system will face, the Namibia government developed an integrated, multimodal, transportation plan for Namibia and the Southern African Development Community (SADC) region. The transportation plan also includes the development of four main regional corridors in Namibia—Trans Cunene, Trans Caprivi, Trans Kalahari, and Trans Oranje.<sup>16</sup>

The Master Plan focuses on four modes of transportation: road, rail, ports, and aviation. The plan outlines transportation priorities in short- and long-term development plans. The short-term plan is projected for 3–5 years ahead and long-term is for the next 5–15 years.

### *Regional Master Plan Example - COOKE Roads Master Plan*

The research team examined the COOKE Roads Master Plan as an example of the Regional Master Plans prepared for the different regions of Namibia, specifically the 5-year implementation section. The acronym COOKE stands for the regions of Caprivi, Omaheke, Otjozondjupa, Kunene, and Erongo, which are the focus of this plan. The document focuses on road development for rural areas. The objectives of the report are as follows:

- provide an overview of the planned rural roads;
- assess the funding needs of rural access roads in terms of labour-based development activities;
- provide various scenarios and mechanisms for funding of rural roads based on the funding needs that were identified;
- recommend the optimal funding solution for funding of rural roads in the study areas; and
- identify and recommend priority programs for medium and long term.<sup>17</sup>

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<sup>16</sup> Infrastructure Trust Fund European Union Africa, Integrated Transport Master Plan for Namibia, at: <http://www.eu-africa-infrastructure-tf.net/activities/grants/integrated-transport-master-plan-for-namibia.htm>

<sup>17</sup> Roads Master Plan. 2013.

### Medium to Long Term Roads Master Plan for Namibia

This plan's objective is to help the Roads Authority meet the following goals:

- address the backlog in road preservation in Namibia;
- achieve long-term sustainability concerning the levels and levying of road user charges;
- expand the strategic planning horizon to a period of between 10 and 15 years;
- achieve the integration of development, rehabilitation, and maintenance project management and funding in one package, for project analyses and for road network asset management;
- provide for funding of rural access in parallel in the development portion of capital expenditures; and
- meet its obligations in terms of the enabling legislation and agreements with the RFA.<sup>18</sup>

The goals and objectives of these transportation plans could be incorporated into the developed sustainability plan for this project. These objectives could be the starting point for discussion during the participant workshop in Windhoek. Furthermore, this plan notes a goal of addressing road preservation and managing environmental concerns, which is relevant for the sustainability plan and could also meet goals of the Fourth National Development Plan. Figure 8 shows the approach to the development of the long-term plan:

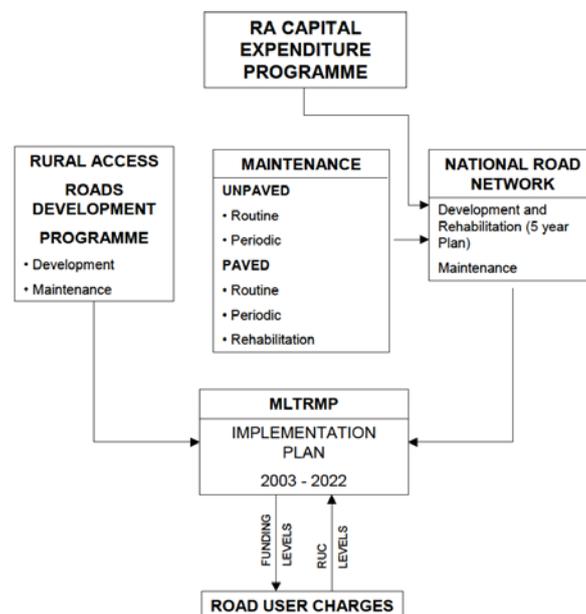


Figure 8. Diagram of Development of MLTRMP.

Source: *Medium to Long Term Roads Master Plan for Namibia. 2001.*

<sup>18</sup> Medium to Long Term Roads Master Plan for Namibia. 2001.

### *Sustainable Urban Transport Master Plan for Windhoek*

The City of Windhoek in collaboration with the Ministry of Works and Transport developed the transportation plan with a 20-year horizon. The plan's objectives are to:

- produce a clear and realistic vision for the development of a sustainable urban transport system for the next 20 years;
- generate strategies and policies to help make that vision a reality;
- maximise the efficiency and safety of the existing public and non-motorised transport system;
- recognise the role that public and non-motorised transport system shall have in contributing to different needs of user groups, in particular the urban poor;
- help the transport system to contribute to environmental and climate change related issues;
- serve as an example for regional and local public transport master plans in Namibia to follow; and
- serve as a basis for a national public transport master plan for Namibia.<sup>19</sup>

The urban master plan for Windhoek is focused on developing a sustainability plan for the local, urban roadways and could provide input and ideas for the development of sustainability plan for this project. The stakeholders involved in developing the Windhoek plan could provide valuable perspective on attainable goals and objectives for the national roads network sustainable plan.

### **Overview of Sustainability Plans in Developing Countries**

The research team reviewed sustainability transportation plans that have been implemented for developing countries to provide insight for the Namibian context. Sustainable development has become a key global focus area in recent years. The conditions in Namibia are unique compared to some other developing nations, because the transport sector covers a vast landscape with a low population density, unlike the highly populated, dense conditions seen in many other places. However, a review of these plans provides an understanding of how sustainable transportation is being implemented in other developing countries. Table 2 provides a summary of some sustainable transportation plans drafted over the last few years.

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<sup>19</sup> Sustainable Urban Transport Master Plan for Windhoek, *Move Windhoek*.  
<http://movewindhoek.com.na/content/background-and-objective>.

Table 2. Review of Sustainability Plans

Title	Sponsoring Agency	Overview
Issue Brief – Saving lives with sustainable transport, Traffic safety impacts of sustainable transport policies <sup>20</sup>	Prepared by EMBARQ and funded by World Resource Institute.	Reviews safety benefits of sustainable transport and a focus on applicability to developing cities.
Sustainable Urban Transport in Asia, Making the Vision a Reality <sup>21</sup>	Prepared by EMBARQ and funded by the Asian Development Bank.	Developed a Strategic Framework for encouraging Asian cities to improve the sustainability of their transport systems.
How should cities plan for sustainable mobility? A framework based on evaluation of city mobility plans <sup>22</sup>	Prepared by Partnership on Sustainable Low Carbon Transport (SLOCAT) and funded by the Ministry of Urban Development, Government of India.	Discussed mobility planning in Indian cities.
China: Building Institutions for Sustainable Urban Transport <sup>23</sup>	Prepared by World Bank and funded by Global Environment Facility and the World Bank. Future funding sources identified in this work include the Japan Bank for International Cooperation and Government of China.	Recommends short- and medium-term institutional development actions for sustainable urban transport.

<sup>20</sup> EMBARQ. *Issue Brief- Saving lives with sustainable transport, Traffic safety impacts of sustainable transport policies*. [http://www.wri.org/sites/default/files/saving\\_lives\\_with\\_sustainable\\_transport.pdf](http://www.wri.org/sites/default/files/saving_lives_with_sustainable_transport.pdf).

<sup>21</sup> EMBARQ. *Sustainable Urban Transport in Asia, Making the Vision a Reality*. [http://www.sustentabilidad.uai.edu.ar/pdf/inv/eco/sustainable\\_urban\\_transport\\_asia.pdf](http://www.sustentabilidad.uai.edu.ar/pdf/inv/eco/sustainable_urban_transport_asia.pdf).

<sup>22</sup> SLOCAT. *How should cities plan for sustainable mobility? A framework based on evaluation of city mobility plans*. <http://www.codatu.org/wp-content/uploads/A.-Tejas-Ghate-S.-Sundar-ARTICLE-Codatu-XV-2012-EN.pdf>.

<sup>23</sup> World Bank. *China: Building Institutions for Sustainable Urban Transport*. <http://www.worldbank.org/transport/transportresults/regions/eap/china-bldg-inst.pdf>.

The Partnership for Sustainable Urban Transport in Asia with support from the Swedish International Development Agency, the Asian Development Bank, and EMBARQ developed the ‘Sustainable Urban Mobility in Asia’ project. The project developed a Strategic Framework for Sustainable Transportation with the goal of encouraging Asian cities to improve the sustainability of their transport systems. The developed framework links sustainable urban transportation and ‘effective environmental management, poverty alleviation, and inclusive social development.’<sup>24</sup> The framework is intended to inform transportation stakeholders on how they can develop more effective sustainability approaches to their urban transport systems. The purpose of the project was to develop and discuss a conceptual approach of city-based sustainable transportation planning relevant for Asia.

In 2013, the World Bank put forward the goal of expanding sustainable development in developing countries. The World Bank worked toward this goal through the ‘use of information and communication technologies, support for public transport systems, development of climate-smart agriculture, and work in integrated urban water management.’<sup>25</sup> The World Bank has partnered with various organisations to support sustainable development projects in countries such as Vietnam, China, and Russia.

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<sup>24</sup> EMBARQ, *Sustainable Urban Transport in Asia, Making the Vision a Reality*.  
[http://www.sustentabilidad.uai.edu.ar/pdf/inv/eco/sustainable\\_urban\\_transport\\_asia.pdf](http://www.sustentabilidad.uai.edu.ar/pdf/inv/eco/sustainable_urban_transport_asia.pdf).

<sup>25</sup>World Bank. *Sustainable Development Goals*.  
<http://www.worldbank.org/en/news/feature/2013/12/23/year-world-bank-fused-sustainable-development-goals-future>.

## APPENDIX B – OBJECTIVES AND PERFORMANCE MEASURES RELEVANT TO NAMIBIA

During the training workshop, the T2 staff received training on how to develop goals, objectives, and performance measures for the sustainability plan. The participants used a spreadsheet-based tool provided as part of the NCHRP guidebook to identify objectives and performances measures that would fit into a Namibian context. These selected objectives and performance measures presented in this appendix were used as a starting point during the stakeholder workshop to select and finalise a limited set of objectives and performance measures.

The NCHRP guidebook listed 11 goals that are broadly applicable to sustainability in the transport sector, as follows:

- 1) *Safety*—Goal is to provide a safe transport system for users and the general public.
- 2) *Basic Accessibility*—Goal is to provide a transport system the offers accessibility that allows people to fulfil at least their basic needs.
- 3) *Equity/Equal Mobility*—Goal is to provide options that allow affordable and equitable transportation opportunities for all sections of society.
- 4) *System Efficiency*—Goal is to ensure the transport system’s functionality and efficiency is maintained and enhanced.
- 5) *Security*—Goal is to ensure the transport system is secure form, ready for, and resilient to threats from all hazards.
- 6) *Prosperity*—Goal is to ensure the transport system’s development and operation support economic development and prosperity.
- 7) *Economic Viability*—Goal is to ensure the economic feasibility of transportation investments over time.
- 8) *Ecosystems*—Goal is to protect and enhance environmental and ecological systems while developing and operating transport systems.
- 9) *Waste Generation*—Goal is to reduce waste generated by transport-related activities.
- 10) *Resource Consumption*—Goal is to reduce the use of non-renewable resources and promote the use of renewable replacements.
- 11) *Emissions and Air Quality*—Goal is to reduce transport-related emissions of air pollutants and greenhouse gases.

The tables in the following pages list relevant objectives and performance measures identified under each of these goals.

**Goal 1. Safety—Provide a safe transport system for users and the general public.**

Objectives	Measures
Reduce the number and severity of crashes	Change in the number and severity of crashes
	Change in the number of crashes by crash type and contributing factor
	Change in the number and severity of truck crashes
Ensure safety considerations are addressed for all modes	Change in the number and severity of crashes by user type (e.g., pedestrian, bicycle, transit user, freight)
	Change in the number of grade crossing collisions/incidents
Ensure safety is considered early in project planning	Change in percentage of projects where safety of a project was reviewed in each of the project development stages by a multidisciplinary review team
	Change in the percentage of projects implementing predictive methods of the AASHTO Highway Safety Manual
Ensure projects consider the 4Es (engineering, education, enforcement, EMS) of safety	Change in the percentage of projects where non-infrastructure based safety countermeasures were selected as part of the project
	Number of projects incorporating the use of innovative TSM and ITS solutions that address human factors considerations
Plan road networks that are predictable and recognisable	Existence of a functional class system of highways
	Existence of a system that adjust speeds based on the presence of alternative modes and context
Develop programs that maximise return on safety investment	Change in return on investment (reduction in the number and severity of crashes for the expenditure)
	Change in the number and proportion of projects evaluated on substantive safety versus nominal safety
Develop a performance based safety improvement program	Number and proportion of projects evaluated for impact on crashes
	Number and cost of projects that address safety concerns at the system, corridor, and local levels
Prioritise projects with explicit safety considerations	Change in number of programmed projects with highest reduction in crashes out of all alternatives

Objectives	Measures
Develop projects that meet maximum safety requirements	Return on investment for individual project (reduction in the number and severity of crashes for the expenditure)
	Project is evaluated on substantive safety versus nominal safety
Apply a performance based safety improvement program	Number and proportion of projects evaluated for impact on crashes
	Number and cost of projects that address safety concerns at the system, corridor, and local levels
Develop projects with explicit safety considerations	Change in number of programmed projects with highest reduction in crashes out of all alternatives
Reduce crash risk in work zones	Change in number of crashes per time unit within a particular work zone
	Change in number of crashes as a portion of total time of work zones by functional class, county, and district/region - where possible, distinguish between active and passive work zone time periods
	Change in number and severity of work zone truck crashes
Reduce the risk of construction and maintenance personnel working in work zones along roadways	Change in number of crashes involving one or more construction and maintenance personnel and/or vehicles per time unit that the work zone exists
	Number of construction and maintenance personnel killed at work zones by functional class, county, and district/region
	Number of construction and maintenance personnel injured at work zones by functional class, county, and district/region
	Change in the number of grade crossing collisions/incidents due to new construction (removal of grade crossing)
Provide improved work zone Traffic Control Activities	Change in the number of traffic control supervisors that are trained and on site
	Change in the number of traveller safety complaints annually
	Change in the number of workers injured during the course of traffic control activities
	Change in the percentage of construction or maintenance projects that use traveller information systems to provide public information on alternative routes and modes during construction or maintenance

Objectives	Measures
Maintain safe facilities	Change in time duration to correct potential roadway safety concerns that requires construction and/or maintenance action
	Change in the time taken to carry out repairs to roadside safety hardware (by category, i.e., guardrail, guardrail end-treatment, cable barrier, cable barrier end treatment)
	Change in the percentage of scheduled maintenance safety activities delivered on time
	Change in the percentage of construction and maintenance projects providing accessible routes during construction and maintenance (where applicable)
Reduce crash risk on two-lane rural highways	Change in number of crashes by crash type on two-lane rural highways
	Change in number and severity of truck crashes in a corridor/segment due to operational improvements
	Change in the number of grade crossing collisions/incidents due to operational improvements (e.g., traffic control and warning devices)
Reduce the crash risk of the travelling public using transit	Change in transit crashes as a proportion of total crashes on the highway network
	Number of fatal and disabling injuries sustained by transit users as a portion of 100 million passenger miles travelled or of 100,000 riders
Reduce the crash risk of vulnerable road users	Change in the total number of pedestrian and bicyclist crashes; and fatal and disabling crashes by 100,000 population
	Change in the percentage of signal systems with active ped devices (e.g., crosswalks, signals, meeting ADA standards)
Reduce the risk of the traveling public on freeways during incidents	Change in the total time taken to clear an incident scene (e.g., crash, hazardous material spill) from the time of the incident
	Change in the total number and severity of secondary crashes (crashes occurring as a result of queuing or disruptions in traffic flow as a result of an incident)
Reduce crashes related to intersection and ramp operations	Change in the percentage of signals coordinated along each major arterial
	Change in the percentage of expressway/freeway ramps metered in a corridor where severe congestion exists

Objectives	Measures
Reduce crashes related to network operations	Change in the percentage of signs meeting retro reflectivity criteria
	Change in the percentage of edge lines meeting retro reflectivity criteria
	Change in the percentage of system meeting curve warning, speed, and signing criteria
	Change in the percentage of intersections providing turn pockets and associated protected left-turn phasing when warranted
	Change in the percentage of system providing accessible routes

**Goal 2. Basic Accessibility – Provide a transport system that offers accessibility that allows people to fulfil at least their basic needs.**

Objectives	Measures
Ensure accessibility to jobs	Change in the number of jobs within reasonable travel time (by mode) for region's population
Change in jobs/housing balance	Change in jobs/housing balance
Ensure accessibility to essential destinations	Change in travel time (by mode) to schools, health services, grocery stores, civic and public spaces, recreation
	Change in travel time of goods to essential markets (region wide)
	Change in number of enterprises in key industries with reasonable access to high capacity highway or rail facilities
Program projects that increase access to job opportunities	Change in the number of jobs within reasonable travel time (by mode) for region's population due to project
Program projects that increase access to essential destinations	Change in travel time (by mode) to schools, health services, grocery stores, civic and public spaces, recreation due to project
	Change in travel time of goods to essential markets due to project
	Change in number of enterprises in key industries with reasonable access to high capacity highway or rail facilities due to project

Objectives	Measures
Develop projects that increase access to job opportunities	Change in the number of jobs within reasonable travel time (by mode) for region's population due to selected project alternative
Develop projects that increase access to essential destinations	Change in travel time (by mode) to schools, health services, grocery stores, civic and public spaces, recreation due to selected project alternative
	Change in travel time of goods to essential markets due to selected project alternative
	Change in number of enterprises in key industries with reasonable access to high capacity highway or rail facilities due to selected project alternative
Reduce delay to commuters due to construction activities	Change in travel time delay for commuters due to construction activities
Minimise travel time delay (by mode) for affected population due to construction	Change in travel time delay (by mode) for affected population due to construction activities
	Change in travel time of goods to essential markets due to construction activities
Reduce delay to commuters due to maintenance activities	Change in travel time delay for commuters due to maintenance activities
Minimise travel time delay (by mode) for affected population due to maintenance activities	Change in travel time delay (by mode) for affected population due to maintenance activities
	Change in travel time of goods to essential markets due to maintenance activities
Reduce travel time to jobs and other essential destinations through operational improvements	Change in travel time per mode per destination type
Improve travel time reliability to jobs and other essential destinations through operational improvements	Change in the reliability of travel time per mode per destination type
	Change in travel time of goods to essential markets due to operational improvements

**Goal 3. Equity/Equal Mobility – Provide options that allow affordable and equitable transportation opportunities for all sections of society.**

<b>Objectives</b>	<b>Measures</b>
Ensure comparable transport system performance for all communities	Change in level of service (LOS) for disadvantaged and non-disadvantaged neighbourhoods
Ensure reasonable transportation options for all communities	Relative change in the percentage of disadvantaged population with convenient access to high quality transit service
	Relative change in the percentage of streets with sidewalks or walking paths within a community
Ensure accessibility to jobs and essential destinations for all communities	Relative change in the level of access for disadvantaged populations to jobs, schools, health services, grocery stores, civic and public spaces, recreation
Ensure affordable transportation for all communities	Relative change in the Transportation cost index
Ensure that competitive options for freight movements exist for all communities	Relative change in freight investment servicing disadvantaged populations
Program transportation projects that improve transportation infrastructure equitably	Change in ratio of transportation disadvantaged to non-disadvantaged population benefitting from program
	Ratio of disadvantaged to non-disadvantaged population experiencing negative impacts of transportation program (e.g., noise, air quality, neighbourhood fragmentation)
Program projects that improve transportation options equitably	All modes (automobile, transit, pedestrian, bicycle) accommodated or improved by program
Program projects that improve accessibility equitably	Ratio of disadvantaged to non-disadvantaged people with increased accessibility due to program
Program projects that reduce transportation costs for low-income communities	Relative change in the transportation cost index due to program

Objectives	Measures
Program projects that increase competitive options for freight movements in all communities	Change in ratio of transportation disadvantaged to non-disadvantaged population benefitting from freight program
Develop transportation projects that improve transportation infrastructure equitably	Change in ratio of transportation disadvantaged to non-disadvantaged population benefitting from project
	Ratio of disadvantaged to non-disadvantaged population experiencing negative impacts of transportation project (e.g., noise, air quality, neighbourhood fragmentation)
Develop projects that improve transportation options equitably	All modes (automobile, transit, pedestrian, bicycle) accommodated or improved by project
Develop projects that improve accessibility equitably	Ratio of disadvantaged to non-disadvantaged people with increased accessibility due to project
Develop projects that reduce transportation costs for low-income communities	Relative change in the transportation cost index due to project
Develop projects that increase competitive options for freight movements in all communities	Change in ratio of transportation disadvantaged to non-disadvantaged population benefitting from freight project
Reduce delay due to construction activities equitably	Ratio of disadvantaged to non-disadvantaged system users experiencing delay due to construction activities
Maintain or improve transportation options during construction for all communities	Ratio of disadvantaged to non-disadvantaged system users experiencing fewer transportation options due to construction activities
Reduce delay due to maintenance activities equitably	Ratio of disadvantaged to non-disadvantaged system users experiencing delay due to maintenance activities

Objectives	Measures
Maintain or improve transportation options during maintenance for all communities	Ratio of disadvantaged to non-disadvantaged system users experiencing fewer transportation options due to maintenance activities
Reduce travel time to jobs and essential destinations through operational improvements equitably and across all modes	Ratio of disadvantaged to non-disadvantaged system users experiencing reduced travel time due to operational improvements
Improve reliability in travel time to jobs and other essential destinations through operational improvements equitably and across all modes	Ratio of disadvantaged to non-disadvantaged system users experiencing improved reliability of travel time by mode and destination type
Ensure that transportation costs do not disproportionately impact low-income users	Change in incidence of travel costs by income group due to operational improvements
Increase competitive options for freight movements in all communities through operational improvements	Relative change in operational investment by freight mode servicing disadvantaged communities

**Goal 4. System Efficiency – Ensure the transport system’s functionality and efficiency is maintained and enhanced.**

Objectives	Measures
Ensure that the transport system is functional for all users	Change in volume/capacity ratio by functional class
	Change in multimodal LOS (using HCM measures)
	Change in LOS on key freight routes OR truck volume to capacity (v/c) ratio

Objectives	Measures
Ensure that the existing transport system achieves and maintains a state of good repair	Change in percentage of roadway/transit infrastructure achieving state of good repair
Ensure that transportation options are efficient for all users	Change in travel time index (TTI) by mode
	Change in person hours of recurring delay, by mode
Ensure that reliable transportation options are maintained for all users	Change in person hours of non-recurring delay, by mode
	Change in buffer time (by mode and freight)
	Relative change in hours of non-recurring delay on key freight corridors and approach network
Program projects that maintain or improve the functionality of the transport system for all users	Change in volume/capacity ratio [congestion reduction per unit (lane-mile)] due to program
	Change in multimodal LOS due to program
	Change in LOS on key freight routes OR truck v/c ratio due to program
Program projects designed to maintain or achieve a state of good repair for the existing transport system	Change in existing (lane miles, track miles, sidewalk miles) in a state of good repair due to program
Program projects that maintain or improve the efficiency of the transport system for all users	Change in TTI (by mode if applicable) due to program
	Change in person hours of recurring delay, by mode, due to program
Develop programs that maintain or improve the reliability of the transport system for all users	Change in person hours of non-recurring delay due to program
	Change in buffer time due to program
	Relative change in hours of non-recurring delay on key freight corridors and approach network due to program
Develop projects that maintain or improve the functionality of the transport system for all users	Change in volume/capacity ratio [congestion reduction per unit (lane-mile)] due to project
	Change in multimodal LOS due to project
	Change in LOS on key freight routes OR truck v/c ratio due to project

Objectives	Measures
Develop projects designed to maintain or achieve a state of good repair for the existing transport system	Change in existing (lane miles, track miles, sidewalk miles) in a state of good repair due to project
Develop projects that maintain or improve the efficiency of the transport system for all users	Change in TTI (by mode if applicable) due to project
	Change in person hours of recurring delay, by mode, due to project
Develop projects that maintain or improve the reliability of the transport system for all users	Change in person hours of non-recurring delay due to project
	Change in buffer time due to project
	Relative change in hours of non-recurring delay on key freight corridors and approach network due to project
Maintain the functionality of the transport system during construction activities	Change in peak hour persons moved due to construction activities
	Change in multimodal LOS due to construction activities
	Change in LOS on key freight routes OR truck v/c ratio due to construction activities
Minimise the impact of construction activities on system efficiency	Change in travel time delay for commuters due to construction activities
	Change in person hours of recurring delay due to construction activities
Minimise the impact of construction activities on system reliability	Change in person hours of non-recurring delay due to construction activities
	Change in buffer time due to construction activity
	Relative change in hours of non-recurring delay on key freight corridors and approach network due to construction
Maintain the functionality of the transport system during maintenance activities	Change in peak hour persons moved due to maintenance activities
	Change in LOS due to maintenance activities
	Change in LOS on key freight routes OR truck v/c ratio due to maintenance activities
Conduct maintenance activities with sufficient frequency to maintain the state of good repair	Change in existing (lane miles, track miles, sidewalk miles) in a state of good repair due to maintenance activities

Objectives	Measures
Minimise the impact of maintenance activities on system efficiency	Change in travel time delay for commuters due to maintenance activities
	Change in person hours of recurring delay due to maintenance activities
Minimise the impact of maintenance activities on system reliability	Change in person hours of non-recurring delay due to maintenance activities
	Change in buffer time due to maintenance activity
	Relative change in hours of non-recurring delay on key freight corridors and approach network due to maintenance activities
Implement operational improvements that maintain system functionality	Change in peak hour persons moved due to operational improvements
	Change in LOS due to operational improvements
	Change in LOS on key freight routes OR truck v/c ratio due to operational improvements
Implement operational improvements that minimise the deterioration of transportation infrastructure and assets	Change in useful life of infrastructure due to operational improvements
Implement operational improvements that enhance or maintain the efficiency of transportation options	Change in TTI due to operational improvements
	Change in person hours of recurring delay due to operational improvements
Implement operational improvements that enhance or maintain the reliability of transportation options	Change in person hours of non-recurring delay due to operational improvements
	Change in buffer time due to operational improvements
	Relative change in hours of non-recurring delay on key freight corridors and approach network due to operational improvements/issues

**Goal 5. Security—Ensure the transport system is secure from, ready for, and resilient to threats from all hazards.**

Objectives	Measures
Prevent incidents within a transportation agency's control and responsibility	Change in level of redundancy for critical passenger and freight infrastructure
Protect transportation users, agency personnel, and critical infrastructure	Change in share of agency staff that have received appropriate emergency training
Improve the capacity of the transport system to recover swiftly from incidents	Change in the capacity of parallel/redundant routes across all modes
Enhance the security of freight transportation assets (e.g., ports)	Change in the capacity of parallel/redundant routes along major freight corridors
	Relative change in funding allocated to disaster/incident response and management
Program projects that prevent incidents within a transportation agency's control and responsibility	Change in level of redundancy for critical passenger and freight infrastructure
Program projects that protect transportation users, agency personnel, and critical infrastructure	Change in the number/value of projects as part of program designed to protect transportation users, agency personnel, and critical infrastructure
Program projects that improve the capacity of the transport system to recover swiftly from incidents	Change in the number/value of projects as part of program designed to improve capacity of the transport system to recover swiftly from incidents
Program projects that enhance the security of freight transportation assets (e.g., ports)	Change in the number/value of projects as part of program designed to enhance the security of freight transportation assets (e.g., ports)

Objectives	Measures
Develop projects that prevent incidents within a transportation agency's control and responsibility	Change in level of redundancy for critical passenger and freight infrastructure
Develop projects that protect transportation users, agency personnel, and critical infrastructure	Change in the number/value of projects designed to protect transportation users, agency personnel, and critical infrastructure
Develop projects that improve the capacity of the transport system to recover swiftly from incidents	Change in the number/value of projects designed to improve capacity of the transport system to recover swiftly from incidents
Develop projects that enhance the security of freight transportation assets (e.g., ports)	Change in the number/value of projects designed to enhance the security of freight transportation assets (e.g., ports)
Prevent incidents within a transportation agency's control and responsibility	Change in level of redundancy for critical passenger and freight infrastructure
	Annual number of incidents
Protect transportation users, agency personnel, and critical infrastructure	Change in the share of agency staff that have received appropriate emergency training
Support regional, state, and local emergency responders with resources including facilities, equipment, and personnel	Relative change in capital funding allocated to disaster/incident response and management
Help the transport system recover swiftly from incidents	Incident clearance time for selected incidents

Objectives	Measures
Implement operational improvements that enhance the security of freight transportation assets (e.g., ports)	Relative change in operational funding allocated to disaster/incident response and management

**Goal 6. Prosperity—Ensure the transport system’s development and operation support economic development and prosperity.**

Objectives	Measures
Support growth in jobs and income by improving travel efficiency/reducing congestion	Change in average truck speed on major freight corridors
	Change in travel delay (e.g., travel time index) at major freight bottlenecks by mode
	Change in corridor/city/commuter-shed-specific travel delay or other congestion-related measure
	Change in cost of goods movement in key national modal corridors
Support growth in jobs and income by improving access to markets and factors of production (labour and raw materials)	Change in population within user-defined distance to four-lane highway facilities; air cargo service; scheduled air service; intercity bus service; intercity rail service, etc.
	Change in access to jobs and labour (How many jobs and how much labour can be accessed within various periods of time for an entire region or smaller areas)
	Change in regional and short line trackage with 286,000 pound rating
Support growth in jobs and income	Net change in jobs/income associated with transportation plan implementation
Support growth in jobs and income by improving travel efficiency/reducing congestion through programming	Change in average truck speed on major freight corridors due to program
	Change in travel delay (e.g., travel time index) at major freight bottlenecks by mode due to program
	Change in corridor/city/commuter-shed-specific travel delay or other congestion-related measure due to program
	Change in cost of goods movement in key national modal corridors due to program
	Net change in jobs/income due to program

Objectives	Measures
Support growth in jobs and income by improving access to markets and factors of production (labour and raw materials) through programming	Change in population within user-defined proximity to access controlled four-lane highway facilities; air cargo service; scheduled air service; intercity bus service; intercity rail service, etc. due to program
	Change in access to jobs and labour (How many jobs and how much labour can be accessed within various periods of time for an entire region or smaller areas) due to program
	Change in regional and shortline trackage with 286,000 pound rating due to program
Program projects that reduce freight transportation costs	Change in cost of shipment per ton/mile, by mode due to program
	Existence of a process for considering the freight specific benefits and costs in the programming phase
Develop projects that support growth in jobs and income by improving travel efficiency/reducing congestion	Change in average truck speed on major freight corridors due to project
	Change in travel delay (e.g., travel time index) at major freight bottlenecks by mode due to project
	Change in corridor/city/commuter-shed-specific travel delay or other congestion-related measure due to project
	Change in cost of goods movement in key national modal corridors due to project
	Net change in jobs/income due to project
Develop projects that support growth in jobs and income by improving access to markets and factors of production (labour and raw materials)	Change in population within user-defined proximity to access controlled four-lane highway facilities; air cargo service; scheduled air service; intercity bus service; intercity rail service, etc. due to project
	Change in access to jobs and labour (How many jobs and how much labour can be accessed within various periods of time for an entire region or smaller areas) due to project
	Change in regional and shortline trackage with 286,000 pound rating due to project
Develop projects that reduce freight transportation costs	Change in cost of shipment per ton/mile, by mode due to project
	Existence of a process for considering the freight specific benefits and costs in the programming phase due to project

**Goal 7. Economic Viability – Ensure the economic feasibility of transportation investments over time.**

Objectives	Measures
Ensure the expected value of social and economic benefits created by proposed transportation projects exceeds their costs	Project-level cost/benefit ratio for proposed alternatives/policies, including freight
Ensure the selection of the lowest cost project alternative	Proportion of projects subjected to life cycle cost analysis (LCCA)
Ensure that revenue sources used to pay for transportation infrastructure are sufficient to meet expected needs	Percent of annual transportation funding needs that can be met with annual revenues
Ensure that the financial burden borne by transport system users is shared equitably	Cost per user/vehicle/household of taxes and fees dedicated to transportation
Ensure the expected value of social and economic benefits created by proposed transportation programs exceeds their costs	Project-level cost/benefit ratio for proposed projects and/or programs, including freight
Ensure the selection of the lowest cost project alternative	Proportion of projects for which LCCA is verified/updated through post project review
Ensure construction costs are within planned budget	Proportion of projects with construction costs within planned budget

Objectives	Measures
Ensure maintenance costs are within planned budget	Proportion of projects with maintenance costs within planned budget
Ensure operations costs are within planned budget	Proportion of projects with operations costs within planned budget

**Goal 8. Ecosystems—Protect and enhance environmental and ecological systems while developing and operating transport systems.**

Objectives	Measures
Ensure properly functioning environmental and ecological systems	Change in the number of formalised working partnerships (e.g. Memorandums of understanding) with public and private environmental stakeholders
	Change in the number of programmatic environmental permits and approvals for streamlining stakeholder regulatory review and support
	Preparation of an annual Sustainability Report on ecological trends and ecological performance against agency sustainability policies and goals
	Change in the percentage of transport system covered by consistent and accessible Regional Ecosystem Framework(s) or spatially-related ecological database(s)
Ensure that environmental and ecological systems are free of contaminants and pollutants	Existence of an agency-wide Environmental Management System (i.e., plan documenting environmental policy, environmental objectives and targets, identified regulatory requirements and compliance with requirements, defined roles and responsibilities, employee training plan, listing of documented processes, preventive actions, corrective actions, and emergency procedures (i.e., ISO 14001))
Program projects that maximise ecological opportunities and ecosystem benefits	Change in the percentage of projects programmed on the basis of achieving priority ecological outcomes
Maintain ecosystem functions and	Change in the number of projects programmed consistent with Regional Ecosystem Framework(s)

Objectives	Measures
processes	Change in percentage of projects evaluated for ecological impacts through an informed decision-making (comprehensive environmental review) process
Maintain enterprise-wide habitat connectivity	Change in road miles/square mile of watershed due to program
	Change in number of fish passage barriers/hydrological obstructions in right-of-way due to program
	Change in the number of retrofitted/maintained drainage and crossing structures due to program
Program projects that maintain and improve quantity and quality of water and aquatic ecosystems	Change in number [percentage] of projects programmed to maintain or improve water quantity or quality
Program projects that allow normal physical processes within the stream-floodplain corridor	Change in the number of new and retrofitted water crossings other than overflow crossings that: (1) promote natural sediment transport patterns for the reach, (2) provide unaltered fluvial debris movement, and (3) allow for longitudinal continuity and connectivity of the stream-floodplain system due to program
	Change in the number of new and retrofitted water crossings that allow lateral connectivity between the stream and floodplain due to program
Program projects that are free of contaminants and pollutants	Change in the percentage of projects covered by a documented Environmental Management System due to program
	Change in the number of projects developed for remediation of contaminated sites due to program
Develop projects that maximise ecological opportunities and ecosystem benefits	Change in the percentage of project alternatives selected on the basis of achieving priority ecological outcomes
Maintain ecosystem functions and processes	Change in the number of projects designed consistent with Regional Ecosystem Framework(s)
Conserve natural resources/capital during project implementation	Change in ratio of resource replacement mitigation (e.g., wetland restoration, creation, enhancement, and preservation) to resource impact (area or function) by habitat type due to project
	Change in net area of undeveloped land converted to transportation uses (acres) due to project

Objectives	Measures
	Change in percentage of projects evaluated for ecological impacts through an informed decision-making (comprehensive environmental review) process due to project
Maintain enterprise-wide habitat connectivity	Change in road miles/square mile of watershed due to project
	Change in number of fish passage barriers/hydrological obstructions in right-of-way due to project
	Change in the number of retrofitted/maintained drainage and crossing structures due to project
Develop projects that maintain and improve quantity and quality of water and aquatic ecosystems	Change in number [percentage] of projects designed to maintain or improve water quantity or quality
Maintain and improve surface water quantity and quality during project implementation	Change in the amount of net impervious surface area (acres) due to project
	Change in the amount of aquatic habitat impacted (i.e., wetlands (acres), stream channel (feet, square feet)) due to project
Design projects that allow normal physical processes within the stream-floodplain corridor	Change in the number of new and retrofitted water crossings other than overflow crossings that: (1) promote natural sediment transport patterns for the reach, (2) provide unaltered fluvial debris movement, and (3) allow for longitudinal continuity and connectivity of the stream-floodplain system due to project
	Change in the number of new and retrofitted water crossings that allow lateral connectivity between the stream and floodplain due to project
Develop projects to be free of contaminants and pollutants	Change in the percentage of projects covered by a documented Environmental Management System
	Change in the number of projects developed for remediation of contaminated sites
Promote biodiversity during project implementation	Number of biological communities, species, populations, and genetic assemblages eliminated from effect zones due to construction
Control dispersal and establishment of invasive species during project implementation	Number of projects implementing integrated pest management or weed control plans during construction

Objectives	Measures
Apply context sensitive corridor habitat restoration and landscaping during project implementation	Ratio of restored and maintained area to disturbed area (acres) within project
Reduce noise and light impacts on fish and wildlife during project implementation	Amount and duration of priority habitat exposure to high levels of noise/light during construction
Reduce herbicide use during project implementation	Area (in acres) sprayed with herbicides during construction
Reduce exposure to pollutants and contaminants during project implementation	Amount of hazardous materials accidentally spilled (e.g., # of spills, gallons spilled, spills per million gallons shipped) during construction
Promote biodiversity during project maintenance	Number of biological communities, species, populations, and genetic assemblages eliminated from effect zones due to maintenance
Control dispersal and establishment of invasive species during project maintenance	Number of projects implementing integrated pest management or weed control plans during maintenance
Apply context sensitive corridor habitat restoration and landscaping during project maintenance	Ratio of restored and maintained area to disturbed area (acres) due to maintenance
Reduce noise and light impacts on fish and wildlife during project maintenance	Amount and duration of priority habitat exposure to high levels of noise/light during maintenance
Reduce herbicide use during project maintenance	Area (in acres) sprayed with herbicides during maintenance
Reduce exposure to pollutants and contaminants during project maintenance	Amount of hazardous materials accidentally spilled (e.g., # of spills, gallons spilled, spills per million gallons shipped) during maintenance

Objectives	Measures
maintenance	
Operate facilities to promote ecological opportunities, ecosystem benefits, and the building of natural capital	Change in number of projects using spatially-related (i.e., GIS-based) ecological condition inventories for managing healthy ecological systems
Conserve natural resources/capital during operations	Change in amount of managed natural resource area by habitat type (acres)
	Change in the area of previously established resource replacement mitigation disturbed by operations (acres)
Reduce vehicle-animal collisions during operations	Change in the number of animal kills
Control dispersal and establishment of invasive species during operations	Change in number of noxious species in right-of-way
Apply context sensitive corridor habitat restoration and landscaping during operations	Change in amount [percentage] of operational budget allocated for landscape maintenance
Manage facilities to be pervious to the movements of biological organisms	Change in the amount [percentage] of operational budget allocated for habitat connectivity
	Change in the amount [percentage] of operational budget allocated for maintenance of hydrology
Reduce noise and light impacts on fish and wildlife during operations	Change in the amount of priority habitat areas exposed to high levels of transportation noise/light [due to operational improvements]
Maintain surface water quantity during operations	Change in the number of water detention facilities in operation
Allow normal physical processes within the stream-floodplain corridor during operations	Change in the percentage of channel crossings with properly functioning fluvial processes
	Change in the percentage of floodplain crossings with properly functioning fluvial processes
Reduce herbicide use during operations	Change in area (in acres) sprayed with herbicides during construction and maintenance

Objectives	Measures
Reduce exposure to pollutants and contaminants during operations	Change in the number of extant contaminated sites in right-of-way

**Goal 9. Waste Generation—Reduce waste generated by transport-related activities.**

Objectives	Measures
Reduce total waste created	Change in the amount of waste generated by type, weight, and/or volume
Increase the percentage of waste diverted	Change in the amount of waste diverted (from landfill) by type, weight, and/or volume
Reduce hazardous waste	Change in the amount of hazardous waste generated by type, weight, and/or volume
Clean up existing hazardous waste	Change in the quantity of hazardous waste cleaned up compared to waste generated (e.g., acres of brownfield, gallons of waste, amount of treated groundwater)
Ensure transport infrastructure (e.g., pavements, bridges) is designed for long life	Change in the average structural life of infrastructure network (e.g., pavement, bridge, tunnels)
Ensure that assets are managed to reduce life cycle cost and increase useful life	An asset management system exists
Reduce total waste created by transportation projects	Change in the amount of waste generated by type, weight, and/or volume due to program
	Change in the percentage of projects with a waste management plan in compliance due to program
Increase the percentage of waste diverted from transportation projects	Change in the amount of project waste diverted (from landfill) by type, weight, and/or volume due to program
	Change in the percentage of projects with of a recycling plan or waste diversion goal due to program
Reduce hazardous waste generated by transportation projects	Change in the amount of hazardous waste generated due to program

Objectives	Measures
Clean up existing hazardous waste	Change in the quantity of hazardous waste cleaned up compared to waste generated (e.g., acres of brownfield, gallons of waste, amount of treated groundwater) due to program
Change in average design life of infrastructure [by major component] due to program	Change in average design life of infrastructure [by major component] due to program
Reduce total waste created by transportation projects	Change in the amount of waste generated by type, weight, and/or volume due to project
	Change in the percentage of projects with a waste management plan in compliance
Increase the percentage of waste diverted from transportation projects	Change in the amount of project waste diverted (from landfill) by type, weight, and/or volume
	Change in the percentage of projects with of a recycling plan or waste diversion goal
Reduce hazardous waste generated by transportation projects	Change in the amount of hazardous waste generated due to project
Clean up existing hazardous waste	Change in the quantity of hazardous waste cleaned up compared to waste generated (e.g., acres of brownfield, gallons of waste, amount of treated groundwater) due to project
Develop infrastructure projects designed for long life	Change in average design life of project infrastructure [by major component]
Reduce total waste created during construction	Change in the amount of waste generated by type, weight, and/or volume during construction
	Change in the percentage of projects with a waste management plan in compliance
Increase the percentage of waste diverted during construction	Change in the amount of construction waste diverted (from landfill) by type, weight, and/or volume
	Change in the percentage of construction projects with a recycling plan or waste diversion goal
Reduce hazardous waste generated during construction	Change in the amount of hazardous waste generated by project construction
Reduce total waste created during maintenance	Change in the amount of waste generated by type, weight, and/or volume during maintenance
Increase the percentage of waste	Change in the amount of maintenance waste diverted (from landfill) by type, weight, and/or volume

Objectives	Measures
diverted during maintenance	Change in the percentage of maintenance projects with a recycling plan or waste diversion goal
Reduce hazardous waste generated during maintenance	Change in the amount of hazardous waste generated during maintenance
Reduce total waste created due to system operations	Change in the amount of waste generated by type, weight and/or volume due to system operations
	Change in the percentage of projects with a waste management plan in compliance
Increase the percentage of waste due to system operations that is diverted	Change in the amount of operations waste diverted (from landfill) by type, weight, and/or volume
	Change in the percentage of operational activities with of a recycling plan or waste diversion goal
Reduce hazardous waste generated due to operations	Change in the amount of hazardous waste generated by operational activities
Reduce litter	Change in the quantity of total litter collected annually (weight, volume, etc.)
Increase composting, reuse of existing vegetation, and clearing/grubbing waste	Change in total weight/volume composted annually
Reduce use of toxic cleaners, pesticides, and other chemicals	Change in the total quantity used annually (weight, volume, etc.)
Ensure transportation infrastructure is operated for long life	Change in the average actual life of infrastructure [by major component]
Ensure that assets are managed to reduce life cycle cost and increase useful life	An asset management system is actively operated

**Goal 10. Resource Consumption—Reduce the use of non-renewable resources and promote the use of renewable replacements.**

Objectives	Measures
Maintain a sustainable fleet	Change in the percentage of zero/low emissions vehicles in departmental fleets
	Change in the percentage of total diesel fuel substituted with alternative fuels, ultra-low sulphur diesel, electric motors
Purchase sustainable materials as a priority	Existence of a purchasing plan that establishes priority for sustainable materials
	Change in percentage of sustainable materials (by weight, volume, or dollar value)
Use renewable energy to provide project power	Change in percentage of renewable energy, in kWh, created in relation to energy requirements
Reduce the demand for single-occupancy vehicle travel	Change in the number [or cost] of multimodal options for state employees
Purchase green energy	Change in the amount and percentage of green energy purchased
Reduce energy usage	Change in total energy consumed by DOT facilities [should relate to quantity of facilities]
	Change in the number [or value] of investments in operational technologies to reduce fuel consumption
	Percentage of trucks with Smartway type technologies
Provide electric vehicle infrastructure	Change in the number of plug-in stations, amount of energy distributed from those stations
	Change in percentage of truck stops with electrification (IdleAire, etc.)
Encourage the sensible use of recycled materials in project programming	Existence of a policy or specification prioritising the use of sustainable materials in program
	Change in percentage of sustainable materials (by weight, volume, or dollar value) due to program
Encourage the use of renewable energy in project programming	Change in percentage of renewable energy, in kWh, created in relation to project energy requirements due to program
Program projects that use less energy	Change in the number and percentage of projects in program that have lighting meeting Energy Star requirements
Develop projects that encourage the sensible use of recycled materials	Change in percentage of sustainable materials (by weight, volume, or dollar value) due to project

Objectives	Measures
Use renewable energy to provide project power	Change in percentage of renewable energy, in kWh, created in relation to project energy requirements in project
Develop projects that use less energy	Change in the number and percentage of projects that have lighting meeting Energy Star requirements
Use biofuel for non-road construction equipment	Percentage of machine-hours or gallons of biofuel used during construction
Purchase regionally-produced construction materials	Total weight/volume/cost purchased within a certain radius (e.g., 500 miles) from the project
Reduce energy usage due to construction	Total machine-hours of energy efficient non-road equipment as a percentage of all construction-related machine-hours
Use biofuel for non-road maintenance equipment	Percentage of machine-hours or gallons of biofuel used during maintenance
Purchase regionally-produced maintenance materials	Total weight/volume/cost purchased within a certain radius (e.g., 500 miles) from the project
Reduce energy usage due to maintenance	Total machine-hours of energy efficient non-road equipment as a percentage of all maintenance-related machine-hours
Maintain a sustainable fleet	Change in the percentage of zero/low emissions vehicles in DOT fleet
	Change in the percentage of total diesel fuel substituted with alt fuels, ULSD, electric motors
Purchase sustainable materials as a priority	Sustainable purchasing plan that defines and establishes priority for sustainable materials (e.g., recycled, reused, local)
Purchase green energy	Change in the amount and percentage of green energy purchased
Reduce energy usage due to operations	Change in the number of energy efficient fixtures, total kWh saved, etc.
	Change in percentage of renewable energy, in kWh, created in relation to operations energy requirements

**Goal 11. Emissions and Air Quality – Reduce transport-related emissions of air pollutants and greenhouse gases.**

<b>Objectives</b>	<b>Measures</b>
Reduce activity that generates pollutant emissions (travel, trip length, mode split, emissions)	Change in trips, vehicle trips, VMT, percent non-driver, tons of emissions per day
	Change in percentage of commercial vehicles by EPA Tier compliance
Reduce polluting exhaust emissions (criteria pollutants and greenhouse gases [GHGs])	Change in emissions by criteria pollutant, total, and by mode/ton mile
	Lane miles of new access improvements to intermodal and port facilities
	Number of new separated rail crossings replacing grade crossings
Increase land use compactness, density, and balance of interacting uses (compactness, density, balance)	Change in jobs/housing balance
	Change in zoned residential density levels around essential service hubs
Increase the use of non-motorised modes	Change in planned miles of transit routes, pedestrian facilities, designated bike facilities, population within one mile of transit, connectivity index (pedestrian facilities, bike facilities, transit routes)
Increase street connectivity	Change in street connectivity index
Reduce congestion; promote low emissions travel speeds	Change percent VMT at low emission speed ranges
	Change in percentage of toll lanes with EZPass
Reduce proximity of air pollution-sensitive land uses to major pollution sources (high volume highways)	Change in sensitive receptors within close proximity , residential population within critical distance, percentage of ethnic/racial population groups within critical distance
Reduce concentration of critical pollutants in populated areas (model forecast) (criteria pollutants, GHGs)	Change in population within areas above EPA standard [non-attainment areas?], percent of ethnic/racial population groups within areas above EPA standard, percent school population within areas above EPA standard

Objectives	Measures
Provide measures that can reduce air pollutant concentrations (e.g., landscaping)	Change in CO <sub>2</sub> → O <sub>2</sub> conversion capacity of planned ROW plant materials
Program projects that reduce pollutant emissions (travel, trip length, mode split, emissions)	Change in trips, vehicle trips, VMT, percent non-driver, tons of emissions per day due to program
	Change in percentage of commercial vehicles by EPA Tier compliance due to program
	Change in emissions by criteria pollutant, total, and by mode/ton mile due to program
	Lane miles of new access improvements to intermodal and port facilities due to program
	Number of new separated rail crossings replacing grade crossings due to program
Increase use of non-motorised modes	Change in route or service miles of: transit routes, pedestrian facilities, designated bike facilities, population within one mile of transit, person-miles walk distance to transit stops, person-miles distance from building entrances to public pedestrian facilities (sidewalks, pedestrian ways), connectivity index (pedestrian facilities, bike facilities, transit) due to program
Increase street connectivity	Change in street connectivity index due to program
Reduce congestion; promote low emissions travel speeds	Change in percent VMT at low emission speed range; total vehicle delay; percent stops (of intersection approach volumes); multimodal level of service (by mode); percent VMT at each level of service due to program
Reduce populations within critical distance of major highway emissions sources (criteria pollutants, GHGs)	Change in population within critical distance of high volume highways (specify threshold ADT) (schools, hospitals, residences, ethnic/racial group equity) due to program
Reduce traffic volumes on major highways within critical distance of sensitive receptors (schools, hospitals, residences, ethnic/racial equity)	Change in ADT (total, diesel), emissions due to program
Provide measures that can reduce air pollutant concentrations (e.g., landscaping)	Change in CO <sub>2</sub> →O <sub>2</sub> conversion capacity of project plant materials due to program

Objectives	Measures
Reduce travel speeds to those within the lowest emissions ranges (criteria pollutants, GHGs)	Change in population percentage within a critical distance of traffic operating at speeds outside the lowest emissions range due to program
Develop projects that reduce pollutant emissions (travel, trip length, mode split, emissions)	Change in trips, vehicle trips, VMT, percent non-driver, tons of emissions per day due to project
	Change in percentage of commercial vehicles by EPA Tier compliance due to project
	Change in emissions by criteria pollutant, total, and by mode/ton mile due to project
	Lane miles of new access improvements to intermodal and port facilities due to project
	Number of new separated rail crossings replacing grade crossings due to project
Increase use of non-motorised modes	Change in route or service miles of: transit routes, pedestrian facilities, designated bike facilities, population within one mile of transit, person-miles walk distance to transit stops, person-miles distance from building entrances to public pedestrian facilities (sidewalks, pedestrian ways), connectivity index (pedestrian facilities, bike facilities, transit) due to project
Increase street connectivity	Change in street connectivity index due to project
Reduce congestion; promote low emissions travel speeds due to project	Change in percent VMT at low emission speed range; total vehicle delay; percent stops (of intersection approach volumes); multimodal level of service (by mode); percent VMT at each level of service due to project
Reduce populations within critical distance of major highway emissions sources (criteria pollutants, GHGs)	Change in population within critical distance of high volume highways (specify threshold ADT) (schools, hospitals, residences, ethnic/racial group equity) due to project
Reduce traffic volumes on major highways within critical distance of sensitive receptors (schools, hospitals, residences, ethnic/racial equity)	Change in ADT (total, diesel), emissions due to project
Provide measures that can reduce air pollutant concentrations (e.g., landscaping)	Change in CO <sub>2</sub> →O <sub>2</sub> conversion capacity of project plant materials due to project

Objectives	Measures
Reduce travel speeds to those within the lowest emissions ranges (criteria pollutants, GHGs)	Change in population percentage within a critical distance of traffic operating at speeds outside the lowest emissions range due to project
Reduce construction activity that generates pollutant emissions (engine operation, engine emission rates, idling time, emissions)	Engine-hours of operation, emission rates, idling hours per day, tons of emissions per day due to construction
Reduce adverse impact on traffic operations (lane reductions, traffic interruptions, detours, night operations)	Change in peak hour/period capacity (e.g., lane miles), vehicle hours of delay, extra VMT, percent of passing VMT affected by construction
Reduce equipment emissions (equipment conforming to latest EPA emissions standards)	Percent of construction equipment at each tier of emissions standards (weighted or unweighted), percent of construction equipment retrofitted to meet latest EPA emissions standards
Reduce on-site construction equipment activity	Percent change in hours of diesel equipment operation compared to conventional techniques, percent of construction completed off-site (e.g., precast)
Reduce construction equipment emissions within a critical distance of sensitive populations (schools, hospitals, residences, ethnic/racial group equity)	Daily emissions within critical distance (criteria pollutants, GHGs) due to construction
Reschedule urban construction activity with high emission rates to periods of low pollutant concentrations	Percentage of diesel construction equipment operating hours during low pollutant concentration hours

Objectives	Measures
Reduce maintenance activity that generates pollutant emissions (engine operation, engine emission rates, idling time, emissions)	Engine-hours of operation, emission rates, idling hours per day, tons of emissions per day due to maintenance
Reduce adverse impact on traffic operations (lane reductions, traffic interruptions, detours, night operations)	Change in peak hour/period capacity (e.g., lane miles), vehicle hours of delay, extra VMT, percent of passing VMT affected by maintenance
Reduce equipment emissions (equipment conforming to latest EPA emissions standards)	Percent of maintenance equipment at each tier of emissions standards (weighted or unweighted), percent of maintenance equipment retrofitted to meet latest EPA emissions standards
Reduce maintenance equipment emissions within a critical distance of sensitive populations (schools, hospitals, residences, ethnic/racial group equity)	Daily emissions within critical distance (criteria pollutants, GHGs) due to maintenance
Reschedule urban maintenance activity with high emission rates to periods of low pollutant concentrations	Percentage of diesel maintenance equipment operating hours during low pollutant concentration hours
Reduce congestion-related emissions	Change in the percent of VMT at low emission speed ranges, total vehicle delay, percent of approaching traffic that is stopped, multimodal level of service (by mode)
	Change in emissions by criteria pollutant, total and by mode/ton mile due to operational improvements
Reduce engine idling (on-road, non-road)	Change in vehicle-hours of idling

Objectives	Measures
Promote non-motorised modes	Change in multimodal level of service, percent telework jobs (person-days/week), percent jobs within __ minutes of population (average) by non-motorised modes, percent population within 1/4 miles of transit service, percent jobs within 1/4 mile of transit service, percent jobs within 1/2 mile of designated bike route, percent population within 1/2 mile of designated bike routes, average auto/transit travel time ratio (selected corridors)
Maintain efficient traffic operations	Percent of area traffic signals retimed during past three years, percent of area traffic signals within coordinated signal systems re-coordinated during past three years
	Change in percentage of toll payers using EZPass
Promote driving shifts to non-school hours	Change in percent [volume] of traffic passing 'school zones' during times when schools are not in session
Promote non-motorised modes	Change in the percentage of PMT by non-motorised modes; emissions