# ROAD AND TRANSPORTATION MASTER PLAN

WEST BANK AND GAZA STRIP

TA 2012013 PS 00 F10

**Annex 17 – Environmental Criteria for Transport Impact Assessment**

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Systematica POLITECNICA INGEGNERIA E ARCHITETTURA IDROTEC AIR SUPPORT SOCIETÀ DI INGEGNERIA

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# 1. Introduction

During the choice of the road layout, it is necessary to minimize interference with areas of high value or vulnerability; considering the characteristics of the West Bank territory, and in accordance with the National Plan for natural resources and historical landmarks protection, the following areas should be safeguarded:

- Agricultural lands of high value
- Sightseeing areas
- Natural parks
- Important historical sites and the surrounding areas
- Dangerous areas such as glides areas and areas threatened by collapse
- Areas with biological diversity (areas that contain exceptional plant or animal species)

In other cases, the road infrastructure may affect sensitive areas, unless mitigation interventions are implemented; this is the case for the following environmental components:

- Medium value agricultural lands
- Forests
- River Bands (hydraulic relevance areas, morphology and nature of the waterway)
- Floodable areas (e.g. The Jordan Valley)
- Areas of respect and protection of wells/springs
- Areas for building interventions placed at a distance less than 250 meters from the road (highways and main roads)1.

The following is a summary description of the additional criteria for the location, mitigation and compensation measures in relation to natural and anthropogenic components generally more stressed by the construction of linear infrastructures. Guidelines and manuals published in the European context are also provided below.

## Ecological Fragmentation

The priority issues of the location of roads in natural contexts, fundamentally affect the ecological aspects, in particular the risk of triggering processes of ecological fragmentation, leading to reductions in biodiversity and the degradation of natural environments. The project of road infrastructure needs to ensure the proper functioning of ecological processes. The infrastructure can if well designed and in specific situations, be an opportunity to implement the so-called green infrastructure 2. To reduce the fragmentation of natural areas, ecosystems and habitats, it is necessary to consider the following aspects:

- Avoid division and disturbance of large and not interrupted areas of natural Eco-mosaics. Fragmentation should be avoided, particularly in priority areas for biodiversity conservation, and those not yet subject to fragmentation.
- If the disorder in these areas is unavoidable, the layout of the road should be located as far away from the core areas and other areas that are highly vulnerable and with most ecological significance.
- Keep the functionality of wildlife corridors used for travel, dispersal, and migration: in particular, the rivers, torrents and other waterways, riparian forests, hedges and rows of trees. Use

[1] According to the Italian legislation in this range, it is necessary to reduce noise levels within the limit of 65 dba in daytime and 55 dba night for receptors such as houses and within the 50 and 40 dba dba for schools, hospitals, nursing homes, etc.

[2] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions; Green Infrastructure (GI) — Enhancing Europe's Natural Capital. COM/2013/0249 final.

measures that reduce the barrier effect of the road against plants and animals. These include measures to be provided in the design phase, such as wildlife corridors and crossings.

Other mitigation measures, in technical literature, proposed to reduce negative impacts on Fauna and Flora/habitats during operation, are the following:

- Traffic signs posts along the roads (indication of speed limits, warning about valuable habitats and animals inhabited in the area, etc.);
- Ensure stricter control to conserve biodiversity/poaching prevention;
- Provide properly designed rest stops to minimize impact on environment;
- Undertake continuous measures towards prevention and minimization of erosion;
- Continuous vegetation/re-vegetation along roads;
- Ensure compliance of vehicle conditions with technical standards to minimize risk of environmental pollution (air, soil, water);
- Ensure protection measures to avoid danger to animal species caused by road accidents (fences along roads).

More details are also listed in the following guidelines:

- COST341: Habitat Fragmentation due to Transportation Infrastructure. A European Handbook for Identifying Conflicts and Designing Solutions3 (Kettunen, M, Terry, A., Tucker, G. & Jones A. 2007. Guidance on the maintenance of landscape features of major importance for wild flora and fauna - Guidance on the implementation of Article 3 of the Birds Directive (79/409/EEC) and Article 10 of the Habitats Directive (92/43/EEC). Institute for European Environmental Policy (IEEP), Brussels 4.
- The fragmentation of the territory deriving from the linear infrastructures address and best practices for the impacts prevention and reduction. ISPRA, 2011 5.

## Water Resources

Existence of roads and their associated infrastructure, and vehicle traffic and passenger or goods transportation may cause significant negative impacts on water resources.

The impacts include:

- Accidental pollution of groundwater by spills during road accidents (the karst nature of the West Bank area means that when rain falls over roads, it will dissolve any pollutants and salty materials, dumped on them. These pollutants can then pass, unfiltered, through the rocks into the groundwater system);
- Reduction in groundwater recharge due to installed road drainage system;
- Increase in surface runoff and flooding; due to urbanization and surface rigidity;
- Potential for interruption or lowering of underground water table due to road operation;
- Groundwater pollution by wastes produced by road associated infrastructure (parking, food, sanitary facilities, filling stations, shops, etc.).

It is important that road routes are designed without causing any significant harm to the existing wells and springs, their access, their irrigated lands, and their water supply facilities. Possible impacts of road routes on wells and springs may include:

- Physical and chemical changes;
- Changes in hydrological cycle;
- Increase of demand on local water resources.

The following measures are to be implemented as to mitigate adverse impacts on water resources:

[3] www.iene.info/wp-content/uploads/COST341_Handbook.pdf).
[4] http://ec.europa.eu/environment/nature/ecosystems/docs/adaptation_fragmentation_guidelines.pdf
[5] http://www.isprambiente.gov.it/files/pubblicazioni/manuali-lineeguida/mlg76-1-2011.pdf

- Road police and ecological authorities are to check regularly vehicles quality and their compliance with technical standards;
- Road police is to properly control vehicles conditions to minimize risk of accidents/accidental spills;
- Properly control road drainage system to avoid soil erosion/sedimentation into waterways, direct runoff to waterways, turbidity of waterways;
- Planting trees and bushes to prevent surface erosion and landslides;
- Properly control development and operation of road associated infrastructure along the roads (food and parking facilities, filling stations, recreation stops, etc.);
- Petrol stations are not to be located near water resources.

## Air Quality

The effects of the construction of new roads on air quality are internationally and widely known. They depend on a number of factors, linked to the characteristics of the road (speed of project development elevation profile, type of flooring, etc.) and the context of location (urban, suburban, topography and vegetation, local climate conditions) and, finally, to the intensity of traffic flows and the type of vehicles. The upgrading of existing roads can lead on the other hand, to the generation of benefits related to a better flow of vehicles.
Reducing emissions in the transport sector requires attention to vehicles, fuels, and alternative modes of transportation. The most vital measures that were taken and applied all over the world include: investment in unleaded gasoline, taxes on leaded gasoline and tightened standards for vehicles.
Other key measures that will favour the reduction of air pollution during roads operation are:

- Maintaining proper quality of road pavement;
- Appropriate road traffic control measures, allowing to reduce frequent braking and speed acceleration of traffic flow;
- Provision of proper condition of ignition and combustion systems of vehicles and road machinery during operation;
- Quality control of fuel used for vehicles;
- Designing and planting vegetation (buffer strips) along roads to minimize spreading of combustion gases.

Other mitigation and compensation measures are reported inside *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes. National Roads Authority, 2006, Dublin.*

## Landscape

The first step towards integrating the work with its context is to consider the characteristics of the landscape. The available manuals and guidelines define criteria to limit interference between landscapes crossed and road infrastructure, but also to solve and/or mitigate, through the construction of a new road, pre-existing situations of harmful interference. For instance:

- The landscaping of road infrastructure: methodological tools and best practices of project, ISPRA, 20106.

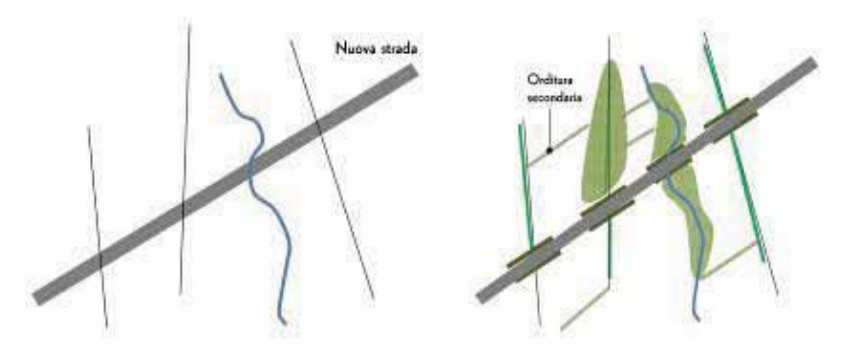
[6] http://www.isprambiente.gov.it/en/publications/handbooks-and-guidelines/ambiente-paesaggio-e-infrastrutture-environment?set_language=en);

- For Mediterranean and mainly hilly-mountainous landscapes, see also the following manual: Roads in the landscape. Criteria for their planning, layout and project design, Junda de Andalusia, 20097.

## Soil, Agriculture and Land Use

Agriculture is a very important sector in the economy of the West Bank. A new road may break the agrarian plot and support land fragmentation with significant negative effects on the agricultural economy. In order to avoid that the new road becomes a barrier inside rural landscape, the design must relate as much as possible to the existing landscape signs (warping of the fields, morphology, hydrography, etc.) and the vegetation equipment must be anchored to the road landscape design so as to accelerate the insertion of the same infrastructure in the landscape.

*Figure 1. Infrastructure and Landscape Interference*

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Issues related to water pollution, land use (due to traffic emissions) and crops close to the infrastructures, are also of great importance. The plantations along the roads accumulate harmful particles that enter later in the food chain. Hence, the impacts on agricultural crops can be reduced by placing in the proximity of the infrastructure non-food crops (e.g. Energy crops).
In a more general manner, the existence of roads may cause significant negative impacts on soil and lands. These include:

- Continuous damage due to land erosion and formation of gullies on slopes along drainage channels;
- Soil contamination by fuel and its compounds; especially heavy metals;
- Soil pollution due to run-off/migration of spills/leaks from vehicles;
- Soil pollution by wastes produced by infrastructure connected with services located along roads (parking, food facilities, filling stations, restaurants, shops, etc.).

The impacts on soil, during roads operation, can be minimized by applying the following measures:

- Planting trees and bushes along roads (on an appropriate distance);
- Providing roadways/protection strips along the roads, if appropriate;
- Proper construction of road drainage system;
- Road police and ecological authorities are to check regularly vehicles quality and their compliance with emissions standards;

[7]http://www.paisajeyterritorio.es/index.php%3Foption%3Dcom_docman%26task%3Ddoc_download%26gid%3D206%26Itemid%3D67).

- Road police is to properly control traffic of vehicles to minimize risk of accidents;
- Properly controlling development and operating of road associated infrastructure/ food, sanitary/car filling/ parking facilities;
- Undertaking continuous measures towards prevention and minimization of erosion.

From the point of view of land use, the location, distribution, density, or growth rate of population will be altered in regions located around road corridors due to present or planned road construction. There are three types of impacts that can be attributed to roads:

- Direct conversion of different land-uses from their current usages to a transportation corridor;
- Indirect impacts from new or relocated developments due to better provision of access may also change land-uses in the region surrounding roads;
- Cumulative impacts include impacts to utilities from the changes in the development locations of residential, commercial, or industrial sites.

The operation of roadways could indirectly lead to undesirable changes in land-use, especially agricultural areas adjacent to road corridors. These changes would result in the loss of high value farmlands to commercial, residential or other non-agricultural uses.
Due to the complex relationship between land-use and transportation, most land-use mitigation measures are outside the sphere of road construction and operation projects. A better integration between comprehensive spatial plan and the Transportation Master Plan will help to achieve higher levels of productivity and efficiency, preserve the capacity of the natural environment to sustain growth, and ensure balanced distribution of population, employment opportunities, and access to public services.

## Infrastructures Integration in Urban and Peri-Urban Contexts

In urban and peri-urban areas, the construction of new roads or the upgrading of existing ones can bring economic and social benefits (time savings, reduction in accident rates, increased accessibility to services or economic activities, increase in property values, etc.). At the same time, it can also cause negative impacts, both in the construction phase (traffic interruptions and disruption to traffic, noise and dust, etc.), and the operational phase (mainly noise and air pollution, health impacts). The stated aspects are well covered by technical manuals[8].
Less treated aspects relate to the lack of soil and the integration in the urban environment, especially in relation to large infrastructure (highways and express-ways). The high impact increases in peri-urban areas, because it creates an expectation of new buildings that will consume additional soil. The need to maintain a physical continuity also in the landscape and to contain the land consumption, especially in case of viaducts and artificial elevations, it is suggested to use the premises underlying the infrastructure to locate different services and activities.

8 Environmental Impact Assessment of National Road Schemes – A Practical Guide. NRA, Revision 1, 20 November, 2008

*Figure 2. Examples dealing with integration of infrastructure*

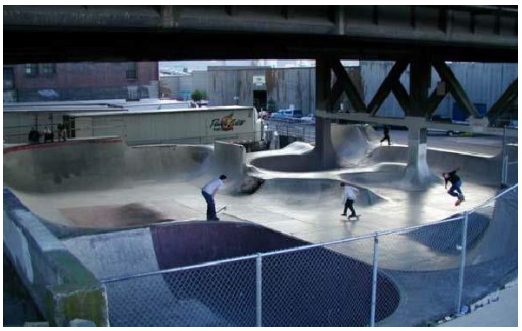

*Figure 3. Examples dealing with the integration of photovoltaic plants in urban areas*

Road infrastructure can also be used for the construction of photovoltaic plants in urban areas and their surroundings. The suggestion would be to adapt the complementary structures (noise barriers, guard rails, etc.) as supports for generation of photovoltaic cells.

## Mitigation Measures during Construction

To minimize potential construction-related negative impacts during the construction phase, a combination of preventive and mitigation actions is to be implemented. The following are the most important measures to be planned:
(a) composition and properties of road construction materials used during the project implementation, that should meet the requirements of national technical standard norms and specifications;
(b) construction of anti-noise screens on road sections going through residential areas;
(c) to avoid bogging in all depressed locations, drainage of surface waters is to be provided by culverts;
(d) to avoid soil erosion, consolidation near culverts should be performed;
(e) consolidation of slopes and shoulders is to be performed to avoid sub-grade washing out;
(f) maximum use of stationary asphalt plants and bitumen storages should be planned by the project, allowing to maintain permissible concentrations of emissions and to provide purification of run-off waters and waste;
(g) location of temporary premises, structures and storage sites for construction materials shall be within the limits of the allocated areas;
(h) sites for temporary parking of road construction machinery shall be located outside protection zones of water basins and shall be contoured along the perimeter by soil which acts as collector of oil containing products accidentally spilled on the ground; and
(i) construction equipment and machinery equipped with internal combustion engines should be adjusted and checked for toxicity of exhaust gases.

## Strategies for Sustainable Mobility in Urban Context

The construction of the road system proposed by the Master plan, requires to be sustainable, and that cities and major urban centers adopt a mixed strategy to reduce congestion and emissions, based on the following elements: integrated planning, regulation and pricing systems, efficient public transport infrastructure and services and support for non-motorized modes, limited traffic areas, etc... The cities above a certain demographic-economic dimension (governorate capitals) should be encouraged to adopt "Urban Mobility Plans" bringing together all of these elements.
See the guide-lines for the Development of Urban sustainable mobility Plan written by the European Commission in 2014[9].
An urban plan of sustainable mobility must take up the following challenges:

- Health – How to create a healthy environment for citizens
- Congestion – How to create an economically viable and accessible city
- Safety and security – How to ensure a safe and secure urban environment and mobility
- Participation – How to involve citizens and other urban mobility stakeholders
- Strategic planning – How to achieve policy goals while ensuring that mobility needs of society and its citizens are met
- Climate change – How to reduce climate change related emissions from urban transport to contribute to achieving local, national and global climate change goals (as an additional and underlying global challenge to be considered in urban mobility policies.

It is important to remember that addressing urban mobility challenges requires the implementation of integrated packages of measures (solutions) as opposed to single, isolated measures. Experience shows that isolated measures can only have a limited impact, while packages of measures can make use of synergies and reinforce each other. The strongest connections between measure fields/solutions and urban mobility challenges are illustrated in the matrix in the next page. Source: CiViTAS-CATALIST Project: CiViTAS Guide for the Urban Transport Professional – Results and Lessons of Long-Term Evaluation of the CiViTAS Initiative, 2012[10].

It is possible to identify some minimum measures, widely used in urban areas to reduce impacts related to traffic, which may be adopted and/or strengthened in the main cities of the West Bank and Gaza Strip:

- Introduce restricted traffic zones

Create restricted traffic zones in the main urban areas and, in relationship with the Master plan phases, fix a minimum surface of them, according to a defined target (inside EU, the target could reach 100% on surface in the historical centers), then define homogeneous rules for the access to the Restricted traffic zones.

- Create or expand the pedestrian areas

Well-designed and well integrated into the urban context, pedestrian areas produce positive effects in the immediate and long-term period. There is an immediate reduction in the levels of smog and noise accompanied by a growth in the number of users of public transport. Simultaneously, there is a better protection of monuments and historical and artistic heritage, a tourist-commercial exploitation, a general increase in living conditions and security.

- Promote the pedestrian-cycle mobility

9 (http://ec.europa.eu/transport/themes/urban/urban_mobility/urban_mobility_actions/sump_en.htm
10 www.civitas.eu/guide_ebook/index.php and www.civitas-initiative.eu/docs/2086/CIVITAS_Guide_For_The_Urban_Transport_Professional.pdf

Foster and encourage sustainable approaches in the daily and leisure-oriented transfer, through actions aimed at the promotion and dissemination of cycling, such as

- the construction of bicycle paths, to form a continuous network (uniform road surface and free of obstacles) for daily movements;
- the upgrading of inter-modality between bicycle traffic and public transport in order to encourage the use of bicycles for home-work transfer and leisure activities;
- the reduction of the current speed limit for motor vehicles on urban and suburban roads, used promiscuously by motorists and cyclists;
- the implementation of measures that facilitate the non-conflictual coexistence of motorized vehicles, bicycles, pedestrians etc. by means of traffic calming, that eventually ensures even greater livability of huge areas of the city.