

A median separated 4-lane carriageway is considered as an alternative of the existing Bara – Kahu alignment to avoid the construction of 4-Lane Flyover / Overhead Bridge in the urban / built-up area of Bara – Kahu, if possible. Before establishing the substitutes of the existing alignment general characteristics of the surroundings are observed considering the population density / built-up areas which are a key factor to decide roughly the possibility of bypass.

Densely populated area up to 2.2 Km. offset from the existing alignment is observed on right side (South of N-75) of the project alignment up to Simly Dam road. Beyond Simly Dam road no space is available to construct the new facility. Further, the land beyond 2.2 Km. offset is reserved for the newly developing housing societies and forest area. Possibility to detour the alignment on the right side is not considered in view of the above explanation.

Following map (Figure – 5.3) shows the existing condition of population / built-up area South of the existing highway (N-75).

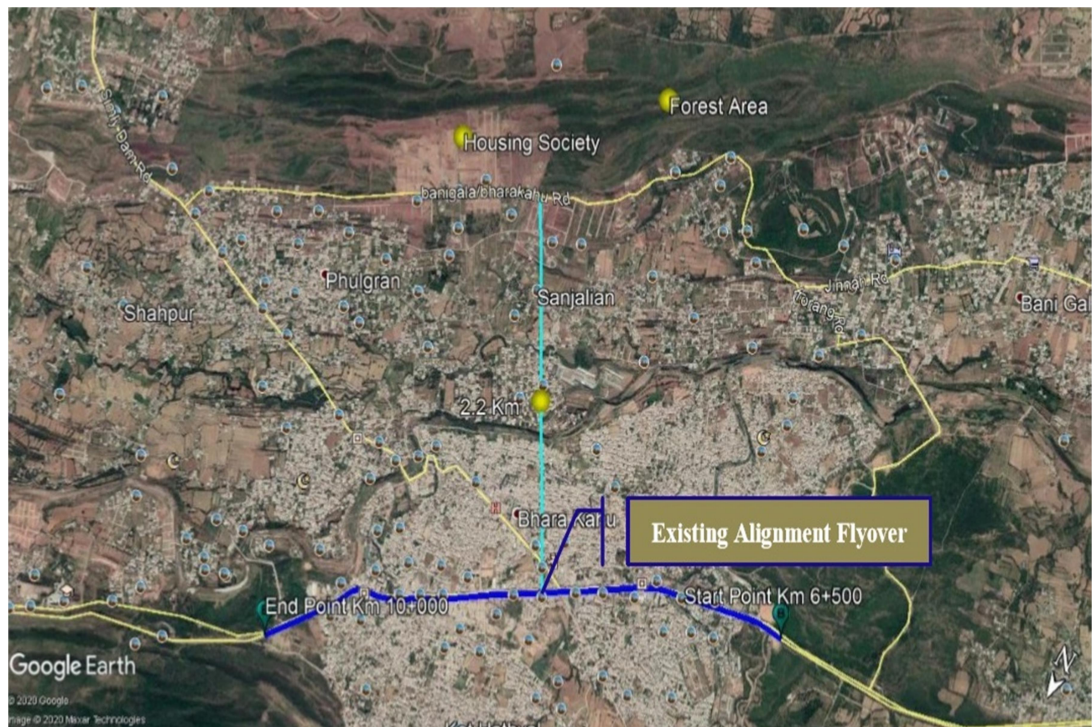


FIGURE – 5.3 : EXISTING CONDITION OF POPULATION / BUILT-UP AREA SOUTH (N-75)

On the other hand, three (03) alignment alternatives are considered to be a bypass on North for the existing alignment.

1. **1st Alternative** (Figure – 5.4), new alignment is considered as a bypass road from the out skert of Bara – Kahu near Korang Road to Phulgran Toll Plaza near Islamabad Murree Expressway start point. This alignment alternative is suggested to bypass Bara – Kahu and all near-by areas.

2. **2nd Alternative** (Figure – 5.5), following the alternative–1 up to National Institute of Vacuum Science and Technology and onward unoccupied / empty space on left side (North of N–75 at 1.7 Km. offset from the existing alignment). After that the existing track with narrow width in built up area both sides proposed to be followed and for the last portion follows the foothill before terminating on N–75.
3. **3rd Alternative** (Figure – 5.6), existing alignment of shahdara road along with the existing reserved space / ROW for Margalla Avenue may be utilized for a bypass and following the existing alignment of N–75 partially up to the end point of project.

5.6.2 Alternate 1: Bara – Kahu Northern Bypass (Length = 9.3 Km)

Location of the start point of the proposed alignment is near the Korang Road, Bara – Kahu where Y–interchange shall be provided. The length of the alternate–1 is 9.3 kilometers whereas the the existing length of National Highway (N–75) which is to be bypassed is 7.0 Km. The proposed alignment of bypass terminates at an existing round about situated at the start point of Islamabad–Murree Expressway near Phulgran Toll Plaza. This route may be considered for construction of Bara – Kahu bypass as it will run at an offset of 2.0 Km. on North from the existing alignment. The alignment runs parallel to the existing Shahdara road up to the River Korang tributary then it turns towards East following the natural valley up to Malach village. From the Malach to the end point, proposed alignment traverses along the existing Malach road towards South and terminates at an existing round about situated at the start of Islamabad–Murree Expressway.

One interchange shall be required at the start point to provide grade separated connection. The length of this route is 2.3 Km. more than the existing alignment (N–75). This alignment can be considered as an option for the planning and construction of Bara – Kahu Bypass but following constraints need to be evaluated before making any decision :

- (i) Land acquisition shall be required for the new alignment and cost of land acquisition is very high in Islamabad.
- (ii) Number of horizontal curves are more than the existing alignment.
- (iii) Extensive cutting in foothill of Margallah hills shall be required to limit the vertical grade up to 6%.
- (iv) Vehicle operational cost will be greater due to increased length.
- (v) Four (04) number of nullah bridges over tributaries of River Kurang shall be required along with retaining structures.
- (vi) Three (03) number of underpasses / flyovers for the local road Shahdara and Malach shall be required for crossings.



FIGURE – 5.4 : FIRST ALTERNATE OF PROPOSED PROJECT

5.6.3 Alternate 2: Bara – Kahu Northern Bypass (Length = 5.4 Km)

The proposed alignment of alternative–2 follows the alignment of alternative–1 from start point up to National Institute of Vacuum Science and Technology. After crossing the River Kurang tributary it follows the open area available at 1.7 km offset from the existing alignment on North. Traversing through the thin populated area of Qaziabad, alignment runs along the toe of Margallah Hills up to the end point before terminating on N75 between the Shahpur link road and Qaziabad link road near the existing police check post.

Two interchanges (Y–interchange) shall be required at the start and end points to provide grade separated connection on N–75. The length of the proposed alignment of alternative–2 is 5.4 kilometers. The length of this route is only 1.2 km more than the existing alignment (N–75) so, this alignment may also be considered as an option for the planning and construction of Bara – Kahu bypass but due to the following constraints needs to be evaluated before making any decision :

- (i) Land acquisition shall be required for the new alignment and cost of land acquisition is very high in Islamabad.
- (ii) Resettlement in area of Qaziabad shall be required to acquire right of way of the alignment.
- (iii) Number of horizontal curves are more than the existing alignment including few sharp curvatures.
- (iv) Huge cutting in foothill of Margallah hills shall be required to limit the vertical grades up to 6%.

- (v) Two number of bridges over tributaries of River Kurang shall be required along with retaining structures.
- (vi) Three number of underpasses for the local roads Shahdara and Qaziabad shall be required for crossings.



FIGURE – 5.5 : SECOND ALTERNATE OF PROPOSED PROJECT

5.6.4 Alternate 3: Bara – Kahu Bypass with Flyover (Length = 5.0)

The proposed alignment of alternative–3 follows the existing Shahdara road from N–75 up to 1.0 km and then turns on the existing Kiani Road up to the bridge over River Korang tributary. From the bridge location to the proposed end point on N–75, alignment follows the open space reserved by CDA for Margallah Avenue. The alignment terminates in Bara Kahu urban area near the Chugi Bus Stop on N–75 where Y interchange will have to be provided. From this point the alignment will follow the existing alignment of N–75 through urban area of Bara Kahu and flyover / overhead bridge will be required up to the end of urban area. Hence, in this option, combination of bypass and flyover can be utilized as an alternative of the existing alignment.

The length of the proposed alignment of alternative–3 is only 5.0 kilometers with construction of road in Bara – Kahu bypass up to Chugi Bus Stop and Flyover / Overhead bridge in the remaining length.

However, it is reported that the existing empty space in the vicinity of existing Kiani Road is reserved for Margallah Avenue which is included in the master plan of Islamabad by CDA. Margallah Avenue also known as Khayaban–e–Margallah would run along the foothills of Margallah Hills and will connect Sector B–17 (the G.T. Road a little on the

south of the Nicholson Monument) to Sector E-11 (11th Avenue and Khayaban-e-Iqbal) up to Bara – Kahu by utilizing the existing Margallah Road.

This alignment cannot be considered as an option for the planning and construction of Bara – Kahu Bypass due to the following reasons:

- (i) Land acquisition has already been done by CDA for the construction of Margallah Avenue as per the master plan of Islamabad.
- (ii) Improvement / dualization of the existing Shahdara road up to 1 km and Kiani road up to river Korang bridge shall be required to fulfil the design criteria.
- (iii) One bridge over river Kurang tributary shall be required.
- (iv) Flyover / Overhead bridge (Length = 1.4 km) shall be required in the length that shall traverse on N75.
- (v) Vehicle operational cost will be greater in comparison with the existing alignment due to increase in the length.

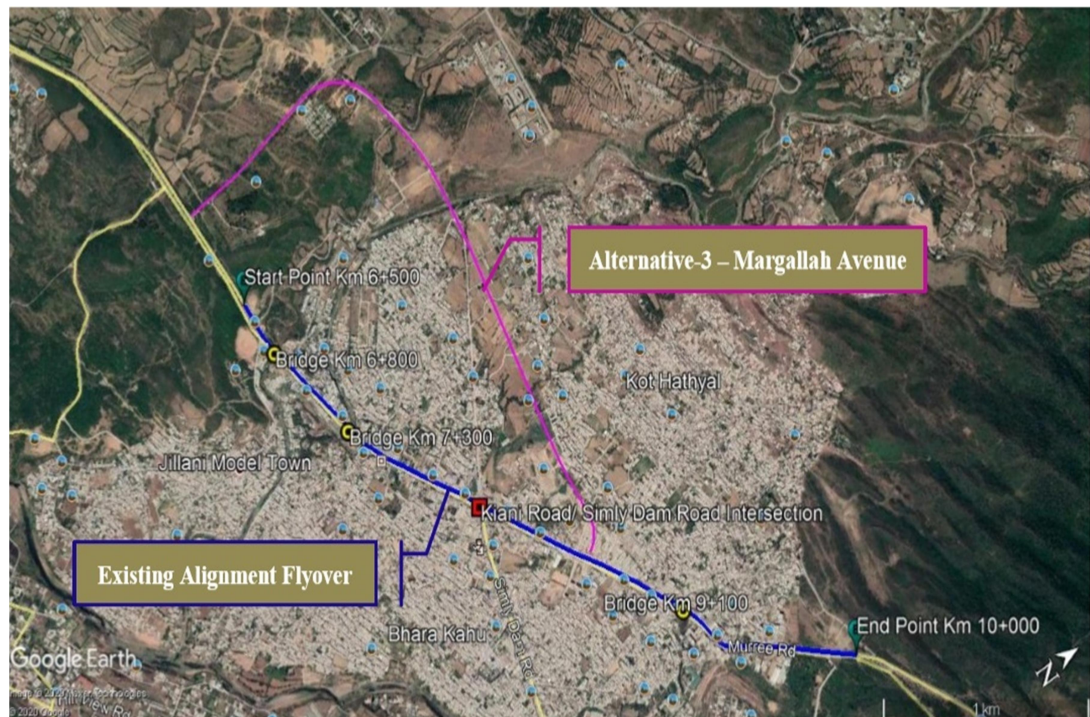


FIGURE – 5.6 : THIRD ALTERNATE OF PROPOSED PROJECT

5.6.5 Traffic Management

However, this alignment is a route that may be utilized for the traffic diversion / traffic management during the construction of flyover / overhead bridge on the existing alignment of N-75. Light traffic might be diverted on this alignment to facilitate the construction during execution of the project. To utilize alternate 3 as traffic management plan following will be required :

- ❖ Widening of existing Shahdara and Kiani road.
- ❖ Construction of a bridge over river Kurang tributary near the start of Kiani road.
- ❖ Construction of new road from river Kurang bridge up to Chugi bus stop.

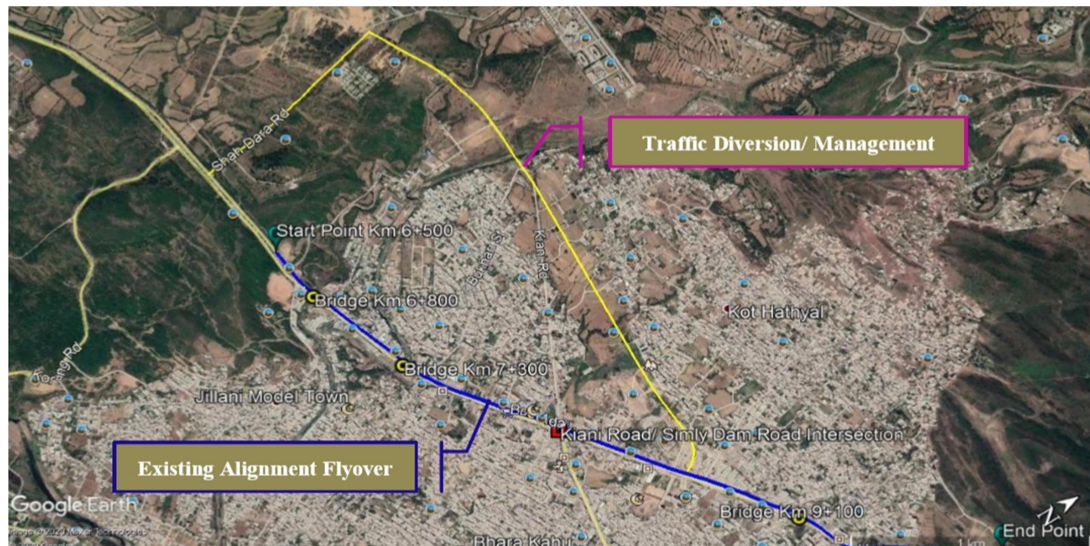


FIGURE – 5.7 : TRAFFIC DIVERSION / MANAGEMENT DURING CONSTRUCTION

5.7 REVIEW OF EXISTING ALIGNMENT (N-75)

Based on the site visit, study of maps and topographic survey of existing alignment, detailed review of the existing alignment has been carried out and it is recommended to use existing alignment (N-75) by constructing elevated bridge / flyover for the through traffic due to following reasons :

- (a) No land acquisition is required as minimum 31.5-meter ROW is available and construction of flyover / overhead bridge on the center line of existing facility is quite possible.
- (b) No major resettlement related issues shall be encountered while accommodating dual carriageway flyover / overhead bridge in build-up area of Bara – Kahu.
- (c) Shortest possible way between the start and end point of the project.
- (d) Existing alignment (N-75) is almost straight having a single sharp curve (Minimum radius is 125 meters) which fulfills the design speed of 60 Kph. However, efforts shall be made to improve the existing alignment to meet the minimum design speed of 70 kph as per TOR.
- (e) Maximum longitudinal grade is 4% on the existing alignment. However, criteria of maximum 3% longitudinal grade shall be followed in detail design of flyover / overhead bridge as per the required design parameter in TOR.
- (f) Local traffic will utilize the existing road after rehabilitation and through traffic shall ply on new flyover / overhead bridge hence elimination of congestion shall be achieved.
- (g) Vehicle operational cost shall be reduced due to enhancement in the level of service and reduction of travel time in built-up area of Bara – Kahu.
- (h) Safety of pedestrians and traffic shall be enhanced.
- (i) Difficulties in land acquisition and very high land cost in Islamabad justify the option of fly over on the existing alignment.

However, there will be challenges to face in following the existing alignment and to construct flyover / overhead bridge due to :

- ❖ In view of current traffic volume on the existing road (N-75) safety related issues may arise during execution.
- ❖ Execution shall be difficult with operational traffic and traffic management plan along with traffic diversion plan shall be required.
- ❖ High cost may be involved in construction of 4-lane flyover / overhead bridge for dual carriageway as compared to construction of bypass.
- ❖ Removal / relocation of utilities may affect the execution and delay the project completion

5.8 ALIGNMENT COMPARISON

An alignment comparison has been made on Google Earth to better understand the existing (N-75) alignment with the suggested Alternatives 1,2 & 3 shown in Figure – 5.4, to Figure – 5.6 respectively. Following Map (Figure – 5.8) shows the comparison of three different alignments of Bara – Kahu Bypass with the Existing Alignment.



FIGURE – 5.8 : COMPARISON OF THREE (03) ALIGNMENT ALTERNATIVES

Following Table – 5.1 shows the comparison of all alignments with route length, minimum curve radius and maximum longitudinal grade :

TABLE – 5.1 : COMPARISON OF THREE (03) ALIGNMENT ALTERNATIVES

DESCRIPTION OF ALIGNMENT	LENGTH (KM.)	MINIMUM RADIUS (M)	MAXIMUM GRADE (%)
Existing Alignment – Flyover	3.5	≈ 135	≤ 3 %
Alternative 1 – Bypass	9.3	≈ 80	≤ 6 %
Alternative 2 – Bypass	5.4	≈ 40	≤ 6%
Alternative 3 – Bypass & Flyover	5.0	≈ 135	≤ 3 %

5.9 SUGGESTED ALIGNMENT

Based on extensive reconnaissance survey it is found that general topography of the area and soil properties, geological and hydrological characteristics for all possible alternative alignments are similar except lengths of alternative routes and type of land use.

In 1st, 2nd and 3rd alternative agriculture land and natural forest land along with built-up areas is witnessed in reconnaissance survey however, existing alignment is fully surrounded by the thickly built up area of Bara – Kahu.

Detail reconnaissance survey of all alignments augmented with maps it is concluded that existing alignment of N75 may be used with the construction of 4-lane flyover / overhead bridge being only a viable solution as widening of the existing road for the current traffic volumes is not possible due to limited ROW.

6.0 SCREENING OF ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

6.1 GENERAL

The potential impacts of the proposed project on the area's geomorphology, surface and groundwater resources, air quality, biological resources, and socio-cultural environment have been discussed in the following sections. Where appropriate, mitigation measures have also been included to reduce the unacceptable impacts. Likely impacts that trigger the Environmental Management Plan (EMP), and accompanied mitigation measures have been identified in this EIA. The organizational structure and responsibilities of various functionaries towards EMP also have been highlighted, indicated generic environmental control measures that need to be applied during the possible implementation of EMP if and when required. The primary objectives are to :

Facilitate the implementation of the mitigation measures required by EPA.

- ❖ Identify monitoring parameters in order to ensure the effectiveness of the mitigation measures.
- ❖ Provide a mechanism for taking timely action in the face of unanticipated environmental situations.
- ❖ Identify training requirements at various levels

Accordingly, mitigation measures have also been prepared to manage the environment and for sustainable development.

6.2 ENVIRONMENTAL PARAMETER INCLUDING LOCATION OF PROJECT

Environmental problems related to location of the project are mostly in the areas of physical setting, socioeconomic setting, ecological setting and special areas. The project involves rehabilitation of the existing road and construction of elevated flyover / overhead bridge for the through traffic.

6.3 ENVIRONMENTAL PARAMETER REGARDING DESIGN

The design of project has sought to minimize any environmental potential impacts by ensuring that the project should be in according to the environmental standards. Local aesthetic value is another issue to be considered during project design.

6.4 IMPACT PHASES

This impact assessment and mitigating measures cover the entire cycle of the project activities, from pre-construction to construction, operation and maintenance. The coverage of each of project phases is defined as follows :

- ❖ Design Phase,
- ❖ Pre-construction Phase
- ❖ Construction Phase
- ❖ Operation Phase

6.5 TYPES OF IMPACTS

The types of impacts that may arise during Project works can be classified as follows :

Direct Impacts – i.e., those directly due to the Project itself such as the impacts to air quality resulting from construction activities, equipment and vehicles. Direct impacts also include the impact of construction expenditures in the local economy.

Indirect Impacts – i.e., those resulting from activities prompted by the Project, but not directly attributable to it. The use of rock and other construction materials, for example, has an indirect impact of increasing the demand for these materials.

Cumulative Impacts – i.e., impacts in conjunction with other activities. A single road improvement may not exert a significant environmental impact, but if some roads are developed in the same area developing a road network the cumulative or additive effect could be more significant.

Impacts in all three categories may be either :

Short-term – i.e., impacts which occur during construction and affect land use, air quality and other factors. Many of these impacts, however, will be short-term and without long lasting effects. Even the effects of some relatively significant impacts such as borrow pits, for example, may be eventually erased if appropriate mitigation actions are taken.

Many potential short-term negative impacts can be avoided or otherwise mitigated through proper engineering designs and by requiring Contractors to apply environmentally appropriate construction methods.

Long-term – i.e., construction impacts that could, for example, affect regional community health and safety if poor design practices are used.

Both short-term and long-term impacts may be either beneficial or adverse. Short term positive impacts will include, for example, the generation of employment opportunities during construction period. Long-term benefits will include enhanced development opportunities, improved transport services, easier access to commercial and service facilities; faster communications and commodity transport; improved access to markets and growth centers and increased services and commercial facilities.

6.6 POTENTIAL IMPACT SOURCES

Environment impacts are attributable to the project implementation and can broadly be classified into those taking place during construction and those occurring during operational phase. Some of these impacts can be anticipated and avoided through appropriate adjustments in the project design. Some can be mitigated by careful implementation of the project while other can be mitigate with by appropriately following the operational manual and an effective collaboration with local communities.

Construction related Impacts are heavily dependent on :

- ❖ The contractor's work practices, especially those related to storage of construction mater
- ❖ Project management's enforcement of correct construction practices and standards;
- ❖ An effective collaboration with local communities in evolving a workable Social framework.
- ❖ The quality of Monitoring and Reporting of EMP implementation

Operational impacts of the proposed project are associated with the movement of vehicular traffic on it and allied activities. These include air and noise pollution, safety hazards and other similar impacts.

For this Project, potential impacts are reviewed under construction and operational phases. The environment has been studied under the following sub-heads:

- ❖ Physical Environment
 - Land Resource
 - Water Resource
 - Air Quality
 - Noise Level
- ❖ Biological Environment
 - Flora
 - Fauna
 - Fish
 - Endangered Species
 - Cultural and Historical Sites
 - Socio-economic Environment

6.7 ENVIRONMENTAL IMPACTS AND THEIR MITIGATION MEASURES DURING CONSTRUCTION AND OPERATIONAL PHASE

Anticipated impacts during construction and operational phase is given in Table – 6.1 and Table – 6.2 similarly in details with discussion of suggested mitigation measures.

TABLE – 6.1 : ANTICIPATED IMPACTS AND THEIR MITIGATION MEASURES DURING CONSTRUCTION PHASE

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
TOPOGRAPHY	The main impact during the construction will be the clearing of ROW, cutting and filling of borrow pits including	<ul style="list-style-type: none"> ❖ To minimize erosion and avoid creating hazards for people Ditches or borrow pits that cannot be fully rehabilitated will be landscaped ❖ Land for temporary facilities like

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
	erosion of topsoil cover.	<p>construction camp, storage areas etc. shall be brought back to its original land use.</p> <ul style="list-style-type: none"> ❖ No waste dumping should take place in borrow areas ❖ Slope protection by providing frames, dry stone pitching, masonry retaining walls, planting of grass and trees. ❖ Side slopes of all cut and fill areas will be graded and covered with stone pitching, grass and shrub as per design specifications. ❖ Care should be taken that the slope gradient shall not be greater than 2:1. ❖ To avoid soil erosion the earth stock piles will be provided with gentle slopes.
This impact is temporary and Moderate adverse in nature		
SOIL	Soil erosion due to Construction activities, earthwork, and cut and fill, stockpiles etc.	<ul style="list-style-type: none"> ❖ Low embankments will be protected by planting vetiver grass that can flourish in relatively dry conditions. ❖ Soil contamination by asphalt will be minimized by placing all containers in caissons. ❖ All spoils will be disposed of as desired and the site will be restored back to its original conditions before handing over. ❖ Store and reuse topsoil. This requires that topsoil will be separated from subsoil during the initial excavation. The more fertile topsoil can later be deposited on the slopes to form a superficial layer conducive to seedling establishment. ❖ Replanting cleared areas and slopes is the most effective action to be taken in reducing erosion and stability problems, It will be undertaken as early as possible in the construction process, before erosion becomes too advanced.
	Compaction of soil and impact on quarry haul roads due to movement of vehicles and	<ul style="list-style-type: none"> ❖ Construction vehicles, machinery, and equipment to be stationed in the designated ROW to avoid compaction.

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
	equipment.	<ul style="list-style-type: none"> ❖ Approach roads / haulage roads shall be designed along the barren and hard soil area to reduce the compaction. ❖ Transportation of quarry material to the dumping site through heavy vehicles shall be done through existing major roads to the extent possible to restrict wear and tear to the roads.
	Contamination of soil due to leakage / spillage of oil, bituminous and non-bituminous debris generated from demolition and road construction	<ul style="list-style-type: none"> ❖ Construction vehicles and equipment will be maintained and refueled in such a fashion that oil / diesel spillage does not contaminate the soil. ❖ Fuel storage and refueling sites to be kept away from drainage channels. ❖ Unusable debris shall be dumped in ditches and low lying areas. ❖ To avoid soil contamination Oil Interceptors shall be provided at wash down and refueling areas. ❖ Waste oil and oil soaked cotton / cloth shall be stored in containers labeled. ❖ Non-bituminous wastes to be dumped in borrow pits with the concurrence of landowner and covered with a layer of topsoil conserved from opening the pit. ❖ Bituminous wastes will be disposed off in an identified approved dumping site.
This impact is temporary and moderate adverse in nature.		
AIR QUALITY	Dust Generation due to construction activities and transport, storage and handling of construction materials	<ul style="list-style-type: none"> ❖ Unloading of loose and fine materials through covered vehicles. ❖ Paved approach roads. ❖ Storage areas to be located downwind of the habitation area. ❖ Water spraying on earthworks, unpaved haulage roads and other dust prone areas. ❖ Provision of PPEs to workers. ❖ Storage of construction materials to be carried out in accordance with the construction material storage and handling plan.

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
	Emission of air pollutants (PM ₁₀ , PM _{2.5} , HC, SO ₂ , NO _x , CO etc.) from vehicles due to traffic congestion and use of equipment and machinery	<ul style="list-style-type: none"> ❖ Storage areas shall be at least 500m from communities. ❖ Regular maintenance of machinery and equipment. ❖ Batching, asphalt mixing plants and crushers at downwind (1km) direction from the nearest settlement. ❖ Regular Ambient air quality monitoring will be conduct. ❖ Construction traffic management plan (CTMP) will be followed. (mention in details: Potential Environmental Enhancement Measures.)
The overall impact on the quality of air during the construction phase will, however, be limited to the project's construction phase only		
NOISE	<p>Noise from construction activities and operation of equipment and heavy machinery i.e.</p> <ul style="list-style-type: none"> ❖ bulldozers, ❖ excavators, ❖ stabilizers, ❖ concrete mixing plant, ❖ pneumatic drills, ❖ stone crushers ❖ asphalt plants and ❖ other equipment's 	<ul style="list-style-type: none"> ❖ All equipment to be timely serviced and properly maintained ❖ Construction equipment and machinery to be fitted with silencers and maintained properly. ❖ Confining noisy work to normal working hours in the day, wherever possible. ❖ Providing the construction workers with suitable hearing protection like ear cap, or earmuffs and training them in its use. ❖ Restricting construction vehicle movements during nighttime. ❖ Contractors shall comply with submitted work schedule, keeping noisy operations away from sensitive points; implement regular maintenance and repairs; and employ strict implementation of operation procedure.
This impact is temporary and minor adverse in nature.		
CONSTRUCTION CAMP	Due to the proposed camp sites, loss of vegetation and dissatisfaction of rehabilitation measures during and after completion of	<ul style="list-style-type: none"> ❖ Camp site to be selected after careful reconnaissance so as to minimize the social and physical disruption to local communities and road users. ❖ Setting up of a complaint office for public complaints registration and advertisement of the grievance

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
	construction phase may occur.	<p>redress mechanism</p> <ul style="list-style-type: none"> ❖ The contractor shall provide plan for removal & rehabilitation of site upon completion. ❖ Reinstate any temporary facilities to pre-existing conditions in ecologically sensitive areas. ❖ Implement landscaping plan for all facilities in areas where high landscape value and visual vulnerability to the proposed activities warrants site-specific landscape restoration measure..
This impact is temporary and moderate adverse in nature.		
BORROW PIT	<p>Borrow areas / open pits and its excavation activities may result in:</p> <ul style="list-style-type: none"> ❖ land disputes, ❖ soil erosion, ❖ loss of potential cropland, ❖ loss of vegetation, ❖ landscape degradation, and ❖ damage to road embankments 	<ul style="list-style-type: none"> ❖ Non-productive, barren lands, upland shall be used for borrowing earth with the necessary permissions / consents. ❖ Depths of borrow pits to be regulated and sides not steeper than 25%. ❖ Topsoil to be stockpiled and protected for use at the rehabilitation stage ❖ In borrow pits the depth of the pit will be regulated so that the sides of the excavation will have a slope not steeper than 1:4. ❖ Soil erosion along the borrow pit shall be regularly checked to prevent / mitigate impacts on adjacent lands. ❖ In case borrow pits fill with water, measures have to be taken to prevent the creation of mosquito-breeding sites. ❖ A pit shall have a barrier controlling access and such barriers shall be clearly visible to prevent safety hazards to the public. ❖ The use of cable, chain or similar barrier will prohibit. ❖ The control barrier shall deny access when the pit is not in operation;
This impact is permanent and moderate adverse in nature.		
WATER	Sourcing of water during Construction	<ul style="list-style-type: none"> ❖ Arrangements shall be made by contractor that the water availability and supply to nearby communities remain unaffected.

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
		<ul style="list-style-type: none"> ❖ Water intensive activities not to be undertaken. ❖ Provision of water harvesting structure to augment groundwater condition in the area.
	Disposal of water during construction	<ul style="list-style-type: none"> ❖ Provisions shall be made to connect roadside drains with existing nearby natural drains.
	Alteration in surface water hydrology	<ul style="list-style-type: none"> ❖ Existing drainage system to be maintained and further enhanced. ❖ Provision shall be made for adequate size and number of cross drainage structures particularly in the areas where land is sloping towards road alignment.
	Siltation in water bodies due to construction activities / earthwork	<ul style="list-style-type: none"> ❖ Embankment slopes to be modified suitably to restrict the soil debris entering water bodies. ❖ Provision of Silt fencing shall be made at water bodies. ❖ Silt / sediment will be collected and stockpiled for possible reuse as surfacing of slopes where they have to be revegetated. ❖ Earthworks and stone works to be prevented from impeding natural flow of rivers, streams and water canals or existing drainage system.
	Deterioration in Surface water quality due to : <ul style="list-style-type: none"> ❖ leakage from vehicles ❖ leakage from equipment ❖ waste from construction camps. 	<ul style="list-style-type: none"> ❖ No vehicles or equipment should be parked or refueled near water-bodies, so as to avoid contamination from fuel and lubricants. ❖ All chemicals and oil shall be stored away from water and concreted platform with catchment pit for spills collection. ❖ All equipment operators, drivers, and warehouse personnel will be trained in immediate response for spill containment and eventual clean-up. Readily available, simple to understand and preferably written in the local language emergency response procedure, including reporting, will be provided by the

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
		contractors. ❖ Construction camp to be sited away from water bodies. ❖ Wastes must be collected, stored and taken to approve disposal site only. ❖ Water quality shall be monitored.
This impact is temporary and moderate adverse in nature.		
CONSTRUCTION WASTE & DEBRIS	Selection of Dumping Sites	❖ Dumping sites will be selected away from residential areas and water bodies ❖ Dumping sites must be having adequate capacity equal to the amount of debris generated. ❖ Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. ❖ Burning of solid waste will be prohibited. ❖ All personnel will Train and instruct in waste management practices and procedures as a component of the environmental induction process
	Reuse and disposal of construction and dismantled waste	❖ All excavated materials from roadway, shoulders, verges, drains, cross drainage will be used for backfilling embankments, filling pits, and landscaping. ❖ Unusable and non-bituminous debris materials will be suitably disposed off at pre-designated disposal locations, with approval of the concerned authority. ❖ The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. ❖ Unusable and surplus materials, as determined by the Project Engineer, will be removed and disposed off-site.
This impact is temporary and moderate adverse in nature.		
HEALTH & SAFETY OF WORKERS	Safety of Workers and accident risk from construction activities	❖ Safe work practices will be followed and applied by the contractor. ❖ At construction site fluorescent and retro refractory signage will be used. ❖ Training to workers on safety

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
		<p>procedures and precautions.</p> <ul style="list-style-type: none"> ❖ All regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress shall be complied with. ❖ Provision of PPEs to workers. ❖ Provision of a readily available first aid unit including an adequate supply of dressing materials.
This impact is temporary and minor adverse in nature		
SOCIAL ISSUES	<p>Approach / hindrance problems for the local residents / business owners and movement of the people will be disturbed during construction activities.</p>	<ul style="list-style-type: none"> ❖ Maintaining regular communication with local communities and other stakeholders to minimize tensions arising from Project activities. ❖ Maintaining a grievance procedure to facilitate stakeholders in expressing concerns. ❖ Timely completion of the construction work and provision of alternate routes for the areas where the construction is being carried out.
This impact is temporary and minor adverse in nature		
CONSERVATION OF RESOURCES AND ENVIRONMENTAL SUSTAINABILITY	<p>Construction will pose burden on the existing natural resources</p>	<ul style="list-style-type: none"> ❖ One strategy for conserving aggregate resources and reducing the demand for virgin aggregate is to recycle and reuse materials in road construction; ❖ Reuse of materials, such as concrete and asphalt, reduces the need for concrete and asphalt manufacturing, reduce greenhouse gas (GHG) emissions, and reduces waste disposal costs and emissions; ❖ Use of solar panels and LED lights in the construction camps instead of using diesel operated generators and normal bulbs. ❖ Waste minimization strategies will be developed and followed. ❖ To reduce the level of energy consumption, warm-mix asphalt (WMA) will be used to replace hot-mix asphalt (HMA). Besides the fact

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
		that WMA is produced at a lower temperature, it also induces great benefits such as an improvement of working conditions (less exposure to heat and fumes) and asphalt compaction, reduction of paving cost and longer hauling.
This will be a permanent negative impact.		
SITE RESTORATION AND REHABILITATION	Clean-up Operations, Restoration and Rehabilitation	<ul style="list-style-type: none"> ❖ Contractor will prepare site restoration plans, which will be approved by the 'Engineer'. ❖ The clean-up and restoration operations are to be implemented by the contractor prior to demobilization ❖ All construction zones including culverts, road-side areas, camps, hot mix plant sites, crushers, batching plant sites and any other area used / affected by the project will be left clean and tidy, to the satisfaction of the Environmental officer. ❖ All the opened borrow areas will be rehabilitated and 'Engineer' will certify.
This will be a permanent negative impact.		

TABLE – 6.2 : ANTICIPATED IMPACTS AND THEIR MITIGATION MEASURES DURING OPERATIONAL PHASE

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
AIR QUALITY	Air quality will improve due to smooth flow of traffic	<p>During operational stage, the overall air quality will improve due to smooth flow of Traffic, however following mitigation measures are recommended to be adopted for minimum deterioration of air quality:</p> <ul style="list-style-type: none"> ❖ Vehicles with excessive smoke emissions shall not be allowed to enter the project area ❖ Permissible limits of air pollution (as specified in the guidelines) will be monitored on regular basis and any deviation shall be taken care of; ❖ Signs for sensitive zones to disallow

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
		<p>the use of pressure horns.</p> <ul style="list-style-type: none"> ❖ To improve air quality roadside tree plantation will be done.
This impact is permanent and minor adverse in nature.		
NOISE	Noise level will decrease because of smooth traffic flow	<p>To avoid any noise pollution following mitigation measures should be taken into account :</p> <ul style="list-style-type: none"> ❖ Ban on use of pressure horns; ❖ Proper implementation of inspection and maintenance program for vehicles. ❖ Strict check on use of proper silencers especially for motorcycles.
This impact is permanent and minor adverse in nature.		
LAND AND SOIL	Soil erosion at embankment during heavy rainfall	<ul style="list-style-type: none"> ❖ Periodic checking to be carried to assess the effectiveness of the stabilization measure ❖ Necessary measures to be followed wherever there are failures.
This impact is temporary and minor adverse in nature.		
WATER	No major adverse impact on surface and groundwater, however Water logging may be caused due to blockage of drains	<ul style="list-style-type: none"> ❖ Regular visual checks and cleaning of drains shall be done along the alignment to ensure that flow of water is maintained through cross drains and other channels. ❖ To avoid exception of some occasional oil spills due to any road accident emergency plan will be followed.
This impact is temporary and minor adverse in nature.		
MAINTENANCE OF RIGHT OF WAY & SAFETY	Accident risks associated with traffic movement	<ul style="list-style-type: none"> ❖ All safety features provided in the main approach roads such as guide rails, speed bumps, will be maintained and kept in good condition. ❖ Traffic control measures, including speed limits, will be forced strictly. ❖ Further encroachment of squatters within the ROW will be prevented. ❖ Monitor / ensure that all safety provisions included in design and construction phase are properly maintained.
This impact is temporary and minor adverse in nature.		

ENVIRONMENT COMPONENT	ACTIVITIES AND POTENTIAL IMPACTS	MITIGATION MEASURES
ROAD MAINTENANCE WORK	Lack of maintenance during operational phase can cause harm	<ul style="list-style-type: none"> ❖ Implementation of HSE Plans during the maintenance period. ❖ Strict implementation of PPEs. ❖ Use of high quality equipment and material by the contractor ❖ Continuous improvements in the emergency plans. ❖ Placement of sign boards for traffic diversions and proper implementation of traffic diversion plans. ❖ Selection of suitable sites for contractor camps and implementation of all the related important protocols for the management of camp activities in order to avoid environmental and HSE issues. ❖ Conservation practices that limit particulate matter emissions will be incorporated into long-term maintenance plans.
This impact is temporary and minor adverse in nature.		

6.8 POTENTIAL ENVIRONMENTAL ENHANCEMENT MEASURES

As an additional measure, following steps will further enhance roadways environments where its related dividends will be continued to be received for a very long time far beyond the project life. Following potential environmental enhancement measures will be taken to protect the environment of the project area, workers and road users.

6.8.1 Construction Traffic Management Plan (CTMP)

An appropriate systematic traffic management system is essential for safety and smooth traffic flows on roads, making a maximum usage of road facilities to enlarge the current road capacities.

- (a) To achieve smooth traffic flow
- (b) To reduce traffic accidents, and
- (c) To create pedestrian –friendly facilities

This TMP addresses the following Key Issues :

- ❖ Safety and amenity of road users and the public;
- ❖ Site security, site access and signage;
- ❖ Project identification, including advertising and site signage;
- ❖ Traffic and road user delay and inconvenience management;

- ❖ Speed limit signage;
- ❖ Traffic transfer (switch) arrangements and procedures;
- ❖ Maintenance during Construction;
- ❖ Traffic and Safety Management Responsibilities;
- ❖ Construction staging including detailing the intersection layout and capacities for each and every construction stage;
- ❖ Emergency and Incident Response Plans

Table – 6.3 below shows the risks to be dealt with during the design and construction stage of the Project that may affect safety.

TABLE – 6.3 : CONSTRUCTION TRAFFIC MANAGEMENT PLAN

RISKS	POTENTIAL CONSEQUENCES	PROPOSED RISK TREATMENT
Construction methods may cause disruption to traffic	Traffic delays causing frustration to drivers	<ul style="list-style-type: none"> ❖ Consider methods of construction at an early stage during the design to reflect community needs and reduce delay times therefore minimizing the impact on traffic
Traffic management– inadequate anticipation and communication of issues	Potential community issues causing dissatisfaction and frustration	<ul style="list-style-type: none"> ❖ Determine traffic routes and engage with community to refine details. ❖ Confirm pre–existing conditions. ❖ Consider the need for night assessment. ❖ Identify any short–term corrective actions.
Severe delays to traffic perceived by the community as a direct result of the construction activities.	Community dissatisfaction, claims for time delays.	<ul style="list-style-type: none"> ❖ Establish good public relations from the outset. ❖ Erect Early Warning information signs through Variable Message Signs (VMS). ❖ Early engagement of ascertain needs and potential effects of changed access.
Major Traffic Incident.	Local traffic disrupted upsetting locals	<ul style="list-style-type: none"> ❖ Regular checking of Traffic Management Plan implementation. ❖ Have procedures in place for rapid recovery, Keep locals informed.
Access to site for deliveries	Traffic disruption or interference	<ul style="list-style-type: none"> ❖ Development of this Plan in conjunction with Community Communication Strategy – access

RISKS	POTENTIAL CONSEQUENCES	PROPOSED RISK TREATMENT
		<p>points will be high risk locations and will need detailed consideration.</p> <ul style="list-style-type: none"> ❖ Simplification of traffic staging will simplify access arrangements or minimize impacts ❖ Signage and pre-delivery notifications for delivery routes to be clear and simple as per the VMP
Traffic Speed	Works in multiple areas across the Project may result in intermittent speed changes that may frustrate road users	<ul style="list-style-type: none"> ❖ Traffic to generally be reduced to 80kph speeds within construction zone. Construction zone to be full length of the Project
Pedestrian access	Potential disruption to progress causing pedestrians to not comply with pedestrian provisions	<ul style="list-style-type: none"> ❖ Liaise closely with the relevant bodies from an early stage to ensure pedestrian access provisions are adequately addressed, well established and maintained
Lowering speeds, when it is perceived unnecessary	Poor public opinion and safety for workers if motorists start ignoring limits	<ul style="list-style-type: none"> ❖ Appropriate design of traffic protection measures, intersections, alignments etc. to allow consistent speed limits, i.e., 80km / h where-ever possible.
Too many changed configurations	Unfamiliarity causing potential confusion of road users that may cause traffic incidents	<ul style="list-style-type: none"> ❖ Keep motorists on existing alignment for as long as possible. Effective use of TMP for advanced notification and clear direction during any traffic flow adjustments
Inadequate provisions for break-downs during construction	Traffic delay	<ul style="list-style-type: none"> ❖ Design temporary break down bays. Consider temporary verges where possible during design of traffic staging
Dangerous entry and exits to sites and properties	Traffic Incident	<ul style="list-style-type: none"> ❖ Ensure that entries and exits are designed to cater for expected traffic volumes and with respect to sight distances, acceleration and deceleration provision and clear advanced warning signage

RISKS	POTENTIAL CONSEQUENCES	PROPOSED RISK TREATMENT
Seasonal traffic variations not allowed	High volumes during holidays and weekends	❖ Consider seasonal volumes in programming works. Keep TMP informed and up to date. Be aware of reporting and notification requirements
Reduced allowable movements	Traffic delay, confusion to commuters that may lead to an incident	❖ Implement effective community engagement strategies that will consider businesses, property owner's requirements
Damage to local roads due to heavy vehicle movements	Vehicle damage and potential incidents.	❖ Allow for heavy vehicle movements in traffic staging and planning ensuring existing, temporary alignment and pavements are suitable during the construction period.

6.8.2 Labor Camps

Although a majority of the labor force will come from local sources, they will get picked up and dropped by contractor transport. Some unskilled, most semiskilled and skilled workers may have to be brought in by contractor from far off towns who will live in camps. Being located near the work base, the camps will make the work access easy to the camp dwellers. Like camp, the work base can also be 500 m away from the nearest habitation, water resources and sensitive receptors

6.8.3 Machinery Maintenance and Equipment Yards

Near the work base a machinery and equipment yard will be provided. The yard will have enough storage and haulage space with ample moving and working space. The yard will be walled and will have a gate provided with ample security staff.

6.8.4 Material Depots

Near the work base a material depot will be required for storing construction material. It will have temporary sheds for storing cement, steel and asphalt and open space for storing stones, shingles and bricks. The material depots will be walled and gate will be provided with ample security. A store keeper will keep account of incoming and outgoing material.

6.8.5 Machinery Repair Workshops & Asphalt Plant

With a large number of vehicles and other similar machinery a repair workshop is essential. The contractor may establish his own workshop. The asphalt plant shall be at

least one kilometer away from the any population dwellings, water resources and sensitive receptors.

6.8.6 healthcare

With a large number of labor and employees working in the project of flyover construction, small accidents are expected to take place on all construction sites. A dispensary will be set by the contractor. For major cases the patients will be shifted to the District Hospital under a pre-coordinated arrangement.

6.8.7 Work Uniform and Health Safety Equipment

Road construction is a special job and the labor working on such work requires special protective uniforms and special HSE measures. It will be ensured that the labor engaged in breaking of stones, handling bricks, mixing concrete or mixing and laying asphalt will have long boots, overall dresses, goggles, gloves, ear muffers, Safety Jackets, safety hats etc. As an overall HSE measure all construction workers and anyone going into the construction area will use necessary PPEs.

6.8.8 Signage

During construction suitable signboards and traffic signs will be displayed on construction site in particular and on the entire road length in general. This will help in forestalling any possible accidents.



FIGURE – 6.1 : ROAD SAFETY SIGNS

6.8.9 Lighting and Illumination

Suitable lighting arrangement will be made by the contractor over all work base, work sites, camp site, machinery yard and material depots. This can help the contractor for extended working hours as well as security. If local electric supply is not available, electricity generators will have to be arranged on all spots where lighting is required.

6.8.10 Environmental Training

Capacity building can be achieved through on-the-job training, short-courses, training workshops, lectures, educational visits and seminars. Such interactions include leading team members of NHA, EPA, consultants, construction managers / supervisors and other related agencies on road related environmental issues.

6.8.11 Awareness Raising

Awareness about roads related current and potential environmental threats for the public at large and roadside dwellers, in particular, requires due attention; the aspect neglected in the past. Enhanced education in road related environmental issues and awareness raising can be achieved through campaigns by; Visual graphics, Print media, Seminars & workshops.

7.0 ENVIRONMENT MANAGEMENT & MONITORING PLAN

7.1 ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAM

This section provides brief description of environmental issues, mitigation measures to eliminate and / or reduce environmental and social impacts to an acceptable level, institutional arrangement for the implementation of the mitigation measures and also carrying out environmental monitoring for air quality, water quality and noise pollution related parameter.

7.2 ENVIRONMENTAL MANAGEMENT PLAN

This EMP describes the mitigation and management measures to address the environmental issues during construction, its regular operation.

7.3 OBJECTIVES OF ENVIRONMENTAL MANAGEMENT PLAN

7.3.1 General Objectives

The objectives of the EMP are as follow :

- ❖ Identify and assess environmental status and trend continuously;
- ❖ Act as an early warning system, by identifying any sudden environmental deterioration that needs to be countered.
- ❖ Afford effective environmental surveillance and to provide reliable information upon which continued environmental management of the project can be updated and refined.
- ❖ To outline functions and responsibilities of responsible persons.
- ❖ To state standards and guidelines, which are required to be achieved in term of environmental legislation.
- ❖ To outline mitigation measures and environmental specifications which are required to be implementation for all phase of the project in order to minimize the extant of environmental impacts and to manage environmental impact associated with the proposed project.
- ❖ To prevent long term or permanent environmental degradation
- ❖ To identify training requirement at various levels.

7.3.2 Objectives during Pre–Construction and Construction Stages

These are to :

- ❖ Monitor actual impacts on physical, biological and socio–economic & human resources.
- ❖ Provide early warning to the project management whether intensity of an impact is severer than the one predicted.
- ❖ Suggest mitigation measures for the impacts which had not been anticipated in the EIA.

- ❖ Suggest mitigation measures for the impacts whose intensity is severer than those predicted during the EIA.
- ❖ Furnish feedbacks for correction of any deficiencies / improper situations.
- ❖ Ensure compliance with the administrative and legal framework.
- ❖ Ensure fulfillment of the obligations required under National Environmental Quality Standards (NEQS).
- ❖ Restore / rehabilitate construction camps and workshop sites.
- ❖ Ensure proper disposal of excavated soil and excess construction materials.
- ❖ Monitor rehabilitation of the borrow areas / pits.
- ❖ Ensure specified construction of project infrastructure.
- ❖ Monitor a-forestation along roads.

7.3.3 Objectives during Operation and Maintenance (O&M) Stage

These are to :

- ❖ Monitor effectiveness of mitigation measures.
- ❖ Evaluate effectiveness of the EIA in the backdrop of projected levels of impacts.
- ❖ Suggest modifications / improvements in construction procedures.
- ❖ Determine survival rate of tree plantation along the roads.

7.4 INSTITUTIONAL CAPACITY

Project Proponent, (NHA) will be responsible for Monitoring and Evaluation, but Environment consultant (of the proponent) will responsible to monitor EMP implementation in the field and reporting to the Project Proponent. The Project Proponent will integrate monitoring reports in the main monthly reports of the project. District Office of the EPA at the project area will monitor the overall activity at the site.

7.5 ORGANIZATIONAL STRUCTURE : ROLES & RESPONSIBILITIES

7.5.1 Primary Responsibilities

Project Manager of Construction of 4-Lane Flyover at Bara – Kahu N-75 (3.5 Km.) Project will be responsible on the NHA behalf to carry the primary responsibilities and local legislations in overall duration of project.

7.5.2 Operation Management & Control

Conducting the development activities in an environmentally sound manner will be the responsibility of the Project Manager.

7.6 PERFORMANCE INDICATORS

Following are the performance indicators :

- ❖ Decreased Vehicle Operating Costs.

- ❖ Control of air and noise pollution.
- ❖ Improved flow of traffic.
- ❖ Alleviation of poverty.

7.7 COMMUNITY AND WORKER HEALTH & SAFETY

The objective of environmental health and safety is to provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. It also covers the establishment of preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities. It is therefore a combination of occupational health and safety of staff / workers at the subcomponent facilities and community health and safety of people living nearby or potentially affected by failures or poor operation of facilities.

Safety risks are mainly related to the construction phase. Residents, particularly children, are at risk during project construction. In linear construction activities such as road construction and pipe network construction which typically occur in areas frequented by the public, physical and educational measures to protect residents from risks are needed.

Safety measures for construction staff and public will include the following responsibilities of the Contractor :

- (i) Providing safe and convenient passages for the public;
- (ii) Providing construction workers sufficient personal protection equipment such as hard hats, earpiece, safety shoes, and others;
- (iii) providing seminars on safety issues to local public, particularly school students;
- (iv) Installing warning signs where potential dangers are present;

Ensuring construction staff are on duty on or near heavy movement of construction vehicles, or heavy construction vehicle traffic through the villages to ensure safety; and Setting up traffic signs at and near construction sites. Health risks are primarily related to increased transit population during construction (construction workers) and operation (visitors) in the regions. The increased mobile population could potentially bring and spread infectious diseases in the Project area. Workers could spread diseases such as hepatitis to local residents as well as among themselves. Measures for protecting community health include:

- (i) providing disease prevention and control training to construction workers, particular epidemic diseases such as hepatitis B prior to the start of construction. Leaflets, education seminars will be organized, in association with the local government and communities, to increase the awareness and knowledge;
- (ii) Providing posters in and around the construction sites for disease control, for not only construction workers but also villagers and others in the areas;
- (iii) Providing periodical health checks to construction workers to ensure their health and wellbeing.

7.8 INSTITUTIONAL MONITORING ARRANGEMENTS

7.8.1 Establishment of Environmental Monitoring Cell

The monitoring and evaluation will be carried out during construction and operation of the Project. There is thus a need of establishing a well-structured Environmental Monitoring Cell (EMC) for the Project. Keeping in mind the financial constraints, the EMC personnel will be taken from the existing establishment.

7.8.2 Training of Monitoring Team

For capacity building of NHA staff, there is a dire necessity of environmental training, where a general training vacuum has been felt at all levels. Without appropriate trainings there are apprehensions that EMP cannot be implemented in letter and spirit. The following training activities have been proposed for wider dissemination of benefits to larger number of stakeholders:

Following three different types of training workshops are proposed, each having its own function, level of participants and a particular segment of stakeholders, including their sensitization in environmental affairs of roads.

- (a) Advanced Environmental Training Workshops
- (b) Environmental Mitigation & Monitoring Workshops
- (c) Community Consultative Workshops.

7.9 ENVIRONMENTAL MANAGEMENT PLAN DURING CONSTRUCTION AND OPERATIONAL PHASE

Table – 7.1 and Table – 7.2 shows the planned Environmental Management Plan (EMP) for the project Construction of 4-lane flyover at Bara – Kahu N-75 (3.5 Km.) during construction and operational phase respectively. This EMP shows the goal of each effect that why we are moderating the undertaking predicting impacts. The individual responsible to actualize and screen the EMP is also discussed in the Table – 7.1 and Table – 7.2 below. Details of anticipated impact mitigation are discussed in Chapter No: 5 of this EIA Report titled Screening of Environmental Impacts & Mitigation Measures.

**TABLE – 7.1 : ENVIRONMENTAL MANAGEMENT PLAN
DURING CONSTRUCTION PHASE**

IMPACT	OBJECTIVES	MITIGATION	RESPONSIBILITY	
			Implementation	Monitoring
Topography	To ensure minimum changes in topography of the project area.	Project design should consider aesthetic concerns.	Construction Contractor	Project Manager Construction Contractor
Land Acquisition	To minimize land acquisition.	Careful alignment selection by the designer to minimize the impact. Adequate budget will be provided in the	Construction Contractor	Project Manager Construction Contractor

IMPACT	OBJECTIVES	MITIGATION	RESPONSIBILITY	
			Implementation	Monitoring
		Project cost for the compensation to the affected people as per Land Acquisition Act, 1894.		
Air Quality	Ensure that the pollution level does not exceed the limit	Regular monitoring of vehicular emissions All vehicles, machinery, equipment and generators used during construction activities shall be kept in good working condition and be properly tuned and maintained in order to minimize the exhaust emissions; Open burning of solid waste from the Contractor's camps will be strictly banned. To avoid dust from construction activity Storage of construction materials to be carried out in accordance with the construction material storage and handling plan and storage areas shall be no less than 500m from communities.	Construction Contractor	Project Manager Construction Contractor Approved Monitoring Authority
Noise	To minimize noise level	Selection of up-to-date and well maintained plant or equipment with reduced noise levels ensured by suitable in-built damping techniques or appropriate muffling devices. Confine excessively noisy work to normal working hours in the day, as far as possible. During construction suitable hearing protection like ear cap or earmuffs will provide to workers. Preferably, restrict construction vehicles movement during nighttime Contractors shall comply with submitted work schedule, keeping noisy operations away from sensitive points; implement regular maintenance and repairs; and employ strict implementation of operation procedures;	Construction Contractor	Project Manager Construction Contractor Approved Monitoring Authority
Construction Camps	To minimize loss of assets and vegetation / trees due to construction of construction camps.	The contractor shall provide plan for removal & rehabilitation of site upon completion; Reinstate any temporary facilities to pre-existing conditions in ecologically sensitive areas; Implement landscaping plan for all facilities in areas where high landscape value and visual vulnerability to the proposed activities warrants site-specific landscape restoration	Construction Contractor	Project Manager Construction Contractor

IMPACT	OBJECTIVES	MITIGATION	RESPONSIBILITY	
			Implementation	Monitoring
		measures; Operate equipment in a manner sympathetic to the ambient noise environment. Do not leave equipment idling unnecessary;		
Ecology	To avoid / minimize tree cutting.	Incorporate technical design measures to minimize removal of trees, if possible such as change in alignment. Disallow introduction of exotic species with known environmental setbacks.	Construction Contractor	Project Manager Construction Contractor
Social Disturbance	To minimize the entry / exit problems of the locals in the Project Area.	Inform residents of the area about detail of work, likely disturbances, and their duration and to whom they should address their complaints. Establishing good community relationship so that any disruption can be resolved with due consideration of community Mitigation measures should include provision of pedestrian overhead bridges in the design to minimize the impact.	Construction Contractor	Project Manager Construction Contractor
Public Utilities	To avoid disturbance to the public.	Incorporate technical design features to minimize effect on public utilities. All public utilities will need to be relocated well before the commencement of construction work.	Construction Contractor	Project Manager Construction Contractor
Water Resources	To avoid / minimize the contamination of surface and ground water bodies.	Provision of septic tanks in the design to treat the wastewater;	Construction Contractor	Project Manager Construction Contractor Approved monitoring agency
Health and safety of workers	To minimize health risks	Provide basic medical training to specified work staff and basic medical service and supplies to workers; Work safety measures and good workmanship practices are to be followed by the contractor to ensure no health risks for laborers; Protection devices (ear muffs) shall be provided to the workers doing job in the high noise areas. Provision of adequate sanitation, washing, cooking and dormitory facilities; Proper maintenance of facilities for workers will be monitored; Provision of protective clothing i.e. helmet, adequate footwear for bituminous pavement works, protective	Construction Contractor HSE Officer	Project Manager Construction Contractor HSE Officer

IMPACT	OBJECTIVES	MITIGATION	RESPONSIBILITY	
			Implementation	Monitoring
		goggles, gloves etc. for laborers handling hazardous materials; Ensure strict use of wearing these protective clothing during work activities. Instruct foremen to strictly enforce the keeping out of non –working persons, off work sites; Adequate signage, lightning devices, barriers, yellow tape and persons with flags during construction to manage traffic on Road.		
Borrow Areas	To avoid land disputes and to minimize soil erosion	No excavations are allowed within distance of 500 m to RoW; In borrow pits the depth of the pit will be regulated so that the sides of the excavation will have a slope not steeper than 1:4; Soil erosion along the borrow pit shall be regularly checked to prevent / mitigate impacts on adjacent lands; and In case borrow pits fill with water, measures have to be taken to prevent the creation of mosquito–breeding sites.	Construction Contractor	Project Manager Construction Contractor
Impacts of Heavy Vehicles	The working of heavy vehicles on the existing road network may result in air pollution	Materials having potential to produce dust shall not be loaded to a level higher than the side and tail boards and shall be covered with clean tarpaulin in good condition. Noise mufflers shall be installed and maintained in good condition on all motorized equipment under the control of the contractor	Construction Contractor	Project Manager Construction Contractor
Traffic Management	To minimize traffic problems in the Project Area.	Proper traffic management plan shall implemented to avoid traffic jams / public inconvenience.	Construction Contractor	Project Manager Construction Contractor
Maintenance of Construction Equipment	Improper maintenance of construction equipment may lead to safety and environmental hazards	Place substantial blocking under any chain–hoist suspended or jack supported equipment under which people must work. All work areas shall be provided with proper ventilation. Secure unbolted heavy parts or engines if necessary to leave the work.	Construction Contractor	Project Manager Construction Contractor
Waste	To minimize odor, spreading of diseases and clogging of canal and drain.	Waste management plan shall be implemented including provision of waste bins, defining collection frequencies, allocating personnel and defining safe disposal options.	Construction Contractor	Project Manager Construction Contractor

**TABLE – 7.2 : ENVIRONMENTAL MANAGEMENT PLAN
DURING OPERATIONAL PHASE**

IMPACT	OBJECTIVES	MITIGATION	RESPONSIBILITY	
			Implementation	Monitoring
Air Quality	Ensure that the pollution level does not exceed the limit.	Regular monitoring of vehicular emissions. Impose fine on vehicles emitting gaseous emissions beyond the prescribed limit.	NHA Project Manager	Project Manager Approved Monitoring Authority
Noise	To minimize noise levels	Ban use of pressure horns Proper implementation of inspection and maintenance program for vehicle Strict check on use of proper silencers especially for motor cycles	NHA Project Manager	Project Manager Approved Monitoring Authority
Land and Soil	To avoid soil erosion	Periodic checking to be carried to assess the effectiveness of the stabilization measures viz. turfing, stone pitching, river training structures etc. Necessary measures to be followed wherever there are failures	NHA Project Manager	Project Manager Approved Monitoring Authority
Water Quality	To avoid blockage of drains (water logging)	Monitoring of water borne diseases due to stagnant water bodies	NHA Project Manager	Project Manager Approved Monitoring Authority
Safety	To avoid chances of accidents	Safety measures shall provide in case of emergency Social awareness will be addressed among people how to avoid any accidents with fast moving vehicles.	NHA Project Manager	Project Manager Project HSE Officer
Road Maintenance work	To control HSE and environmental related issues.	Strict enforcement of speed limits, installation of speed guns and channelization of traffic with respect to categories (heavy vehicle traffic and light vehicle traffic) and enforcement of penalties for the violators. Implementation of HSE Plans during the maintenance period. Strict implementation of PPEs. Use of high quality equipment and material by the contractor. Continuous improvements in the emergency plans. Placement of sign boards for traffic diversions and proper implementation of traffic diversion plans.	NHA Project Manager	Project Manager Project HSE Officer

7.10 EQUIPMENT MAINTENANCE DETAIL

Equipment shall be inspected, tested and maintained by qualified trained personnel. If any equipment is not in good operating condition, it should be repaired immediately. Authorized dealers will be responsible for maintenance of equipment's. Equipment procedures and maintenance guidelines shall be kept in a central location for quick reference when needed

7.11 ENVIRONMENT MANAGEMENT COST

The total cost for the environmental management is estimated as 10 Million Pak Rupees. Details are given below in the Table – 7.3 :

TABLE – 7.3 : ENVIRONMENT MANAGEMENT COST

ENVIRONMENTAL COMPONENT	QUANTITY	AMOUNT PKR
Contractor Environmental Specialist	1	1.3
Air and Water Quality & Noise Monitoring	4	2.3
Health and Safety Measures and Provision of PPEs	Lumpsum	2.9
Roadside Tree Plantations of Endemic / Local Species	Lumpsum	2.8
TOTAL		10 Million

8.0 ASSESSING IMPACTS

This chapter contains detailed environmental impact, its identification on the basis of timing, nature, duration, magnitude and significance.

8.1 IMPACTS ASSESSMENT

Environmental Impact Assessment (EIA) is a systematic and integrative process for considering possible impacts prior to a decision being taken on whether or not a proposal should be given approval to proceed.

Table – 8.1 below shows the impact classification criteria on the basis of its potential.

TABLE – 8.1 : CLASSIFICATIONS OF IMPACTS

IMPACT POTENTIAL	ABBREVIATION	IMPACT CRITERIA
Low Adverse	LA	Causing low environmental deterioration
Medium Adverse	MA	Causing ordinary environmental deterioration
High Adverse	HA	Causing extreme environmental d deterioration
Not Applicable	NA	Not related to project activity
None or Insignificant	O	Causing no environmental deterioration
Low Beneficial	LB	Less positive environmental impacts
Medium Beneficial	MB	Ordinary positive environmental impacts
High Beneficial	HB	Extreme positive environmental impacts
Not Determinable	ND	Not present

TABLE – 8.2 : ANTICIPATED IMPACTS AND THEIR MAGNITUDE OF THE PROJECT

Environmental Components Components / Activities	Physical Environment											Biological Environment							Social Environment							
	Topography	Agricultural Lands	Soil (Erosion / Stability)	Cultural / Religious Properties	Infrastructure	Mineral Resources	Land pollution	Surface water quality	Groundwater quality	Air quality	Noise	Aquatic Ecosystem	Wetland Ecosystem	Terrestrial Ecosystem	Habitat change	Animal Movement	Wildlife	Disease Vectors	Public Health / Safety	Land Use	Communication System	Employment	Community Stability	Benefit to Community	Traffic Management	
CONSTRUCTION PHASE																										
Construction camps, workshops etc.	O	O	LA	NA	LA	NA	LA	LA	LA	MA	MA	NA	NN	O	O	NA	NA	O	O	LA	LA	LB	O	LB	LB	
Transportation of construction materials	O	O	LA	NA	NA	NA	LA	NA	NA	LA	LA	NA	NA	O	O	O	O	O	O	O	O	MB	LA	MB	LA	
Use of construction materials etc.	O	NA	LA	NA	O	NA	LA	LA	LA	LA	LA	NA	NA	O	O	O	NA	NA	LA	LA	LA	LB	LA	LB	LA	
Earthwork / concrete work operations	LA	NA	LA	NA	O	NA	LA	LA	LA	LA	LA	NA	NA	NA	O	NA	NA	NA	LA	LA	O	LB	LA	LB	LA	
Operation of concrete batching plants.	O	NA	LA	NA	O	NA	LA	LA	O	MA	MA	NA	NA	NA	O	O	NA	NA	LA	LA	O	LB	LA	LB	LA	
Machinery and Equipment's work	O	NA	LA	NA	O	NA	LA	NA	NA	MA	MA	NA	NA	NA	NA	O	NA	LA	LA	LA	LA	LB	NA	LB	LA	
Solid Waste	O	NA	LA	NA	O	NA	LA	LA	LA	LA	O	NA	NA	NA	NA	NA	NA	LA	LA	LA	O	LB	LB	O	O	
Health and safety		NA	NA	NA	LA	NA	NA	O	O	NA	MB	NA	NA	NA	NA	MB	NA	HB	MB	O	MB	HB	MB	NA		
Material Storage	O	NA	LA	NA	O	NA	LA	LA	O	LA	O	NA	NA	NA	NA	O	O	O	O	LA	NA	LB	NA	O	O	
Movement of Traffic	O	NA	O	NA	O	NA	LA	LA	O	LA	LA	NA	NA	NA	NA	O	NA	O	O	LB	LB	MB	MB	HB	HB	
Road Maintenance Works	O	NA	LA	NA	O	NA	LA	LA	LA	LA		NA	NA	NA	NA	O	NA	O	LA	LA	LA	MB	LA	LA	LA	
Air Quality	O	NA	NA	NA	O	NA	NA	O	O	LB	O	NA	NA	NA	NA	O	NA	O	LB	LB	O	O	LB	LB	O	

LA: Low Adverse

MA: Medium Adverse

HA: High Adverse

NA: Not Applicable

O: None or Insignificant

LB: Low Beneficial

MB: Medium Beneficial

HB: High Beneficial

ND: Not Determinable

8.2 MITIGATION ASSESSMENT

Mitigation refers to minimizing or avoiding the described impacts. Overall, mitigation measures are a response to the findings of impact assessment; they need to cover all the areas identified. The key focus of mitigation actions should be on:

- ❖ Preventive measures that avoid the occurrence of impacts and thus avoid harm or even produce positive outcomes.
- ❖ Measures that focus on limiting the severity and the duration of the impacts.
- ❖ Compensation mechanisms for those impacts that are unavoidable and cannot be reduced further.

8.3 PURPOSE OF MITIGATION AND IMPACT ASSESSMENT

The purpose of conducting an EIA is to clearly identify and understand (assess), and then prevent or minimize (mitigate) the adverse impacts of the planned project on the environment and people. Because the impacts of the project can change over time, the impacts need to be assessed and measured over the lifetime of the project – from its construction through to operations and after closing.

Impact assessment is indispensable in order to provide systematic and detailed descriptions of the probable impacts in comparison to the identified project alternatives. Mitigation measures are a critical part of the EIA process, as these actions aim to prevent adverse impacts from the planned project on the environment and people, ensuring that unavoidable impacts are maintained within acceptable levels

8.4 ENVIRONMENTAL MONITORING PLAN (EMP)

Environmental Monitoring is undertaken during project activities to ensure the effectiveness of the mitigation measures. In order to respond to the anticipated environmental concerns at an early stage and to determine the intensity of the impact, prediction is required. Specific monitoring programs are outlined below as well as responsibilities for the collection and analysis of data and the reporting requirements. Table – 8.3 is showing the environmental monitoring plan suggested for proposed project activity.

TABLE – 8.3 : ENVIRONMENTAL MONITORING PLAN

ENVIRONMENTAL MONITORING PLAN (EMP)					
WHAT (Is the parameter to be observed)?	WHERE (Is the parameter to be monitored)?	HOW (Is the parameter to be monitored)?	WHEN (Is the parameter to be observed)?	WHY (Is the parameter being monitored)?	WHO (Is responsible for monitoring)?
CONSTRUCTION PHASE					
Ambient Air Monitoring	Flyover Construction Site	PM ₁₀ SO _x as SO ₂ , NO _x as NO ₂ , CO	Quarterly	To meet the NEQSAA (National Environmental Quality Standards for Ambient Air)	NHA through Approved Monitoring Agency
Ground & Drinking Water Quality	Flyover Construction Site	By analyzing pH, TDS, Chloride, Fluoride, Colour, NO ₃ -, Selenium, Residual chlorine, Lead, Total hardness, Turbidity, Zinc, Manganese, Aluminum, Chromium, Cadmium, Boron, Barium, Antimony, Arsenic, Cyanide, Mercury, Nickel, Total Coliform, E.Coli, Total count.	Quarterly	To meet the WHO Drinking Water quality Guidelines	NHA through Approved Monitoring Agency
Noise Level	Flyover Construction Site	Using noise level meter (minimum dB and maximum dB)	Quarterly (During operation)	To meet the Noise Standards	NHA through Approved Monitoring Agency
Occupational health & safety	Flyover Construction Site	Proper provision of PPEs to workers	Daily	To avoid any risk to human health	HSE Officer
OPERATIONAL PHASE					
Ambient Air Monitoring	Flyover Site	PM ₁₀ SO _x as SO ₂ , NO _x as NO ₂ , CO	Quarterly (During operation)	To meet the NEQSAA (National Environmental Quality Standards for Ambient Air) & WHO (World Health Organization)	NHA through Approved Monitoring Agency

ENVIRONMENTAL MONITORING PLAN (EMP)					
WHAT (Is the parameter to be observed)?	WHERE (Is the parameter to be monitored)?	HOW (Is the parameter to be monitored)?	WHEN (Is the parameter to be observed)?	WHY (Is the parameter being monitored)?	WHO (Is responsible for monitoring)?
Noise Level	Flyover Site	Using noise level meter (minimum dB and maximum dB)	Quarterly (During operation)	To meet the Noise Standards	NHA through Approved Monitoring Agency
Water Quality	Flyover site	By analyzing pH, TDS, Chloride, Fluoride, Colour, NO ₃ -, Selenium, Residual chlorine, Lead, Total hardness, Turbidity, Zinc, Manganese, Aluminum, Chromium, Cadmium, Boron, Barium, Antimony, Aresenic, Cyanide, Mercury, Nickel, Total Coliform, E.Coli, Total count.	Quarterly (During operation) & End of summer before the onset of Monsoon every year.	To meet the WHO Drinking Water quality Guidelines	NHA through Approved Monitoring Agency

9.0 INVOLVEMENT OF STAKEHOLDERS / PUBLIC CONSULTATION

9.1 GENERAL

Stakeholder consultation is a means of involving all primary and secondary stakeholders in the project's decision-making process in order to address their concerns, improve project design, and give the project legitimacy. Stakeholder consultation, if conducted in a participatory and objective manner, is a means of enhancing project sustainability. Community input (both of knowledge and values) on socioeconomic and environmental issues can greatly enhance the quality of decision-making. Stakeholder consultation was conducted near the project area not only to satisfy the legal requirements of the EIA process in Pakistan but also to improve and enhance the social and environmental aspect of the project.

9.2 OBJECTIVES OF CONSULTATION

The objectives of this process were :

- ❖ To disseminate information on the project and its expected impact, long-term as well as short-term, among primary and secondary stakeholders,
- ❖ To gather information on relevant issues so that the feedback received could be used to address these issues at an early stage,
- ❖ To determine the extent of the negative impacts of different project activities and suggest appropriate mitigation measures.

9.3 PAKISTAN ENVIRONMENTAL PROTECTION ACT 1997

Public consultation is mandated under Pakistan's environmental law; however, after the amendment in authoritative decision making of act, all the legal rights and power of delegation were given to provincial Agency. Hence, the Provincial Agency, under Regulation 6 of the IEE-EIA Regulations 2000, has issued a set of guidelines of general applicability and sectoral guidelines indicating specific assessment requirements. This includes Guidelines for Public Consultation that is summarized below:

9.3.1 Objectives of Public Involvement

To inform stakeholders about the project, to provide an opportunity for those otherwise unrepresented to present their views and values, providing better transparency and accountability in decision making, creating a sense of ownership with the stakeholders.

9.3.2 Stakeholders

People who may be directly or indirectly affected by project will clearly be the focus of public involvement. Those who are directly affected may be project beneficiaries, those likely to be adversely affected, or other stakeholders. Consultation should include not only those likely to be affected, positively or negatively, by the outcome of a project, but should also include those who can affect the outcome of a project.

9.3.3 Mechanism

Provide sufficient relevant information in a form that is easily understood by non-experts, allow sufficient time for stakeholders to read, discuss, consider the information and its implications and to present their views, responses should be provided to issues and problems raised or comments made by stakeholders, selection of venues and timings of events should encourage maximum attendance.

9.3.4 Timing and Frequency

Planning for the public consultation program needs to begin at a very early stage; ideally it should commence at the screening stage of the project and continue throughout the EIA process.

9.3.5 Important Considerations

The development of a public involvement program would typically involve consideration of the following issues; objectives of the project and the study; identification of stakeholders; identification of appropriate techniques to consult with the stakeholders; identification of approaches to ensure feedback to involved stakeholders; and mechanisms to ensure stakeholders consideration are taken into account.

9.4 STAKEHOLDER CONSULTATION PROCESS

The overall strategy for stakeholder's consultation is as shown in Table – 9.1.

TABLE – 9.1 : PROCESS OF STAKEHOLDER CONSULTATION

STAKEHOLDERS	PURPOSE OF CONSULTATIONS	METHODOLOGY	STAGE
Primary Stakeholder	<ul style="list-style-type: none"> ❖ Information gathering and data collection. ❖ Information sharing about the project (disclosure) ❖ Opinion seeking (concerns and expectations) ❖ Grievance redress ❖ Involvement of PAPs 	<ul style="list-style-type: none"> ❖ Focus Group Discussions ❖ Formal and informal ❖ Community meetings 	<ul style="list-style-type: none"> ❖ Base line Study ❖ Impact Assessment ❖ Inventory of Losses ❖ Price fixation ❖ Discloser
Secondary Stakeholder	<ul style="list-style-type: none"> ❖ Participation in the process ❖ Information gathering ❖ Authentication and validation of the processes verification of the record 	<ul style="list-style-type: none"> ❖ One on one meetings ❖ In-depth interviews ❖ Group meetings 	<ul style="list-style-type: none"> ❖ On need basis

10.0 GRIEVANCE REDRESSAL MECHANISM

The social and environmental issues relating to the implementation of the Project works and their mitigation shall be identified in the chapter Screening of Potential Environmental Impacts and Mitigation Measures and Environmental Management Plan (EMP) of EIA Report. However, in spite of best efforts, there is every chance that the individuals / communities affected by the project are dissatisfied with the measures adopted to address the adverse environment or social impacts of the project. In this situation an effective Grievance Redressed Mechanism (GRM) is established to ensure timely and successful implementation of the project. It will also provide a public forum to the aggrieved to raise their objections and through conflict resolution, address these issues adequately.

10.1 OBJECTIVE OF GRM

The main objective of the GRM is to investigate charges of irregularities and complaints received from any affected person and provide an early, transparent and fair resolution. Keeping in view the findings of the baseline study, it is anticipated that the nature of such complaints may be as following:

- ❖ Problems in the location of contractor's infrastructure like camp site, etc.
- ❖ Any disruption by the civil works by contractor / s like water channel disturbance, etc.
- ❖ Non-observance of project principles as laid down in the contract documents
- ❖ Any other issue arising during the project implementation including the dust generation, tree cutting, indiscriminate disposal of solid waste, involuntary resettlement, if any, traffic issues, etc.

10.2 GRIEVANCE REDRESS COMMITTEE (GRC)

Under the GRM, a Grievance Redress Committee (GRC) will be established at project site, which will look into all the grievance cases related to social, resettlement and rehabilitation. The GRC will include :

**TABLE – 10.1 : COMPOSITION OF CONSTRUCTION SITE GRC
FOR PROPOSED PROJECT**

SR. NO.	DESIGNATION	POSITION IN GRC
1.	Assistant Director Construction (Concerned)	Chairman
2.	Resident Engineer (Concerned)	Member
3.	Assistant Resident Engineer (Concerned)	Member cum Secretary
4.	Project Manager (Contractor)	Member
5.	Resettlement Expert (Consultant)	Member
6.	Environmental Expert (Consultant)	Member

SR. NO.	DESIGNATION	POSITION IN GRC
7.	Environmental Expert (Contractor)	Member
8.	Elected Representative of Local Govt.	Member
9.	Focal Person (Admin. Department)	Member
10.	Affected Persons	03 Member
TOTAL =		12 Members

The Committee will locally resolve the grievance / complaints within seven days. If it fails to address the complaint within seven days, it will refer the complaint to the project committee along with a brief report.

10.3 STEP-WISE PROCESS OF GRM

The GRM will be gender responsive, culturally appropriate and readily accessible to the stakeholders at no cost and without retribution. The step-wise process of the proposed GRM is summarized below.

10.3.1 Stage 1

When a grievance arises, the aggrieved person may contact directly with the contractor / PIU / CSC to resolve the issue of concern. If the issue is successfully resolved, no further follow-up is required.

10.3.2 Stage 2

If no solution can be found at Stage 1, the affected person(s) may submit an oral or written complaint to the GRC at site level. ARE will log the complaint along with relevant details in the community complaint register. The affected person(s) can also approach GRC without going through the Stage 1 described above. For each complaint, the GRC must investigate the complaint, assess its appropriateness / eligibility and identify an appropriate solution. It will provide a clear response within seven working days to the complainant, PIU and Contractor (where relevant). The GRC will, as appropriate, instruct the responsible entity to take corrective actions. The GRC will review the responsible entity's response and undertake additional monitoring as needed. During the complaint investigation, the GRC will work in close consultation with the Contractors, CSC, PIU and other relevant agencies. The responsible entity should implement the redress solution and convey the outcome to the GRC within seven working days.

10.3.3 Stage 3

In case of dissatisfaction of the complainant at stage 2, he / she can approach to GRC stage 3 at PIU level. Here, the GRC is headed by the Project Director. The GRC at PIU level will resolve the complaint / grievance and the agreed action thus determined should be implemented within twenty-one days (if additional time is needed to

implement the corrective action, it should be discussed and decided during the meeting). In case of failure to address the complaint, the complainant can approach to final tier, stage 4.

10.3.4 Stage 4

If the affected person / complainant is still not satisfied with the reply in Stage 3, he or she can pursue judicial proceedings. In such cases, the PIU will also inform the Bank Team of persistent problems and / or where solutions need to be found at higher levels of government.

Implementing the GRC's decision will be a contractual binding on the contractor.

10.4 PROPOSED MECHANISM FOR GRIEVANCE REDRESS

Under the project the following will be established or appointed to ensure timely and effective handling of grievances :

- ❖ A Project Implementation Unit (PIU), which will be responsible to receive, log, and resolve complaints; and,
- ❖ A Grievance Redress Committee (GRC), responsible to oversee the functioning of the PIU as well as the final non-judicial authority on resolving grievances that cannot be resolved by the contractor;
- ❖ Grievance Focal Points (GFPs) having educated people from each community that can be approached by the community members for their grievances against the Project. The GFPs will be provided training by the Project in facilitating grievance redress.

10.5 COMPLAINTS MANAGEMENT REGISTER (CMR)

Under the GRM, community complaint registers will be maintained by RE / ARE of CSC and kept at various site offices. All complaints and grievances will be logged in these registers by RE / ARE concerned along with details including date of complaint, name and address of complainant, and description of complaint. The GRC will then fill additional details in the register including the corrective action needed, timeframe for corrective action to be taken, and person / project entity responsible for corrective action. Once the corrective action is implemented, the complainant will be informed and the GRC will document the associated details in the register including the description of action taken, date of action completed, views of the complainant regarding the corrective action, and any residual grievance. The GRM will be operated in a transparent and participatory manner. Complete details of the GRM including its procedures, actions planned, and action taken will be widely disseminated particularly among the local communities, the GRM registers will remain accessible to communities and other stakeholders, and complete information of the corrective actions taken in response to the grievances will be shared with the stakeholders particularly the complainant and related community.

11.0 CONCLUSION AND RECOMMENDATIONS

Primary and secondary data were used to assess the environmental impacts of the project road, which were assessed in a comprehensive manner. This EIA Report provided a picture of all potential environmental impacts associated with the Project, and makes suitable recommendations for mitigation measures.

The roadway is mostly following the existing alignments, being the best option from the environmental, legal, engineering and socioeconomic points of view. Environmental impacts associated with the Project need to be properly mitigated through the existing institutional arrangements, which need to be augmented for optimum utilization of available resources.

Bulk of environmental impacts will take place during the construction phase. Implementation of mitigation measures during this period will be assigned to the contractors. However, traditionally contractors have little perception and understanding of environmental problems. Hence, the required environmental mitigation must be clearly described in the contract documents, and an environmental supervising consultant must monitor implementation mechanism. This Report, including the EMP, should be used as a basis for an environmental compliance program.

The EIA Report has thoroughly assessed all the potential environmental impacts associated with the Project. The environmental impacts identified by the study are manageable, which will be mitigated by NHA at various stages, as suggested in the Report. On the basis of the findings of the EIA, it is concluded that Construction of 4-lane flyover at Bara – Kahu N-75 (3.5 km) will not pose any adverse impact on the local population and the environment. Therefore, it is recommended that the competent authority may please be issues Environmental Approval for the operation of this project.

REFERENCES

Listed below are some of the documents, reports and other references consulted during the preparation of this Report :

- ❖ Information and data provided by project proponents;
- ❖ Project Pre–Feasibility Study Report;
- ❖ Technical Design Data related to the project.
- ❖ Information gathered through discussions with the project related persons of the project proponent;
- ❖ Information collected from the Technical documents of various suppliers of machinery / equipment.
- ❖ The Pakistan Environmental Protection Act 1997 covers aspects related to:
 - The protection, conservation, rehabilitation and improvement of the environment and the prevention, control of pollution and promotion of sustainable development;
 - Establishing complete regulatory and monitoring bodies, policies, rules, regulations and Pakistan Environmental Quality Standards; and
 - To ensure enforcement, the act establishes regulating bodies i.e. Pakistan Environmental Protection Council (PEPC) and responsible bodies i.e. Pakistan Environmental Protection Agency (Pak EPA) at Federal Level.
- ❖ Environment related Laws in Pakistan;
- ❖ Government of Pakistan, Pakistan Environmental Protection Agency, Policy and Procedures for Filing, Review and Approval of Environmental Assessment, 2000;
- ❖ Google earth, maps.
- ❖ Guidelines for Public Consultations – These guidelines cover:
 - Consultation, involvement and participation of Stakeholders
 - Techniques for public consultation (principles, levels of involvements, tools, building trust)
 - Effective public consultation (planning, stages of EIA where consultation is appropriate)
 - Consensus building and dispute resolution.
- ❖ Work Place Safety and Health Act 2011
- ❖ Land Acquisition Act (LAA) of 1894
- ❖ The forest Act 1927
- ❖ Pakistan Penal Code, 1860

GLOSSARY

Air Quality	Measurement of the pollutants in the air; a description of healthiness and safety of the atmosphere.
Consultation	Consultation refers to two-way transfer of information or joint discussion between project staff and the affected population. Systematic consultation implies a sustained and rigorous sharing of ideas. Bank experience shows that consultation often yields the best resettlement alternatives, fruitful procedures for continued participation, and independent information on actual conditions for implementation.
Contractor	A person or firm that undertakes a contract to provide materials or labor to perform a service or do a job.
Disclosure	The action of making new or secret information known
Environmental Management	Attempt to control human impact on and interaction with the environment in order to preserve natural resources
Effluent	Wastewater – treated or untreated – that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters
Electrical conductivity	Electrical Conductivity is an indirect measure for finding the total dissolved solids in a water body
Evaluation	The making of a judgment about the amount, number, or value of something; assessment.
Flyover	A bridge carrying one road over another.
Geology	A science that studies rocks, layers of soil, etc., in order to learn about the history of the Earth and its life
Ground Water	Aquifers currently being used as a source of drinking water or those capable of supplying a public water system. They have a total dissolved solid content of 10,000 milligrams per liter or less, and are not "exempted aquifers."
Hazardous	Substance or material, which could adversely affect the safety of the public, handlers or carriers during transportation
Impact	Effect on someone or something
Jurisdiction	The extent of the power to make legal decisions and judgments.
Land Acquisition	The process whereby a person is compelled by a public agency to cede all or part of the land a person owns or possesses, to the ownership and possession of that agency, for public purpose in return for compensation.
Mitigation	The action of reducing the severity, seriousness, or painfulness of something
Monitoring	Supervising activities in progress to ensure they are on-course

	and on–schedule in meeting the objectives and performance targets
Occupational Health	Maintenance of the highest degree of physical, mental and social well–being of workers in all occupations by preventing departures from health, controlling risks and the adaptation of work to people, and people to their jobs
pH	pH is a measure of how acidic / basic water is.
Project Area	The area specified by the funding and / or implementing agency according to the Official Gazette Notification and includes the areas within the administrative limits of the Federal or a Provincial Government.
Project Manager	The person in overall charge of the planning and execution of a particular project.
Proponent	A person who advocates a theory, proposal, or course of action.
Rehabilitation	Include all compensatory measures to re–establish; at least lost incomes, livelihoods, living and social systems. It does not include the payment of compensation for required assets.
Resettlement	Means all measures taken to mitigate any and all adverse impacts, resulting due to execution of a project on the livelihood of the project affected persons, their property, and includes compensation, relocation and rehabilitation.
Road	A road is a thoroughfare, route, or way on land between two places that has been paved or otherwise improved to allow travel by foot or some form of conveyance, including a motor vehicle etc.
ROW	A right–of–way(ROW) is a right to make a way over a piece of land, usually to and from another piece of land.
Scope	The extent of the area or subject matter that something deals with or to which it is relevant
Social Environment	It includes the culture that the individual was educated or lives in, and the people and institutions with whom they interact.
Stakeholders	Include affected persons and communities, proponents, private and public businesses, NGOs, host communities and EPA.
Topography	Details of the surface features of land. It includes the mountains, hills, creeks, and other bumps and lumps on a particular hunk of earth.
Turbidity	Turbidity is the amount of particulate matter that is suspended in water.

ENVIRONMENTAL MONITORING REPORTS



AMBIENT PARTICULATE MATTERS MONITORING REPORT

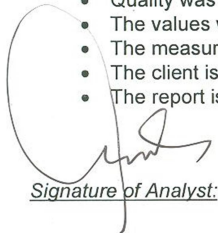
Reference Number	BKB/ENV/93-2020	Site Address:	Barakahu, Islamabad
Project Name:	Construction Of 4 Lane, flyover / Over Head Bridge	Monitoring Instrument:	AQMS 65, Serial # 1810
Source:	Ambient Air		
Monitoring Location	RD 06 + 500 (Near Jillani Town)		

Sr. No	Time Hours	Parameters		Results (Average 24 Hrs)	
		PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀
		Units			
		($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)		
1.	09:00 A.M	31.81	109.21	25.54 ($\mu\text{g}/\text{m}^3$)	101.27 ($\mu\text{g}/\text{m}^3$)
2.	10:00 A.M	29.54	110.08		
3.	11:00 A.M	27.62	108.53		
4.	12:00 P.M	26.87	111.82		
5.	01:00 P.M	26.9	110.27		
6.	02:00 P.M	27.26	109.56		
7.	03:00 P.M	27.2	107.03		
8.	04:00 PM	26.8	105.81		
9.	05:00 PM	25.7	102.59		
10.	06:00 PM	24.47	101.07		
11.	07:00 PM	23.7	99.34		
12.	08:00 PM	24.1	100.82		
13.	09:00 PM	24.6	98.1		
14.	10:00 PM	24.97	97.37		
15.	11:00 PM	22.71	96.85		
16.	12:00 AM	24.59	94.12		
17.	01:00 AM	23.73	93.59		
18.	02:00 AM	25.3	94.88		
19.	03:00 AM	24.6	95.31		
20.	04:00 AM	24.18	93.62		
21.	05:00 AM	23.77	94.47		
22.	06:00 A.M	22.9	96.75		
23.	07:00 A.M	24.58	97.66		
24.	08:00 A.M	25.10	101.65		
NEQSAA				35 ($\mu\text{g}/\text{m}^3$)	150 ($\mu\text{g}/\text{m}^3$)

NEQSAA: National Environmental Quality Standards for Ambient Air

Note:

- Selected measurement units were $\mu\text{g}/\text{m}^3$ otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.


Signature of Analyst:

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AMBIENT PARTICULATE MATTERS MONITORING REPORT

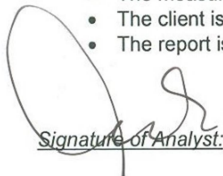
Reference Number	BKB/ENV/93-2020	Site Address:	Barakahu, Islamabad
Project Name:	Construction Of 4 Lane, flyover / Over Head Bridge	Monitoring Instrument:	AQMS 65, Serial # 1810
Source:	Ambient Air		
Monitoring Location:	RD 10 + 000 (Qaziabad)		

Sr. No	Time Hours	Parameters		Results (Average 24 Hrs)	
		PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀
		Units			
		($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)		
1	10:00 A.M	21.27	74.6	21.07 ($\mu\text{g}/\text{m}^3$)	72.73 ($\mu\text{g}/\text{m}^3$)
2	11:00 A.M	21.39	81		
3	12:00 P.M	22.04	86.5		
4	01:00 P.M	21.91	89.06		
5	02:00 P.M	23.72	93		
6	03:00 P.M	24.35	102.6		
7	04:00 PM	24.1	94.9		
8	05:00 PM	23.83	98		
9	06:00 PM	22.86	99.7		
10	07:00 PM	24.23	83.5		
11	08:00 PM	24.97	79		
12	09:00 PM	21.1	67		
13	10:00 PM	20.62	63		
14	11:00 PM	19.73	61.57		
15	12:00 AM	19.48	56		
16	01:00 AM	20.77	57.8		
17	02:00 AM	19.23	56		
18	03:00 AM	19.58	54		
19	04:00 AM	18.76	56		
20	05:00 AM	19.43	55.1		
21	06:00 A.M	18.19	56.8		
22	07:00 A.M	18.42	55		
23	08:00 A.M	17.26	61		
24	09:00 A.M	18.53	64.4		
NEQSAA				35 ($\mu\text{g}/\text{m}^3$)	150 ($\mu\text{g}/\text{m}^3$)

NEQSAA: National Environmental Quality Standards for Ambient Air

Note:

- Selected measurement units were $\mu\text{g}/\text{m}^3$ otherwise stated.
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Environmental Protection Agency (EPA-KPK) Certified

AMBIENT GASEOUS MONITORING REPORT

Reference Number	BKB/ENV/93-2020	Site Address:	Barakahu, Islamabad
Project Name:	Construction Of 4 Lane, flyover / Over Head Bridge	Monitoring Instrument:	AQMS 65, Serial # 1810
Source:	Ambient Air (Gaseous)		
Monitoring Location:	RD 06 + 500 (Near Jillani Town)		

Sr. No	Time Hours	Parameters			
		CO	NO	NO ₂	SO ₂
		Units			
		(mg/m ³)	(µg/m ³)	(µg/m ³)	(µg/m ³)
1.	09:00 A.M	1.53	20.27	24.83	18.87
2.	10:00 A.M	0.71	13.89	23.6	19.01
3.	11:00 A.M	1.47	19.89	24.64	19.74
4.	12:00 P.M	1.31	18.68	24.02	18.35
5.	01:00 P.M	0.68	13.72	23.51	18.75
6.	02:00 P.M	1.29	18.53	23.94	17.3
7.	03:00 P.M	0.82	14.76	22.05	18.09
8.	04:00 PM	0.66	13.54	21.43	17.61
9.	05:00 PM	0.96	15.8	22.57	16.43
10.	06:00 PM	0.81	14.59	21.96	15.87
11.	07:00 PM	0.64	13.37	21.34	16.23
12.	08:00 PM	0.95	15.64	22.5	15.95
13.	09:00 PM	0.79	14.43	21.88	14.99
14.	10:00 PM	1.09	16.67	23.02	16.32
15.	11:00 PM	0.93	15.47	22.41	14.32
16.	12:00 AM	0.77	14.25	21.79	15.28
17.	01:00 AM	1.07	16.51	22.95	16.31
18.	02:00 AM	0.91	15.3	22.33	15.32
19.	03:00 AM	1.2	17.54	23.46	15.34
20.	04:00 AM	1.05	16.34	22.86	16.21
21.	05:00 AM	1.34	13.93	21.63	15.87
22.	06:00 A.M	1.18	17.37	23.38	14.36
23.	07:00 A.M	1.02	16.16	22.77	15.81
24.	08:00 A.M	1.32	18.39	23.89	16.59
Average Concentration		1.02	16.04	22.86	16.62
NEQSAA		05 (24 hr)	40 (24 hr)	80 (24 hr)	120 (24 hr)

NEQSAA: National Environmental Quality Standards for Ambient Air

Note:

- Selected measurement units were mg/m³ and µg/m³ otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.

Signature of Analyst:

FOR ENVIRONMENTAL MONITORING, ANALYSIS & SURVEYS

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Environmental Protection Agency (EPA-KPK) Certified

AMBIENT GASEOUS MONITORING REPORT

Reference Number	BKB/ENV/93-2020	Site Address:	Barakahu, Islamabad
Project Name:	Construction Of 4 Lane, flyover / Over Head Bridge	Monitoring Instrument:	AQMS 65, Serial # 1810
Source:	Ambient Air (Gaseous)		
Monitoring Location:	RD 10 + 000 (Qaziabad)		

Sr. No	Time Hours	Parameters			
		CO	NO	NO ₂	SO ₂
		Units			
		(mg/m ³)	(µg/m ³)	(µg/m ³)	(µg/m ³)
1	10:00 A.M	0.83	12.09	14.93	14.44
2	11:00 A.M	0.84	12.10	14.85	14.83
3	12:00 P.M	0.79	11.97	15.09	15.09
4	01:00 P.M	0.89	12.06	16.78	15.37
5	02:00 P.M	0.96	12.03	16.99	14.61
6	03:00 P.M	0.99	12.71	17.21	15.23
7	04:00 PM	1.03	11.82	17.29	15.67
8	05:00 PM	1.08	11.98	17.37	15.79
9	06:00 PM	0.92	12.05	18.60	16.20
10	07:00 PM	0.89	11.56	15.91	14.90
11	08:00 PM	0.86	11.41	15.76	14.37
12	09:00 PM	0.81	11.20	14.67	13.56
13	10:00 PM	0.76	11.09	14.81	13.25
14	11:00 PM	0.74	11.02	13.92	12.65
15	12:00 AM	0.79	10.72	13.47	12.21
16	01:00 AM	0.71	10.26	13.86	12.54
17	02:00 AM	0.70	9.87	12.90	12.6
18	03:00 AM	0.68	10.39	12.78	12.73
19	04:00 AM	0.72	10.55	12.64	11.59
20	05:00 AM	0.65	11.06	11.89	12.46
21	06:00 A.M	0.68	11.41	12.47	12.14
22	07:00 A.M	0.71	11.37	12.97	11.95
23	08:00 A.M	0.72	11.80	12.88	12.31
24	09:00 A.M	0.78	11.74	12.65	13.67
Average Concentration		0.81	11.42	14.69	13.75
NEQSAA		05 (24 hr)	40 (24 hr)	80 (24 hr)	120 (24 hr)

NEQSAA: National Environmental Quality Standards for Ambient Air

Note:

- Selected measurement units were mg/m³ and µg/m³ otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.

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NOISE LEVEL MONITORING REPORT

Reference Number	BKB/ENV/93-2020	Site Address:	Barakahu, Islamabad
Project Name:	Construction Of 4 Lane, flyover / Over Head Bridge	Monitoring Instrument:	Noise Meter-IEC651- Type-2
Source:	Ambient Noise		
Location:	RD 06 + 500 (Near Jillani Town)		

Sr. No.	Monitoring Time	Unit	Minimum	Maximum	Leq
1.	09:00 AM	dB(A)	49.6	52.5	51.05
2.	10:00 AM		49.4	52.3	50.85
3.	11:00 AM		49.2	52.1	50.65
4.	12:00 PM		49	51.9	50.45
5.	01:00 PM		48.7	51.6	50.15
6.	02:00 PM		48.5	51.4	49.95
7.	03:00 PM		48.3	51.2	49.75
8.	04:00 PM		48.1	51	49.55
9.	05:00 PM		47.9	50.8	49.35
10.	06:00 PM		47.7	50.6	49.15
11.	07:00 PM		47.4	50.3	48.85
12.	08:00 PM		47.2	50.1	48.65
13.	09:00 PM		47	49.9	48.45
14.	10:00 PM		46.8	49.7	48.25
15.	11:00 PM		46.6	49.5	48.05
16.	12:00 AM		46.3	49.2	47.75
17.	01:00 AM		46.1	49	47.55
18.	02:00 AM		45.9	48.8	47.35
19.	03:00 AM		45.7	48.6	47.15
20.	04:00 AM		45.5	48.3	46.9
21.	05:00 AM		45.2	48.1	46.65
22.	06:00 AM		45	47.9	46.45
23.	07:00 AM		44.8	47.7	46.25
24.	08:00 AM		44.6	47.5	46.05

NEQS limit : 65 dB

NEQS: National Environmental Quality Standards

Leq: Log Equivalent Continuous Sound Level

Note:

- Selected measurement units were dB (A) otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
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NOISE LEVEL MONITORING REPORT

Reference Number	BKB/ENV/93-2020	Site Address:	Barakahu, Islamabad
Project Name:	Construction Of 4 Lane, flyover / Over Head Bridge	Monitoring Instrument:	Noise Meter-IEC651- Type-2
Source:	Ambient Noise		
Location:	RD 10 + 000 (Qaziabad)		

Sr. No.	Monitoring Time	Unit	Minimum	Maximum	Leq
1.	10:00 AM	dB(A)	43.9	46.8	45.35
2.	11:00 AM		43.7	46.6	45.15
3.	12:00 PM		43.5	46.4	44.95
4.	01:00 PM		43.3	46.2	44.75
5.	02:00 PM		43	45.9	44.45
6.	03:00 PM		42.8	45.7	44.25
7.	04:00 PM		42.6	45.5	44.05
8.	05:00 PM		42.4	45.3	43.85
9.	06:00 PM		42.2	45.1	43.65
10.	07:00 PM		42	44.9	43.45
11.	08:00 PM		41.7	44.6	43.15
12.	09:00 PM		41.5	44.4	42.95
13.	10:00 PM		41.3	44.2	42.75
14.	11:00 PM		41.1	44	42.55
15.	12:00 AM		40.9	43.8	42.35
16.	01:00 AM		40.6	43.5	42.05
17.	02:00 AM		40.4	43.3	41.85
18.	03:00 AM		40.2	43.1	41.65
19.	04:00 AM		40	42.9	41.45
20.	05:00 AM		39.8	42.6	41.2
21.	06:00 AM		39.5	42.4	40.95
22.	07:00 AM		39.3	42.2	40.75
23.	08:00 AM		39.1	42	40.55
24.	09:00 AM		38.9	41.8	40.35

NEQS limit : 65 dB

NEQS: National Environmental Quality Standards

Leq: Log Equivalent Continuous Sound Level

Note:

- Selected measurement units were dB (A) otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
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WATER ANALYSIS REPORT

Reference Number	BKB/ENV/93-2020	Site Address:	Barakahu, Islamabad
Project Name:	Construction Of 4 Lane, flyover / Over Head Bridge	Source:	Underground (Drinking Water)
Location:	RD 06 + 500 (Near Jillani Town)	Sampling Done by:	Analyst
		Analysis Method:	APHA/USEPA Standard Methods

Sr. No.	Parameters	Standard Methods	Units	NDWQS	Results
1	pH	APHA-4500H+ B	--	6.5-8.5	7.3
2	Taste & Odor	In-house	--	Non Objectionable	Non Objectionable
3	Color	APHA-2120 B/C	TCU	<15	2
4	Turbidity	APHA-2130 B	NTU	<5	2
5	Total Dissolved Solids (TDS)	APHA-2540 C	mg/L	<1000	178
6	Total Hardness as CaCO ₃	APHA-2340 C	mg/L	<500	259
7	Nitrate (NO ₃)	APHA-4500NO3 B	mg/L	≤50	4.7
8	Nitrite (NO ₂)	APHA-4500NO2 B	mg/L	≤3	0.0073
9	Arsenic (As)	APHA-3500As B	mg/L	≤0.05	N.D.
10	Nickel (Ni)	ASTM E3047-16	mg/L	≤0.02	0.004
11	Antimony (Sb)	APHA-3500Sb B	mg/L	<0.005	N.D.
12	Chloride (Cl)	APHA-4500Cl- B	mg/L	<250	94
13	Chlorine	APHA-4500 CL	mg/L	0.5-1.5	0.1
14	Lead (Pb)	APHA-3500 Pb-B	mg/L	≤0.05	0.003
15	Fluoride	APHA-4500F- C	mg/L	≤1.5	0.86
16	Aluminum	APHA-3500 Al	mg/L	≤0.2	N.D.
17	Manganese (Mn)	APHA-3500 MN-B	mg/L	≤0.5	N.D.

NDWQS: National Drinking Water Quality Standards

N.D.: Not Detected

Note:

- Selected measurement units were mg/l otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
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WATER ANALYSIS REPORT

Reference Number	BKB/ENV/93-2020		
Project Name:	Construction Of 4 Lane, flyover / Over Head Bridge	Site Address:	Barakahu, Islamabad
Source:	Underground (Drinking Water)	Sampling Done by:	Analyst
Location:	RD 10 + 000 (Qaziabad)	Analysis Method:	APHA/USEPA Standard Methods

Sr. No.	Parameters	Standard Methods	Units	NDWQS	Results
1	pH	APHA-4500H+ B	--	6.5-8.5	7.1
2	Taste & Odor	In-house	--	Non Objectionable	Non Objectionable
3	Color	APHA-2120 B/C	TCU	<15	2
4	Turbidity	APHA-2130 B	NTU	<5	2
5	Total Dissolved Solids (TDS)	APHA-2540 C	mg/L	<1000	159
6	Total Hardness as CaCO ₃	APHA-2340 C	mg/L	<500	237
7	Nitrate (NO ₃)	APHA-4500NO3 B	mg/L	≤50	3.8
8	Nitrite (NO ₂)	APHA-4500NO2 B	mg/L	≤3	0.0061
9	Arsenic (As)	APHA-3500As B	mg/L	≤0.05	N.D.
10	Nickel (Ni)	ASTM E3047-16	mg/L	≤0.02	0.032
11	Antimony (Sb)	APHA-3500Sb B	mg/L	<0.005	N.D.
12	Chloride (Cl)	APHA-4500Cl- B	mg/L	<250	86
13	Chlorine	APHA-4500 CL	mg/L	0.5-1.5	0.1
14	Lead (Pb)	APHA-3500 Pb-B	mg/L	≤0.05	0.002
15	Fluoride	APHA-4500F- C	mg/L	≤1.5	0.75
16	Aluminum	APHA-3500 Al	mg/L	≤0.2	N.D.
17	Manganese (Mn)	APHA-3500 MN-B	mg/L	≤0.5	N.D.

NDWQS: National Drinking Water Quality Standards

N.D: Not Detected

Note:

- Selected measurement units were mg/l otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
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