



WORKS & SERVICES DEPARTMENT
GOVERNMENT OF SINDH

LINK ROAD PROJECT
SUPERHIGHWAY (M9) TO NATIONAL HIGHWAY (N5)



ENVIRONMENTAL STUDY REPORT
(IEE)

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ENVIRONMENTAL STUDY

This chapter comprises of the findings of an *Initial Environmental Examination* (IEE) of the proposed Link Road (M9-N5) project. The upcoming paragraphs identifies the potential impacts during preconstruction, construction, operation stages on the physical, biological and socio-economic environment of the area of influence around which the Link road has to be built. This IEE encompasses the measures that will help to mitigate the proposed project's adverse environmental effects.

At the outset, table 1 below lists the stage wise impacts during the phases.

Table 1: Matrix for stage wise Impact Identification

S. No.	Impacts	Negative Impact	Positive Impact	No Impact
1.0-	Project Siting			
1.1	Displacement of people	✓		
1.2	Change of land use		✓	
1.3	Loss of trees	✓		
1.4	Shifting of Utilities	✓		
1.5	Impact on archaeological property			✓
2.0-	Construction Stage:			
2.1	Pressure on local infrastructure	✓		
2.2	Contamination of soils	✓		
2.3	Impact on surface and ground water quality	✓		
2.4	Impact on air quality	✓		
2.5	Noise and vibration pollution	✓		
2.6	Impact on flora and fauna	✓		
2.7	Traffic congestion	✓		
2.8	Stacking and disposal of construction material	✓		
2.9	Public health and safety	✓		
2.10	Social impact	✓	✓	
3.0-	Operation Stage:			
3.1	Air environment	✓		
3.2	Noise environment	✓		
3.3	Traffic Congestion		✓	
4.0-	Profit or Impacts of the Project			
4.1	Savings in travel time and fuel costs		✓	
4.2	Transportation of agricultural products		✓	
4.3	Exploitation of coal mines		✓	
4.4	Employment and business opportunities		✓	

- High level negative impact
- Low level negative impact
- High level positive impact
- Low level positive impact
- No impact

Screening

The impacts have been predicted for the Link Road (M9-N5) project through initial screening of potential environmental impacts due to siting of the roadway on the existing 2 lane carriage way and construction as well operation of the 4-lane carriageway by the checklist method and described in Tables given below.

Table 2: Screening Checklist for Potential Environmental Impacts

Screening Questions	Yes	No	Remarks
A. Project Siting			
Is the Project Area			
• Densely Populated?		X	
• Heavy with Development Activities?		X	
• Adjacent to or within any Environmentally Sensitive Areas?		X	
• Cultural Heritage Site		X	
• Protected Area		X	
• Wetland		X	
• Mangrove		X	
• Estuarine		X	
• Special Area for Protecting Biodiversity		X	
B. Potential Environmental Impacts			
Will the Project cause...			
• The construction, operation and decommissioning of the project involve actions which will cause physical changes in the locality (topography, land use, changes in water bodies etc.)	X		Topography will change to some extent
• Will the construction and operation of the project use natural resources such as land, water, materials or energy, especially any resources which are non-renewable or in short supply.		X	Not envisaged
• Degradation of land and ecosystems (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests)?		X	Not envisaged
• Dislocation or involuntary resettlement of people	X		Encroachments on RoW being totally unauthorized will have to be removed
• Dislocation of indigenous communities and Disadvantaged population		X	Not envisaged
• Degradation of cultural property, and loss of cultural heritage and tourism revenues?		X	Not envisaged
• Water resource problems (e.g. depletion/ degradation of available water supply, deterioration for surface and not envisaged, better management & conservation ground water quality, and pollution of receiving waters)?		X	Conservation practices will be followed
• Air pollution due to urban emissions?		X	Minor
• Social conflicts between construction workers from other areas and local workers?		X	Not expected
• Road blocking and temporary flooding due to land excavation during rainy season?		X	Possible but will be mitigated if some such situation emerges through better management practices
• Noise and dust from construction activities?	X		Minor but will be minimized through better management practices
• Traffic disturbances due to construction material transport and wastes?	X		Construction material transportation to the site will be managed through good management practices
• Temporary silt runoff due to construction?		X	Not envisaged but will be mitigated if some such situation emerges through better management practices
• Hazards to public health due to ambient household and occupational pollution, thermal inversion, and smog formation?		X	Not envisaged but will be mitigated if some such situation emerges through better management practices and implementation of Environmental Management and Monitoring Plan
• Water depletion and/or degradation?		X	Not envisaged, better management practices and conservation practices should be followed
• Overplotting of ground water, leading to land subsidence, lowered ground water table, and salinization?		X	Conservation practices will be followed and excessive use will be avoided
• Contamination of surface and ground waters due to improper waste disposal?		X	Solid and Liquid waste Disposal system will be in place to prevent possible contamination of water resources
• Pollution of receiving waters resulting in amenity losses, fisheries and marine resource depletion, and health problems?		X	Solid and Liquid waste Disposal system will be in place to prevent possible contamination of receiving waters.

PRE-CONSTRUCTION STAGE

The inevitable steps needed before any road upgradation process are briefly discussed below:

Displacement of People

The proposed Right-of-Way (RoW) falls under the land owned by the Government of Sindh. Therefore, displacement of people, if any, might be encountered would of encroacher's in legal terms. There is a procedure which the Government adopts in such projects.

Change of Land Use

This is another typical impact in the context of development on land use of a highway project has been positive in Pakistan in terms of Accessibility, Real Estate, Community and Economic development.

Loss of Trees

Removal of Vegetation and trees is another inevitable step along the RoW. of the proposed Link Road at the pre-Construction stage. However, the ground reality is that due to climate and soil conditions, this is an arid or semi-arid area. Hence this impact considered as negative is minimal for practical purpose.

Shifting of Utilities

The inherent process of transforming the location of Utilities and Services' infrastructure for any road project such as the M9-N5 Link Road, although counted initially as minor negative, eventually ends as improvement of infrastructure for long term.

Archeological Property

Fortunately, there are no known archeological sites within the area of influence of M9-N5 Link Road

CONSTRUCTION STAGE:

Topography

The topography along the project area will change to some extent because of the construction structures such as embankments, culverts etc. Visual Changes to the topography will be of permanent and minor, negative in nature and do not require any

Mitigation measures:

Never the less the project design should consider aesthetic concerns.

Built-up areas

The formation width in built up areas may result in access difficulties to market access, loading and vending activities for the locals. This impact is temporary and minor negative in nature.

Mitigation measures

- In Built-up areas, apply flexibility in order to avoid excessive resettlement.
- Incorporate technical design features that allows flexible shoulder width near towns.

Beside approved passages and intersections, the bridges can also be used as underpasses for pedestrians and their cattle.

Location of labor camps & material storage

Wherever Sindh Government's land is available for locating Labor Camps, Material Depots, Equipment and Machinery Yard etc. the Contractor shall choose particular sites within the overall campus indicated in consultation with Resident Engineer (RE). These activities shall not be allowed outside. If the Contractor chooses to locate his facilities on a private land, the contractor be responsible for any compensation, resettlement or rehabilitation costs. The RE or Client shall not get involved in acquiring or using the land in making any payments for doing so.

Change of land use

The proposed project involves rehabilitation of the existing of 2-lane carriageway both ways and construction of additional new lanes (wherever technically feasible) with 3.0 m outer shoulder and 1.0 m inner shoulder. Lane width is to be taken as 3.65 m. The RoW. is the property of Provincial Highway Department, Government of Sindh and is earmarked for road construction. The land use change will have long term potential positive impacts and will bring overall development in the project area.

Cross drainage and accessory structures

Flash flows and Seismic activities may damage structures or cause drainage problems in urban areas.

Mitigation measures

Adequately designed cross-sections of drainage structures based on hydraulic studies and historical rainfall data, taking regional/local lessons learned into consideration. Protective measures against scour problems at bridges and culverts (Gabions at abutments, wing walls and aprons for culverts), wherever applicable, additional planting with soil-stabilizing shrubs and grasses. All structures will be constructed with reasonable safety against seismic probability.

Table 3: Summary of Impact Identification-Construction Phase

S.No	Environmental Attributes	Aspect	Potential of Impact	Mitigation Measures
1.	Ambient Air Quality	Dust emissions from site preparation, excavation, material handling & other construction activities at site.	Major negative impact within site premises. No negative impact outside site premises. Short term.	Regular water sprinkling on the exposed surfaces to reduce dust emission and proper maintenance of all equipment at regular intervals.
2.	Noise & Vibration	Noise & Vibration generated from construction activities, operation of construction machinery, equipment and, fire movement.	Major negative impact near noise generation sources within site. No significant impact on ambient noise levels outside site. Short term.	The contemporary construction techniques provide adequate measures to control noise and vibration limiting its nuisance effects.
3.	Water Resources	<ul style="list-style-type: none"> o Surface runoff from project site. o Oil/fuel & waste spills. o Improper debris disposal. o Discharge of sewage from labour camp. 	Less likelihood. No significant negative impact. Short term.	Construction methods and techniques and disposal of used water need to be designed for proper drainage and control of discharge.
4.	Solid waste	Disposal of excavated soil, construction debris and other waste including domestic waste which can cause soil and air pollution and other health & safety issues.	Minor negative impact. Short term.	Proper solid waste management programme to be designed and executed for the construction and operation phases of the project, to be integrated in the EMP.
5.	Land use	Degradation/restriction of existing emergency services rehabilitation.	Minor negative impact.	
6.	Topography & Geology	Site development.	Temporary and Minor negative impact.	
7.	Soils	Construction and excavation activity leading to topsoil removal & erosion.	Minor negative impact.	
8.	Ecology Flora & Fauna	Habitat disturbance during construction activity.	Minor negative impact Short term.	It is required to adopt appropriate techniques while undertaking construction activities to minimize ecological disturbances.
9.	socio-economy	Increased job opportunity for locals. Economy related to material supply etc. expected to boom. The infrastructure of the project will increase the aesthetic and heritage profile of the project area.	Overall positive impact. Long term.	Regular and proper maintenance of the infrastructure is required throughout the project life.
10.	Public Health	Communicable diseases may be introduced due to the immigration of workers associated with project.	Minor negative impact.	Communicable diseases prevention program shall be prepared for construction workers or resident near the construction site.
11.	Traffic Pattern	Vehicle movement and traffic congestions on the road.	Major negative impact. Short term.	Prepare traffic management plan one month before the commencement of construction work.

AIR QUALITY

The prevalent ambient air quality along the Link Road Project's proposed carriageway as observed at selected field survey point was within allowable limits in accordance to the prescribed NEQS limits except for the CO and NO which were very slightly higher. Any additional emissions expected to arise during construction phase due to activity of construction equipment would be insignificant. Additional dust sources from construction is likely to create significant additional impacts, especially where the works are close to the sensitive receivers that are near to the proposed carriage way.

Potential impacts on the air quality during the construction stage will be due to the fugitive dust and the exhaust gases generated in and around the construction site. Dust is a major component of air pollution, generated mainly from the following construction activities:

- Site clearance and use of heavy vehicles and machinery/equipment etc. at construction site
- Procurement and transport of construction materials such as sand, cement to the construction site
- Other Gaseous emissions during construction result from operation of construction vehicles, plant and equipment.
- Asphalt heating

The negative impact on air quality during construction stage is predicted as "short term".

Fugitive Dust Control

Source wise Fugitive dust control measures are tabulated in Table 4.

The most cost-effective dust suppressant is water. Water can be sprinkled by the handheld sprays or with the help of automatic sprinkler systems as the situation would demand. The incoming loads of dusty materials could be covered to avoid spreading of dust.

Construction material (sand, gravel and rocks) will be transported by trucks covered with tarpaulins. All vehicles (trucks, equipment, trolleys, dozers etc.) shall comply with the NEQS for carbon emissions and noise.

Vehicular Emissions:

- Periodically check and maintenance of the construction machinery and haul vehicles.
- Regular change of engine oil and use of new spare parts/ machinery having good efficiency and fuel characteristics.
- Use of catalytic converters and low Sulphur fuels.
- Training of the operators of construction machinery and drivers of vehicles.
- Air quality monitoring at the project site during construction phase.

Procedural Changes During Construction Activities

Material Production:

The transport of material such as concrete and asphalt to construction sites generate significant amounts of dust. Setting up the temporary portable concrete plants and/or asphalt plants at construction sites can eliminate haulage of these material.

Emission from construction machinery:

The emissions from construction machinery would contain particulates, SO_x, NO_x, CO. However, the quantity of these pollutants is expected to be low due to low fuel requirement and use of cleaner fuel.

Idling Time Reduction:

Construction equipment is generally left idling while the operators are on break or waiting for the completion of another task. Emissions from idling equipment tend to be high. New idling control technologies, which automatically shut the engine off after a preset time can reduce emissions, without intervention of the operators.

Improved Maintenance:

Recognizing that significant emission reductions can be achieved through regular equipment maintenance, contractors could be asked to provide maintenance records for their fleet at regular intervals as a part of the contract awarded to them. A monetary incentive/disincentive provision could be made to encourage contractors to comply with the regular maintenance requirements.

Table 4: Source wise Fugitive Dust Control Measures

Source	Control Measures
Earth moving	- For any earth moving which are more than 30m from site boundary, conduct watering as necessary to prevent visible dust emissions.
Disturbed Surface Areas	- Apply dust suppression measures frequently to maintain a stabilized surface; - Areas, which cannot be stabilized, as evidenced by wind driven dust, must have an application of water at least twice per day.
Inactive Disturbed Surface Areas	- Apply dust suppressants in sufficient quantity and frequency to maintain a stabilized surface.
Unpaved Roads	- Water all roads used for any vehicular traffic at least twice per day of active operations.
Open Storage Piles	- Apply water to at least 30 percent of the surface areas of all open storage piles on a daily basis when there is evidence of wind driven fugitive dust; OR - Install an enclosure all along the storage piles.
Tracks-out Control	- Downwash of construction vehicles (especially tyres) prior to departure from site.

Noise and vibration

Noise and vibration are perceived as one of the most undesirable consequences of construction activity.

The construction activities will include the excavation for foundations and grading of the site and the construction of structures and facilities. Powered mechanical equipment such as generators, excavators, bulldozers, piling rigs, stabilizers, drills, stone crushers, graders, vibratory rollers, concrete-mixing plants, and screening plants can generate significant noise and vibration. Whereas various modern machines are acoustically designed to generate low noise levels.

The cumulative effects from several machines can be significant and may cause significant nuisances. However, these increased noise levels will prevail only for a short duration during the preconstruction and construction stages.

The noise and vibration produced by construction equipment is presented as reference.

Though the construction method has not been determined yet, however it is believed that the adopted method of construction shall produce less noise and vibration if the below suggested mitigation measures are adopted.

Mitigation measures:

In order to mitigate the impact of noise from construction equipment, the contractors should require to

- Provide evidence that all plant and equipment to be used for construction is fitted with

the necessary noise aborting devices to meet any statutory requirements that may apply from the NEQS;

- Install acoustic insulation or use portable noise barriers or install a hoarding where practicable to limit noise to protect sensitive areas such as schools, hospitals, relics, residential areas, etc.
- Plants and machinery with high intensity of noise and vibration such as drilling machines, rollers, excavators, etc. will be allowed to operate during specified / designated timings in day hours only (no operation timings from 0:00 to 5:00 am shall be observed). In case it is necessary to take construction activities in night time to catch up with the required schedule, permissions from local authorities shall be obtained.
- Near settlements, construction activities will be restricted to be carried out between 6 a. m. and 8 p.m. During night time (10 pm to 7 am) the measured impact noise at the sensitive receiver (residential or hospital) shall not be more than 3dB above background noise levels measured at the nearest sensitive receiver two weeks prior to the commencement of works.
- Unnecessary use of horn and hooter by the vehicle operators shall be restricted.
- Use of ear muffs, PPE and protective gears by the workers on the construction site shall be mandatory.
- Vibration due to operation of heavy construction equipment in the sensitive areas may be controlled by imposing time restrictions.
- In accordance with the Environmental Monitoring Plan, noise measurements will be carried out at locations and schedule specified to ensure the effectiveness of mitigation measures.

Table 5: Noise and Vibration Produced by Construction Equipment

Operation	Equipment	Noise (dB)	Vibration (dB)
Excavation and backfill			
Road surface breaker	Road surface breaker	105	73
	Truck	105	68
Soil stability (Pile driving, retaining wall)	Derrick	101	33
	Mortar injector	97	30
	Pile driving	101	63
Excavation	Excavator	101	72
	Bulldozer	98	64
	Crane	101	40
	Truck	105	68
	Concrete pumping	104	30
	Batching plant	98	30
	Bull dozer	98	64
	Rammer	106	57
Concrete placing	Truck	105	68
	Concrete pumping	104	65
	Batching plant	98	30
Soil backfill	Bulldozer	98	64
	Rammer	106	57
	Truck	105	68
	Roller	98	63
Construction of viaduct			
Foundation excavation	Boring machine	100	30
	Derrick	102	35
	Excavator	101	72
	Generator	98	68
	Truck	105	68
Foundation concreting	Concrete pumping	104	30
	Mixing plant	95	30
Soil stability(Sheet piling)	Sheet piling	98	63

Impact on water resources

Construction activities for the proposed development can have minor impact on hydrology and ground water quality of the area. The Malir River, and Kathor River, are two surface water bodies from which the Link Road might have drainage from.

Surface water might get contaminated due to the disposal of construction waste generated. This contamination can endanger the aquatic life and also threatening the health of natives. In addition to that, construction waste, if left unattended will result in forming leachate which will percolate through the soil strata and will reach underground water table and hence, will end up contaminating it.

Following are the most susceptible locations for contamination of surface and water resources during construction stage

- Waterlogged areas that have water in them during the period of construction;

- Surface and ground water resources close to construction material storage yard, concrete mixer etc.
- Workshop and maintenance sites of construction vehicles; and
- Surface water bodies close to labor camp.

Mitigation measures:

- In order to prevent degradation and maintain the quality of the water, adequate control measures have been proposed to check the surface run-off, as well as uncontrolled flow of water into any nearby water body like small pond, stream, etc. Following management measures are suggested to protect the water quality during this phase.
- The drainage designs for roadway should be cleared with the local drainage and irrigation authorities before works commence. Crossing structures should be prefabricated off site to prevent impacts to sensitive receptors near the stream/watercourse crossings (if any).
- Any drainage structures, cross road tunnels, culverts or pipes crossing the carriage way may need to be modified or protected and the detailed designs must make provisions to protect all infrastructure that may be affected by the constructions works.
- The solid waste will be disposed of in designated landfill sites to sustain the water quality for domestic requirements;
- Avoid excavation during monsoon season.
- Pit latrines and community toilets with temporary soak pits and septic tanks should be constructed on the site during construction phase to prevent the wastewater from entering into the water bodies.
- To prevent surface and ground water contamination on account of oil/grease, etc. leak proof containers should be used for storage and transportation of oil/grease. The floors of oil/grease handling area should be kept effectively impervious. Any wash off from the oil/grease handling area or workshop should be drained through impervious drains and effluent should be treated appropriately before releasing it.
- Construction activities generate disturbed soil, concrete fines, oils and other wastes. On-site collection and settling of storm water, prohibition of equipment wash downs, toxic releases from the construction site, etc. are some of the essential measures which prove helpful in minimizing water pollution.

LAND ENVIRONMENT

Land use & aesthetics

The proposed project will be built on existing road and comes under Government of Sindh limit. Land required for proposed project is in possession with Government of Sindh. There is minor change in land use pattern of the area.

Aesthetic and visual impacts during the construction phase are limited to the sections which are passing through the residential areas however the construction of roadway will have a positive impact on the urban aesthetics and architectural beauty that they will bring to the existing Link Road.

Solid waste and land contamination

Solid waste mainly generated is from the construction debris packaging material and workers at site. The mean (average) rates of waste for some specific materials are timber 13% which is the highest percentage of waste among all materials with sand 9% while other materials such as reinforcing steel 5%, cement 5%, and concrete 4%.

The entire solid waste generated at the construction site is recyclable except for the food waste which is perhaps considered to be a major issue in regard to contamination from non-construction waste however is negligible in comparison to the total solid waste generated during construction phase.

The component of construction waste likely to cause contamination of soil and other ecological resources are oil, paints and allied chemicals which require specific containment, proper handling and storage.

Mitigation measures

- A proper solid management program describing safe disposal mainly through recycling process would provide a viable solution against land contamination impact likely to be caused by solid waste generation during the construction phase.
- Excavated soil shall be checked for any harmful materials / contents before disposal.
- Contracts for services of waste collection / transport / dumping / recycling / treatment and reuse shall be formulated and assigned to reliable companies.
- Monitoring of all the waste management activities should be carried out by local municipality.

Topography

As a result of construction, topography of the Project Area will be changed. One of the important activities during construction will be the cutting and dismantling of pavements and borrow areas that will have an environmental impact on the topography of the Project Area.

The impact is temporary and minor negative in nature. Mitigation measure for the impact is the proper landscaping (construction of stone pitching/riprap across the embankments).

Soil erosion and sedimentation

Since the construction involves earth moving activity and lot of earth is disturbed and exposed therefore the impact of construction on erosion is significant.

Sediments dispersion and associated deposition in and around the project area will be of little concern as much is carried out through the aerial rather than hydrological regime.

Disposal of construction material

Disposal of construction materials shall be confined to the project site only and also suitable enclosure will be provided, hence no impacts on surrounding area are envisaged. Improper disposal of construction waste is likely to adversely affect the aesthetic value of the project area. The severity of such impact will depend upon the magnitude and type of construction waste and can be minimized by exercising proper waste disposal mechanisms.

Borrow/open pits

Borrow/Open pits and its excavation activities may result in land disputes, soil erosion, and loss of potential cropland, loss of vegetation, landscape degradation, and damage to road embankments.

Borrow/Open pits may also become potential sources of mosquito breeding and may prove hazardous to human beings, livestock and wildlife. This will also degrade hygienic conditions of the area.

This impact is permanent and moderately adverse in nature in nature.

Mitigation measures

- Necessary permits must be obtained for any borrow pits from the competent

authorities;

- No excavations should be allowed within a distance of 100 meters of the Right-of-Way;
- In borrow pits, the depth of the pits should be regulated so that the sides of the excavation will have a safe and disposal slope.
- Soil erosion along the borrow pit should be regularly checked to prevent/mitigate impacts on adjacent lands;
- In case borrow pits are filled with water, measures have to be taken to prevent the creation of mosquito-breeding sites; and
- Borrow pits can be used for sanitary landfills, but during the excavation, top 20 cm soil cover should be preserved for vegetation after the filling of the pits. This is the best way to restore the flora of that area.

Drainage, paths, roads, linear fixtures crossed

During the construction, if the Contractor s vehicles' moving to and from the construction site(s) cause any damage or disruption of services pertaining to drainage systems, paths, roads linear fixtures e.g., transmission lines and fences, the Contractor shall get the damage repaired and services restored within 24 hours of the damage clause failing which the RE will get an assessment of the damage and losses and debit that amount to Contractors account and the next payment shall be made to Contractor after deducting the debited amount.

Biological environment

The following aspects are of typical consideration while evaluating ecological impacts of Link Road (M9-N5)

Flora

On either side of the project, there is a huge expanse of land with natural native Vegetation. Their removal is definitely going to disturb the natural biodiversity of the area. With the construction of project natural biodiversity of the area may get disturbed. Their natural regeneration would require many years.

Mitigation measures:

It is highly recommended that two nurseries of natural wild plants should be

established with the suggestion of native population and Botanist consultants. It is very important to preserve and protect the natural native plants for its use for the present generation as well as for the generations to come.

Where trees have to be cut, mitigation shall be mandatory planting. Mitigation includes

- Incorporate technical design to minimize removal of roadside plantation;
- Apply flexibility in decision as which side to be widened;
- Plan for compensatory and compulsory plantation for each tree, 4 plants of similar floral function/type; and
- Disallow introduction of exotic species or species with known environmental setbacks (e.g. Eucalyptus, Prosopis).

After removing the existing trees and top soil (down to 0.5 m) the topsoil shall be retained for elsewhere in the project. The cut wood shall not be burned on site. Recent international practice suggests that replacement at a minimum rate of 3:1 for trees would be appropriate given possible difficulties with establishing trees and low survival rate of young trees. This would probably be affordable. Therefore, it is important to recognize that some significant part of the replacement ratio should allow for a high mortality rate among the newly planted trees. advice from the Sindh forest department shall be sought.

Fauna

Most wildlife species have been reported quite away from the Link Road. The area is already disturbed due to movement of traffic and human activities. Mammals and reptiles have shifted to far distances. Only common birds such as Doves, Crows, Sparrows, Kites, and pigeons. which are accustomed to the disturbed environment are commonly seen along the road side. Hence there will be minor impacts on the wildlife due to the road construction activities in the area.

Mitigation plan:

- Planting in the adjacent area can help to support local flora and fauna. It may provide additional habitat and migration routes for native animals while also guarding against erosion.
- Native species of plants are likely to require little maintenance and may prove beneficial for maintaining ecosystem integrity.

- Methods to protect species and their habitats from accidental damage during construction / operation may be adopted.
- Training programs for staff for environmentally sound performances may be taken up.

Migratory birds

The Link Road area does not have wetlands. The movement and feeding / breeding grounds of migratory birds are not envisaged to be disturbed.

IMPACT ON TRAFFIC

Since the existing 2 lane carriageway will be upgraded into 4 lane carriageways so the traffic congestion during the construction stage will be managed by proper planning. Suitable temporal segregation of traffic will be undertaken, especially during morning and evening time.

A temporary traffic management plan will be developed and submitted by the contractor at least one month before commencement of construction. The main objectives of the plan shall be to maximize the safety of the workforce and the travelling public. The secondary objective will be to keep traffic flowing as freely as possible.

Mitigation measures:

The Temporary Transport Management Plan will include consideration of the following:

- Lane availability and minimization of traffic flows along works site.
- Establishment of acceptable work hours.
- Agreement on the time frame for the construction work.
- Acceptability of diversion routes.
- Need for road closures and the necessary formal orders.
- Co-ordination with other.
- Description of Government of Sindh inspection/monitoring role.
- Establishment of incident management system.

The plan will be reviewed by Government of Sindh and approved, if found appropriate. Resources from contractor, government of Sindh, and the traffic police will be provided

as per the plan before construction commences.

Traffic signs and warning instructions are to be displayed at site and along the proposed diversion. Period and location of construction site shall be informed to public in general and specifically to local residents. Any closure of the roads /diversions proposed should be informed to the riders through standard signs and displays.

SOCIOECONOMICS OF THE AREA

The social impacts during the construction stage could result due to influx of migrant workers. A rise in the consumption of consumer goods in the local area, which will tend to boost up the local economy. As local labor will be hired from the vicinity of the project and surrounding areas, so no conflict is expected. As far as possible, local labor within the project area will be hired. All activities related to construction worker shall be confined to the project site only, hence no adverse social impacts are envisaged due to the project.

The expected social impacts related to the road project are as follows;

Land acquisition and resettlement

The economic impacts of expropriation may include the loss of houses or businesses, or the loss of business income, either temporary or permanent. These can be estimated and cost calculated. However, the actual valuation of these losses often proves to be difficult and protracted process.

The social and psychological impacts and associated costs are more complex, and they are often much more devastating.

Mitigation measures:

Mitigation of land acquisition impacts is achieved primarily by modifying the route or design of a road to minimize its effects on nearby properties and land uses. The design of alternative access to affected properties and the management of temporary works and traffic diversion can also reduce the magnitude of impacts on property and welfare. Consultation with affected people and other interested parties can assist planners in mitigating the impacts of land acquisition and resettlement actions by providing clear and timely information as well as opportunities for a complete discussion of options, preferences, and likely outcomes. Thus, by taking full account of the needs of those affected the design of implementation arrangements should be

based on more solid information. In the event that displacement is necessary, or that disruptions to livelihoods will occur, a comprehensive assistance strategy is required. This should go beyond financial compensation to include social and commercial rehabilitation or replacement.

PRESSURE ON LOCAL INFRASTRUCTURE

During the construction stage, demand for amenities such as water and power will increase mainly due to the contractor's camp which will put pressure on the existing local infrastructure. Considering the nature and magnitude of the project, pressure on local infrastructure will be short term and limited to construction stage only.

Shifting of utilities:

The infrastructure like optical fiber cables, gas, 11 KVA Lines & Poles, Pole Mounted Transformers, Electric Poles 220V, Telephone Poles, Light Poles, Sign Boards and other infrastructure etc. will be relocated in consultation with relevant departments. A proper relocation plan has to be prepared by the relevant DCOs consultation with design consultants and responsible authorities of utilities exist in RoW of the project. There will be temporary disturbance to local communities during shifting of utilities.

COMMUNITY AND ECONOMIC ACTIVITY IMPACTS

Traditional lines of travel

The introduction of faster traffic, and median barriers generally have cut traditional lines of travel. The alternative routes for local movements are a little longer, directly affecting businesses, pedestrians, and users of non-motorized transport. The burden of accommodating the changes is generally greater for the poor.

The normal links between villagers and their grazing lands have been cut. This could be a disturbance to increased travel routes and time duration.

By-passed community

Community may fear a loss of from the livelihood diversion of traffic, potentially changing existing land use patterns and possibly undermining the objective of greater control of access on the new dual Link Road (M9-N5).

Reduced convenience of traditional modes of transport

Traditional modes of transport would be disrupted by changes accompanied by

dualization project. The barrier effect of the project would increase travel time for short local trips, affecting access by foot, bicycle and non-motorized transport up to some extent. But this impact is not major in the project area.

Traditional modes of transport have been disrupted by changes accompanied by project. The barrier effect of the project has increased travel time and distance for short local trips, especially effecting access by foot, bicycle, and other non-motorized transport up to some extent. But this impact is not major in the project area.

Gentrification effect

Gentrification is a term applied to situations in which the value of land in a particular area is increased by infra-structural improvements, leading to higher rental values, a turnover in occupancy, and a replacement of lower-income tenants and residents by those who can afford the higher rents. The gentrification effect is foreseen on the entrance and exit at the M9 Superhighway and N5 National Highway for this Link Road Project.

Mitigation measures:

- i) The splitting of a community can be minimized by taking account of local movements, at the design stage and by making provision for improved crossings or alternative access routes.
- ii) The effects of bypassing local businesses can be mitigated by providing service areas adjacent areas the Link road and by encouraging local communities to make use of the new opportunities provided.
- iii) Local communities should be identified early in project planning and considered as constraints for planning of temporary traffic diversions and location of work site camps.

Archaeological and heritage sites

There are no known significant sites of archaeological and heritage value till this writing.

Employment opportunity

The local people (Unskilled and Semi-skilled) would get the job opportunities closer to their places of stay. Expenditure incurred by those employed at the project will go to local economy. Jobs would be created for unskilled, semiskilled as well as skilled labor

category, for which local population would be given preference. Thus, the project is expected to contribute to the overall development of the area.

Construction activity may lead to influx of construction laborer's. Though majority of work force would be recruited locally, technicians with specific skills, may be from outside. However, such manpower would be limited in number. The construction labor camp shall be provided with basic amenities of water supply, public toilets etc. Therefore, no significant pressure on local infrastructure is envisaged.

Public health

A large number of personnel will be engaged in the construction activities that would be subject to direct exposure to dust causing health impacts. Heavy machinery will be used for excavation, land leveling and carpeting during the construction stage. This potential impact will be minimized by providing suitable Personal Protective Equipment (PPE) such as nose mask with suitable filters and Gloves etc. The contractor store will be fenced. There will be signage indicating that construction is in progress will be placed at appropriate intervals on the road.

Communicable diseases may be introduced due to the immigration of workers associated with project. Communicable diseases prevention program will be prepared for construction workers or resident near the construction site and regular checkup and diagnostic will be done for all construction staff.

OPERATION STAGE:

AIR QUALITY

Improvement in road condition will help reduce traffic related emissions by allowing a smoother traffic flow. However, in the longer, run, increased traffic levels may lead to higher values of emissions. The impact is permanent and two-fold. It is positive in case of improvement of road conditions whereas minor negative, when traffic volume increases in future.

Mitigation measures

Following mitigation measures are needed to be suggested:

- Setting up to system to monitor air quality along the project area in accordance with acceptable International Standards;
- Monitoring emissions of vehicle as per NEQS (National Environmental Quality

Standards)

- Helping the owners and occupants of the affected premises to identify and implement special measure such as hedges and vegetation to reduce air pollution.
- Greenbelt Development

Increasing vegetation in the form of greenbelt is one of the preferred methods to mitigate air pollution. Plants generate oxygen, serve as a sink for pollutants, reduce the flow of dust and reduce the noise pollution too alongside the roadway.

Table 6: Summary Matrix of Predicted Impacts due to Proposed Project (Operation Phase)

S.No	Comments	Activities	Predicted impacts	Mitigation Measures
1	Ambient Air Quality	Particulate and gaseous emissions from vehicle movement	Minor negative impact long term	Maintaining emissions of vehicles per AQIS Control and Greenbelt Development
2	Noise	Noise from massive vehicle movement	Significant /Minor negative impact	Provision of adequate noise barriers such as hedges and indigenous tree species
3	Water quality	Oil fuel and waste spills Discharging of contaminated storm water	No significant adverse impact. No wastewater discharge outside the premises to the nearby water source.	
4	Land contamination	Over disposal fuel and material spills	Minor negative impact	Proper waste management plan and spill response plan to be implemented
5	Ecology, Flora & Fauna	Land use change	Significant negative impact not anticipated	
6	Socioeconomy	Increased job opportunities Improvement of infrastructure facilities Water Economic Growth	Overall positive impact. Socioeconomic status of the region will be improved	Regular social impact trainings of communities throughout the project life cycle
7	Traffic congestion	Improved road with free obstructions	Major Positive Impact	

Noise and vibration

Due to the increase in traffic volume, noise is expected to increase. This impact is permanent and minor negative. Provision of adequate noise barriers such as hedges and indigenous tree species will reduce the noise. Further Improvement can be made with the help of Ministry of Works and Services Government of Sindh by enforcing the laws and getting the vehicles tested, regularly after a specific time period, by some reputable vehicle testing laboratory and obtaining a certificate.

IMPACTS ON WATER RESOURCES

Wastewater generation and discharge

The operation of the roadway does not directly involve any discharge of effluents into the surrounding environment except for the certain locations identified in the project where physical activities involving excessive or commercial use of water is involved which may therefore require proper treatment prior to disposal.

The main sources of wastewater regarding the project operation include each service areas, maintenance and operation compounds. The runoff from these areas may affect the water quality of the surface and ground water, if the drainage and collection system is not properly designed and fail to functions.

The water consumption is not estimated yet however the quality of water projected is likely to be contaminated mostly with oil and grease therefore it is proposed that wastewater monitoring shall be carried out at specified locations for any possible incident of contamination and non-compliance to NEQS.

Storm water management:

Most of the storm water produced along the carriage way will be channeled to the well laid out storm water network and it will recharge in ground water recharge. Surface water may get polluted through storm water containing hazardous substances due to drainage or run-off from roads into water bodies. This impact is a negative permanent impact and minor in magnitude.

Mitigation measures

- Water quality monitoring during operation stage according to the approved schedule.
- If monitored parameters are above the prescribed limit, suitable control measures should be taken.

Land Environment

During the operation phase the routine impacts to soils would be limited largely to soil erosion impacts caused by vehicular traffic. Any excavations required for maintenance would cause impacts similar to those from construction phase, but at a lesser spatial and temporal extent. The less likelihood of accidental spill of products (such as fuel and material) may cause soil contamination. Except in the case of large spills, soil contamination would be localized and limited in extent and magnitude.

Mitigation measures:

To minimize the disruption of top soil following remedial measures should be taken.

- The top soil that will be excavated from the area will be preserved and reused for the horticulture purpose.

BIOLOGICAL ENVIRONMENT

During the operation phase, there is fewer chance of habitat disturbance. Hence no major impacts are envisaged. Following remedial measures should be taken to reduce the impact.

Mitigation measures:

Extensive plantation and landscaping is proposed to mitigate any impacts during this phase. Selection of the plant species to be done on the basis of their adaptability to the existing geographical conditions and vegetation composition. During the development of the green belt within the project area, emphasis shall be given on selection of plant species like nitrogen fixing species, species of ornamental values, species of very fast growth with good canopy cover etc.

TRAFFIC CONDITIONS

Driving safety & risk

Overall the condition of the road facilities in the vicinity of Link Road (M9-N5) will be enhanced with the implementation of proposed project. Routine safety measures, signage and road markings shall be introduced to reduce driving risk. The overall visibility will meet the local design standards and will be acceptable under all the foreseeable conditions. Improvement of sight distance and geometries. Signage and Markings should be included at the detailed design stages.

The upgraded 4 lane carriageways will improve safety reduce crashes, loss of lives due to better traffic management. This impact is permanent and major positive in nature.

Reduction in travel time and fuel consumption

Due to increase in speed and undisturbed flow of traffic travel time will be saved to reach at destination which in turn results in savings fuel costs. Trade will improve due to better transport opportunities. This impact is permanent and major positive in nature.

SOCIOECONOMIC

Activities during the operations would contribute to local economy by providing job opportunity as well as project will involve few locations of encroachers. These benefits will definitely increase the socioeconomic status of the region. Hence the overall impact will bring the positive change.

Community development/commercial activities

The development of project will also create or improve the amenities / services like power, road, communication, health, education, etc. thereby improving the life of local populace.

Improved roadway condition will promote better business opportunities such as new petrol pumps and hotels. In addition, such an activity will also increase the land value that will benefit the local residents. This impact is permanent and major positive in nature.

Wider economic growth

The proposed project will increase the economic activities along and around the area, creating avenues for direct/indirect employment in the post project period on long term. It will improve the commercial activity in the project area resulting in economic uplift of the people. There would be a wider economic impact in terms of generating opportunities for businesses much as transportation, food outlets, repair and maintenance etc. It will increase the value of land along the carriage way due to gentrification effect. Property value and Rents may increase in future. The Government may develop Industrial Zones in the proximity of Link Road (M9-M5) enhancing the commercial activities.

NATURAL AND MANMADE HAZARDS

The natural disasters (such as earthquakes) may be experienced during construction or operational phase however the likelihood is low. In case of occurrence of natural calamity safety of workers and population can be guarded by adopting appropriate and adequate mitigation measures.

Fire accidents and terrorist / sabotage activities cannot be foreseen but can be well prepared for, by taking precautionary measures (such as training of staff and extra security measures).