CHAPTER 9

PRELIMINARY DESIGN OF TUNNEL

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9.1 GEOLOGICAL CONDITION

9.1.1 Geological Survey

In order to confirm the geological condition of Nagdhunga tunnel, following investigations has been carried out.

- Geological survey
- Aerial photo interpretation
- Electrical Resistivity Tomography
- Seismic prospecting exploration (Changed into Microtremor Array Measurement)
- Drilling survey

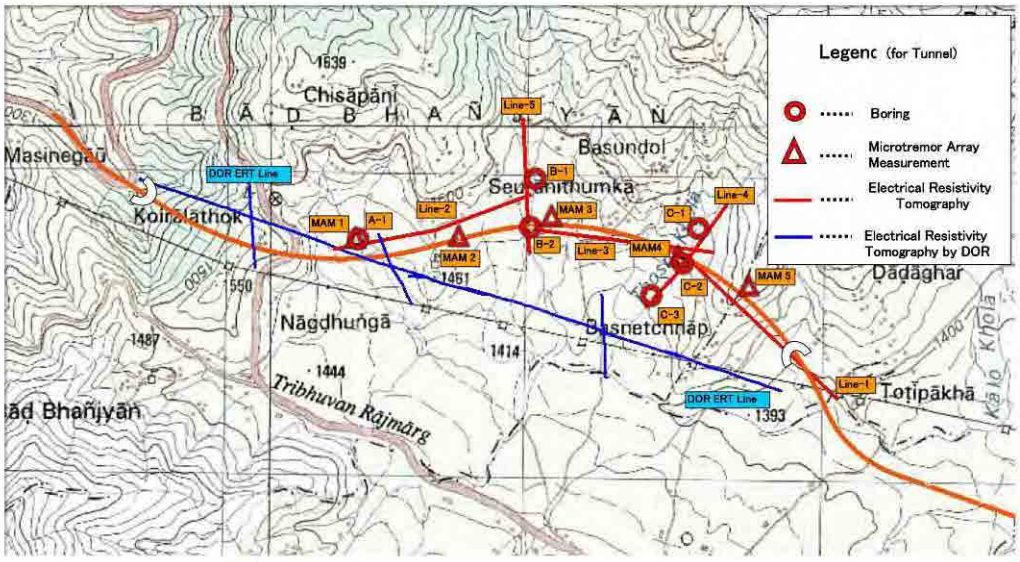


FIGURE 9.1-1 LOCATION MAP OF GEOLOGICAL SURVEY

TABLE 9.1-1 SURVEYED AMOUNT LIST

No.	Item or Work	ID No.	Planned	Achieved
1	Microtremor Array Measurement (MAM)	MAM 1	1.0	1.0
		MAM 2	1.0	1.0
		MAM 3	1.0	1.0
		MAM 4	1.0	1.0
		MAM 5	1.0	1.0
		Total	5.0	5.0
2	Electrical Resistivity Tomography (ERT)	ERT-1	750m	710m
		ERT-2	550m	710m
		ERT-3	800m	710m
		ERT-4	300m	470m
		ERT-5	300m	470m
		Total	2700m	3070m
3	Boring	A1	50m	75m
		B1	60m	55m
		B2	70m	70m
		C1	50m	50m
		C2	50m	60m
		C3	50m	32m
		Total	330m	342m

1) Geological survey was carried out in the range of 12km^2 around the tunnel planned route.

2) The geology of the study area consists of interbedded sandstone and phyllite of the Paleozoic, where many cracks develop as well as thinly developed bedding planes.

3) Survey results are shown in **Figure 9.1-2**.

4) Aerial photo interpretation was carried out by stereoscopic interpretation with scale of 1: 50,000, using the black-and-white photo, taken on 1 November 1992. Results have been reflected on the geological mapping and surface geological survey results.

5) Electrical Resistivity Tomography prospecting has been done along the planned survey lines which cross the original tunnel alignment. And because the seismic prospecting exploration along the tunnel alignment could not be carried out due to the difficulty to obtain permission, ERT was additionally carried out along the tunnel longitudinal alignment. It should be noted that DOR had carried out several surveys for the feasibility study in the vicinity of the project tunnel (in Feb. 2013) and the results of this study are also reflected in the report. The survey results are shown in **Figure 9.1-3**.

6) Seismic refraction exploration was planned to be carried out along the tunnel alignment but because of the availability of dynamite required by the survey was difficult, it was changed to Microtremor Array Measurement (MAM). The survey results are shown in **Figure 9.1-4**.

7) Boring survey was conducted in order to confirm the depth and the properties of the bedrock in the valley areas which cross the tunnel alignment. The boring results obtained are reflected in the photos in **Figure 9.1-5**.

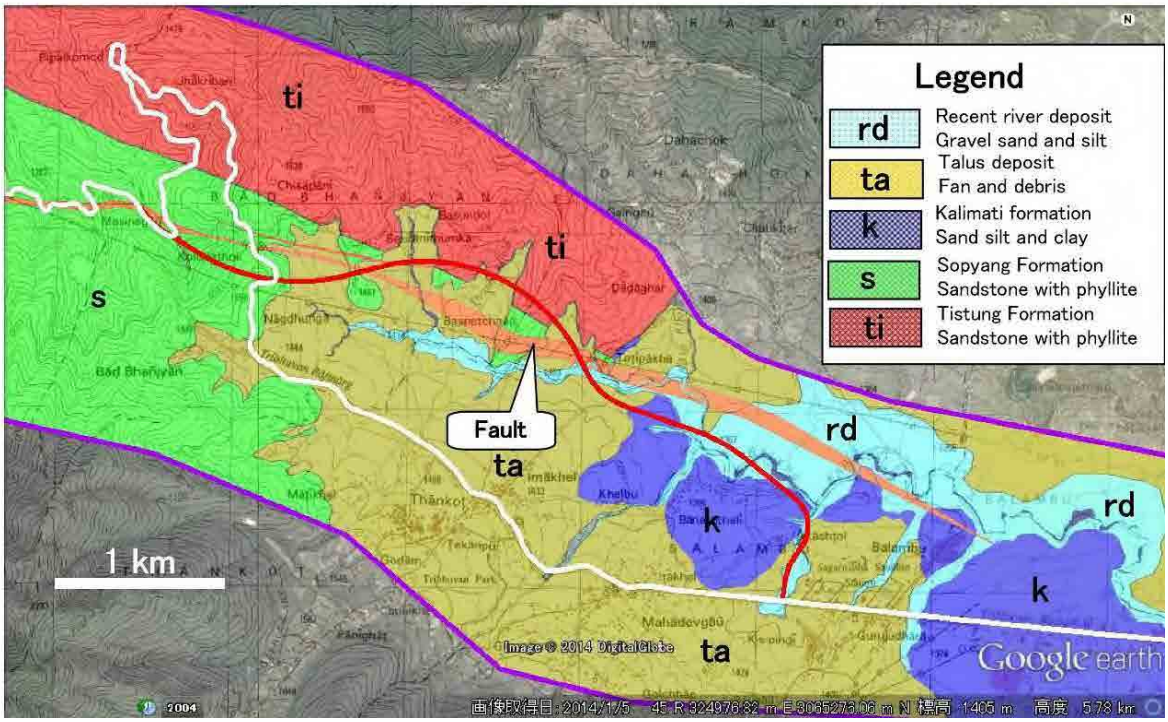


FIGURE 9.1-2 GEOLOGICAL MAP OF SURVEYED AREA

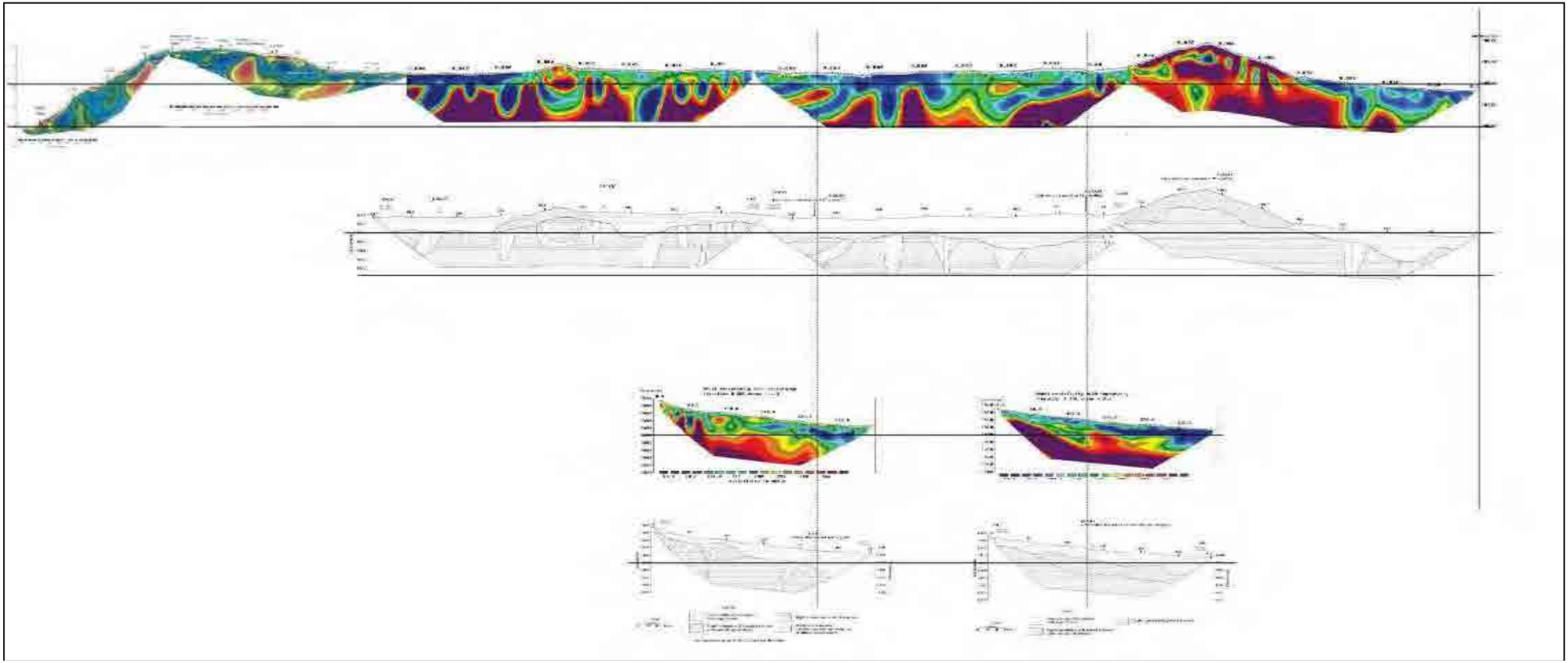


FIGURE 9.1-3 INTERPRETED RESULTS OF ERT

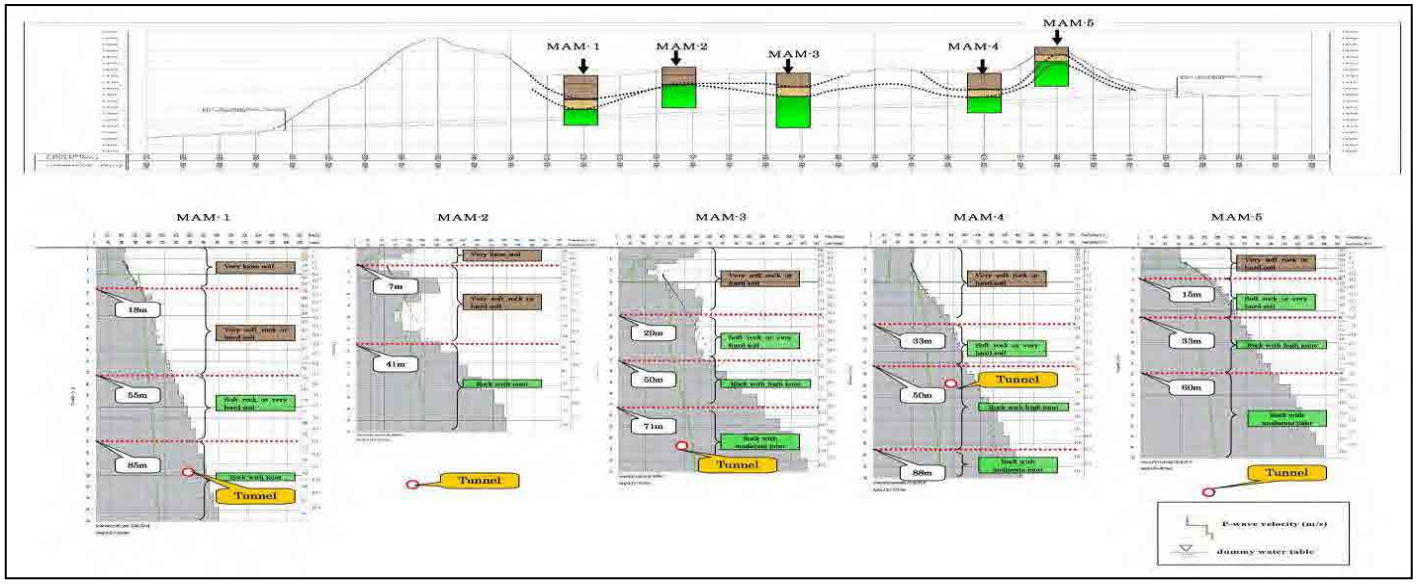


FIGURE 9.1-4 INTERPRETED RESULTS OF MAM

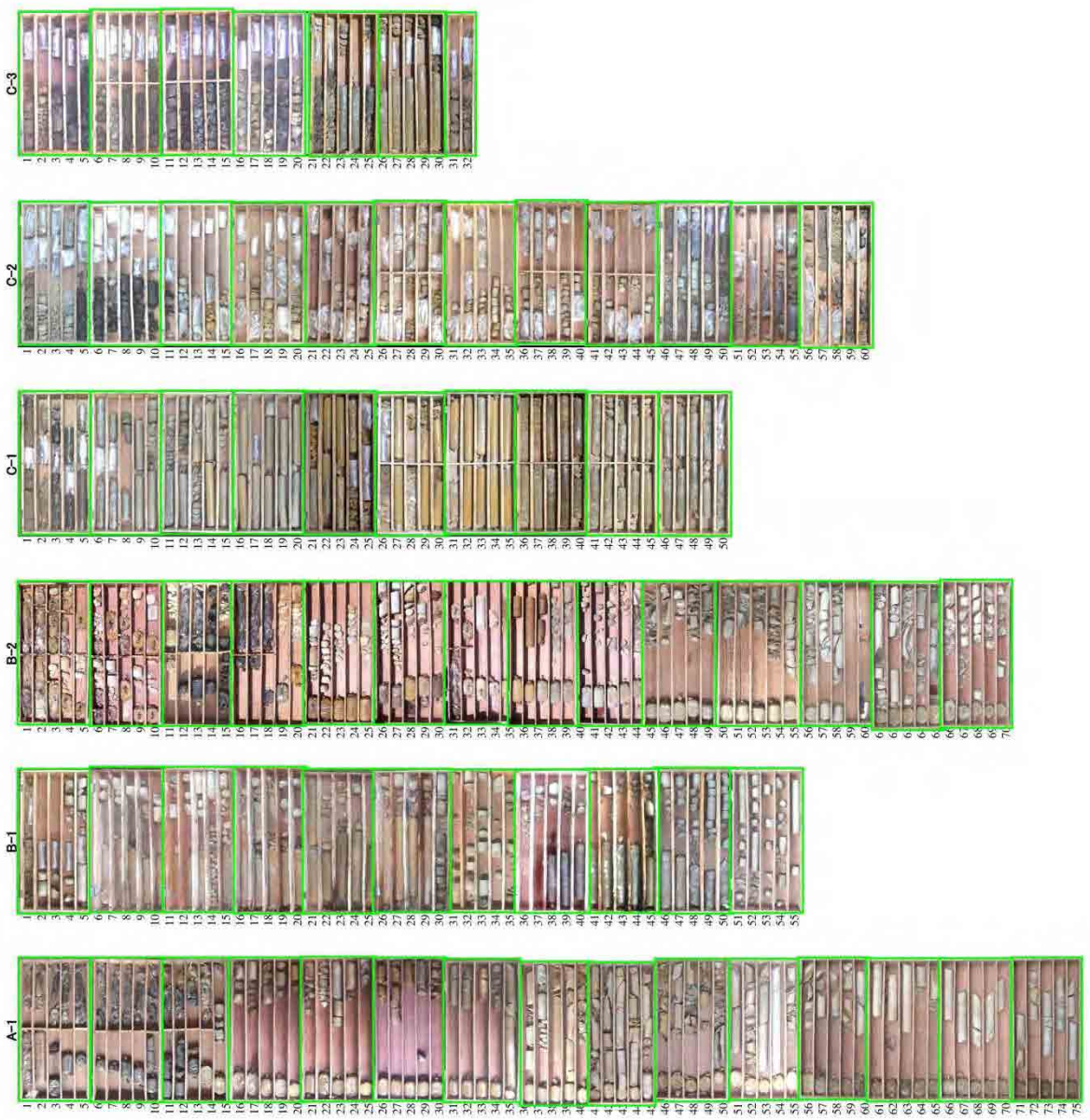


FIGURE 9.1-5 BORING CORES PHOTOS

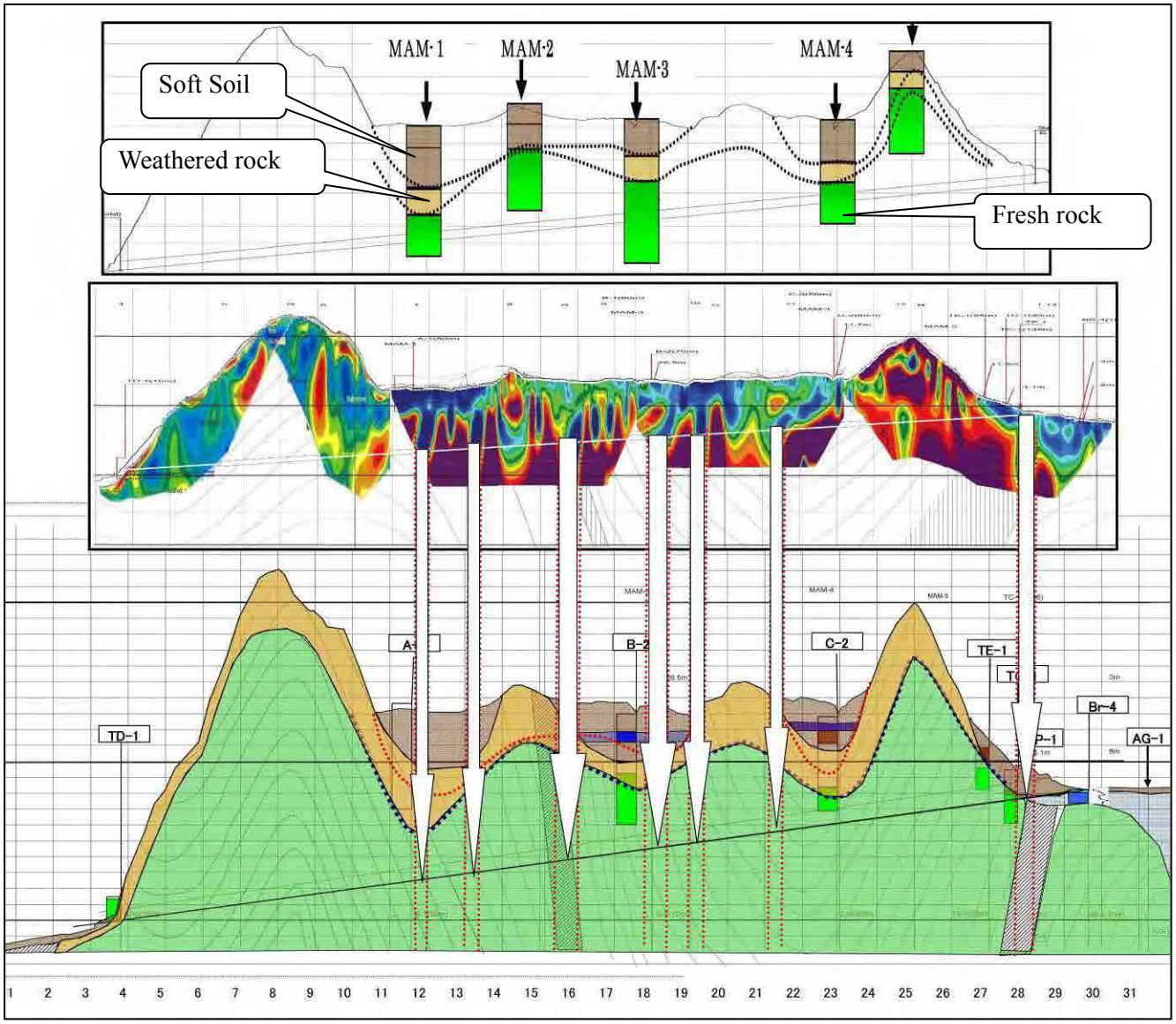


FIGURE 9.1-6 INTERPRETATION OF RESULTS OF MAM, ERT AND BORING

9.1.2 Summary of geological survey on Nagdhunga Tunnel

- The Nagdhunga tunnel is mostly planned in the direction of east and west, starting from Basnetchhap as eastern portal and passes under the Sisne khola to Nagdhunga pass and reaches to the west side portal, and is 2450 m long.
- The geology of this section is Sopyang formation of Paleozoic era.
- Sopyang formation is the thin alternation of sandstones and phyllites.
- The thickness of each sand stone layer is 5 to 30 cm and phyllites are 1 to 5 cm thick, and many cracks develop due to repeated small foldings.
- There are three wide valleys along the tunnel alignment.
- These valleys are filled up with the sediment of talus and clays which deposited when Katmandu basin had been a lake.
- The thickness of the sediments are 20 to 40 m.
- The weathering layer of bedrock is 30 to 40 m from the surface, and below the weathered rock fresh and hard rock with fractures are confirmed by boring.

- Although the groundwater level is assumed to be about 30-40m from surface in a mountain part, about 5-10m from surface are confirmed in the valley area.
- In the west side portal area a little weathered alternations of sandstone and phyllite are exposed, Relationship of excavation slope and bedding planes of the strata shows that slopes to be cut are rather stable because the strata dip into the slope.
- In the east side portal, talus sedimentary layers are thick, and also cohesive soil is distributed over the lower part of a talus cone.
- Longitudinal geological profile is shown in the attached drawing sheets.

FIGURE 9.1-7 FEATURES OF BEDROCK WITH MANY CRACK

9.2 KEY POINTS FOR TUNNELING FROM THE VIEWPOINTS OF GEOTECHNICAL CONDITION

Issues particularly important for the implementation of Nagdhunga Tunnel are summarized as follows;

- It is of great importance in designing the tunnel support pattern and method of tunneling of Nagdhunga Tunnel to maintain the groundwater level as much as possible to the present level, where habitants are using surface water flow and groundwater, and houses near eastern portal shall be maintained safely during tunneling. When shortage of water is triggered it will induce serious difficulty in the implementation of the project.
- Slopes surrounding tunnel portals shall be maintained stable permanently and stream waters shall be adequately managed not to harm the tunnel.
- In the planning of tunneling method it must be reflected that there distributes to some extent hard massive sandstones which may be very difficult for mechanical excavation method without using heavy breaker or some other auxiliary method.
- Another point of importance is that tunneling method and support design shall be adequate to cope with fault zones to be encountered during tunneling although the exact location and nature of the fault zones are not identified yet.

All of the above issues are to be reflected in the design of tunnel support and method of excavation for Nagdhunga Tunnel.

Necessary auxiliary methods and measures and their cost thereof are considered in the design, method of tunneling and cost analysis.

9.3 ENGINEERING APPROACH

9.3.1 Design Standards

There is no design standard for tunnels included in the Nepal Standards. All design standards for road tunnels in developed countries are quite similar.

Japan is the one of the most experienced countries in tunneling in the world, and as the geology and geotechnical condition of Japan is very similar to that of Nepal, the present study for tunneling for the Nagdhunga Pass Project is based upon the experiences in Japan and the design of the tunnel is based on the Standard of NEXCO (Nippon Expressway Company, former Japan Highway Corporation), which is applied to all the highway tunnels and most of national road tunnels in Japan, most of which have been constructed by NATM. Because NATM is applied for most of the tunnels worldwide Nagdhunga Tunnel is to be constructed by NATM.

NATM is first established in Austria, which utilizes shotcrete and rockbolts as major supporting system generally in hard rock mass with measurement of deformation of tunnel walls to evaluate whether the tunnel is stable or not. And if not, additional support measures are applied accordingly.

However, Japanese contractors have applied the method generally in very poor ground and during constructing so many tunnels in difficult ground, Japanese contractors have advanced the method by themselves and innovated various kinds of auxiliary methods and specific equipment for supporting the poor ground.

Result of Data Collection Survey shows that the proposed width of the road in tunnel is 2 x 3.5m lanes with 2.5m wide lane for emergency parking at east bound direction and 0.5m wide shoulders on both sides; a walk way for maintenance of the facilities, 75cm wide and 2.0m high, is required at one side.

No side walk is designed because for the safety of the traffic; non-motorized traffic, such as pedestrians, bicycles, hand cart and animal traction carts, or agricultural tractors are not allowed to enter the tunnel. Thus, the total width of the tunnel is about 12 m and the height is about 7 m.

Tunnel design shall follow the above dimensions and clearance in height for the traffic is determined as 5.0m which is the standard for Asian Highways.

9.3.2 Rock classification method and Standard Support Patterns of the tunnel

(1) Rock classification system and standard support patterns in Japan

Table 9.3.2-1 shows the rock mass classification system of NEXCO and **Table 9.3.2-2** shows the standard support pattern for two lane tunnel.

TABLE 9.3-1 ROCK MASS CLASSIFICATION SYSTEM (NEXCO)

Rock class	Condition of rock mass	RQD	Stability of face	convergence
B	Rock is fresh and hard. Discontinuous planes are stable and the possibility of loosening due to tunnel excavation is very small.	60 to 90	The strength is significantly higher than the expected load and only occasional local spalling of rock fragment may occur.	Convergence of tunnels is negligible.
C Ⅰ	Rock is partly weathered or altered. Discontinuous planes are generally relatively stable	20 to 70	The strength is higher than the expected load and the loosening is expected to be local.	Convergence of tunnels is usually within the elastic range.
C Ⅱ	Rock is partly weathered or altered and fractured.	20 to 70	Strength is not significantly higher than the expected load, but is sufficient to limit the elastic deformation. Rock chunks along slippery discontinuous planes tend to spall. Often requires fore-polling.	Convergence stops to increase before the tunnel face has advanced a distance of 2 D, where D is the tunnel diameter. Convergence of tunnels does not exceed 50 mm.

Rock class	Condition of rock mass	RQD	Stability of face	convergence
D Ⅰ	Rock is significantly weathered and softened or sheared.	< 20	Partial plastic displacement and elastic deformation could occur. Or even if the strength is high enough to limit the elastic deformation, significant loosening of ground along slippery discontinuous planes could occur. Requires fore-pilings.	Where the strength is small and the invert concrete is not placed at an early stage, the convergence could reach 30 to 60 mm and does not stop to increase even if the tunnel face has advanced more than 2 D
D Ⅱ	Rock is completely weathered and partly softened to soil, or heavily sheared. Talus deposits and soil are included in this class.	< 20	The strength is low compared to the expected load and large plastic deformation as well as elastic displacement could occur. In addition to the low strength, significant loosening of ground along slippery discontinuous planes and large displacement could occur.	Convergence of tunnels could reach as large as 60 to 200 mm and does not stop to increase even if the tunnel face has advanced more than 2 D, if the invert concrete is not placed at an early stage
E	Ground such as faults, fractured zones and large talus deposit.		Squeezing occurs and generates occasional collapse in face area.	Large deformation could reach to 400mm.

TABLE 9.3-2 STANDARD SUPPORT PATTERNS FOR TWO-LANES TRAFFIC TUNNELS (NEXCO)

Ground class	Support pattern	Cut per advance (m)	Rock bolts				Shotcrete	Steel rib		Lining thickness (cm)		Allowable deformation (cm)	Excavation method
			Length (m)	Spacing		Construction range	Thickness (cm)	Upper half size	Lower half size	Arch & wall	Invert		
				Peripheral (m)	Longitudinal (m)								
B	B-a	2.0	3.0	1.5	2.0	Upper half 120°	5	-	-	30	0	0	Full face with micro bench or top heading cut
C Ⅰ	C Ⅰ-a	1.5	3.0	1.5	1.5	Upper half	10	-	-	30	(40)	0	
C Ⅱ	C Ⅱ-a	1.2	3.0	1.5	1.2	Upper and lower halves	10	-	-	30	(40)	0	
	C Ⅱ-b			1.5	1.2			H125	-				
D Ⅰ	D Ⅰ-a	1.0	3.0	1.2	1.0	Upper and lower halves	15	H125	H125	30	45	0	
	D Ⅰ-b	1.0	4.0										
D Ⅱ	D Ⅱ-a	1.0 or less	4.0	1.2	1.0 or less	Upper and lower halves	20	H150	H150	30	50	10	

The support patterns are divided into a and b as shown below.
a: Standard support pattern generally used for all rock types
b: Support pattern used in the initial design only when the tunnel excavation is expected to result in a larger displacement in clay stone, black schist, mudstone, shale, tuff, or other rock types.
Note that the values in ( ) for the invert are applied to tertiary mudstone, tuff, serpentinite, and other ground rocks, weathered crystalline schist, and sulfuric soil.

9.4 CROSS SECTION AND SUPPORT PATTERNS OF THE TUNNEL

9.4.1 Tunnel cross section

Cross section of the tunnel is so designed as to meet the requirement to provide two 3.5m wide lanes and one 2.5m wide lane for emergency parking in the east bound direction. Height of the construction gauge for the traffic is 5.0m.

After walk out survey and examining the geological condition on various outcrops, tunnel types and support designs are preliminarily determined. Then after getting information on geotechnical and hydrological condition through field investigations, support patterns (and Tunnel types) and length of distribution of each pattern is defined finally and is reflected in the longitudinal tunnel profile.

Tunnel types are classified into 3 types in this study to reflect the geotechnical condition of the tunnel so far encountered and are classified as CⅡ, DⅠ and DⅡ. Cross sections of each tunnel type are shown in the Sheets NO. 10 to 12 of the Preliminary Design Drawings.

Type CⅡ is to be applied to the ground where rock mass is significantly fractured or sheared. The type of rock is the alternation of thin slate and sandstone. This type of ground is expected to develop in the area beneath the ridges and near western portal area and is supposed to share about 60% of the total tunnel length.

Type DⅠ is to be applied to the ground where rock mass is heavily sheared or weathered or to the CⅡ ground where valley deposits distribute over the rock mass in thin coverage. This type of ground is supposed to be encountered under the valley at two locations, at Thosne Khola and west of it, beneath the small ridge at Chisapani where existence of fault zone is anticipated and in the near portal area where overburden is small. This type of ground is supposed to be of about 35% of the total tunnel length.

Type DⅡ is to be applied to the ground where rock mass is totally weathered and overburden is very small as in the area of both portals. This may occupy about 5% of the total tunnel length.

It is a general requirement for the tunnel to provide emergency parking areas when the tunnel is very long. As for the Nagdhunga Tunnel there is a emergency parking lane in the east bound direction. However, in the west bound direction emergency parking zones shall be provided. In this study 2 numbers of emergency parking zones are designed at about 800m apart and is named Type CⅡ-L.

9.4.2 SUPPORT PATTERNS (See Sheets NO. 13 to 16 of the Preliminary Design Drawings)

Referring to the standard support pattern in **Table 9.4-1**, support patterns for the Nagdhunga Tunnel are designed.

- Support Pattern CⅡ corresponds to Tunnel Type CⅡ. It consists of 10cm thick shotcrete, 3m long rockbolts at spacing 1.5m peripherally and 1.2m longitudinally. Secondary concrete lining is 30cm thick. Due to the fractured nature of the rock mass shotcreting for the excavated face area is sometimes required.
- Support Pattern DⅠ is applied to tunnel class DⅠ. It consists of 15cm thick shotcrete, 3m long rockbolts at spacing 1.2m peripherally and 1.0m longitudinally. Thickness of lining concrete is 30cm. The Pattern requires face shotcrete 3 to 5cm thick to stabilize the excavated face.
- When the rock mass in the invert is very weak and is likely to be deteriorated the support requires extra H-shaped steel arch (H125) and 45cm thick invert concrete and is named Support Pattern DⅠ-a. Pattern DⅠ-a requires also an auxiliary method such as fore-poling and face shotcrete.
- Depending on the rate of ingress of groundwater under the valley area, chemical injection with long span fore-piling may be required instead of fore-poling to maintain the groundwater level. When tunneling encounters fault zones same measures may be required. This support pattern is named as Pattern DⅠ-b.
- Support Pattern DⅡ corresponds to tunnel Type DⅡ. It consists of 20cm thick shotcrete and rockbolts of 4m long at spacing 1.2m peripherally and 0.75m to 1.0m longitudinally depending on the stability of the excavated face. It requires steel arch sets of 150H for the

temporary support of the weight of the above ground. Fore-poling by 3m long rockbolts are generally required. Secondary lining concrete is 35cm thick in arch and 50cm thick in invert.

- In eastern portal area the support pattern requires heavy auxiliary method such as long span fore-piling with chemical injection to maintain the groundwater level (this support pattern is named Support Pattern D Ⅱ-a). On the contrary, in the western portal area portal slope is to be widely cut and fractured but fresh rock mass of C Ⅱ class is expected to appear in a short distance from the portal.
- For the portal zones lining concrete shall be steel-reinforced in order to sustain the non-uniform overburden loads acting on it permanently.
- Western tunnel entrance is to be of reinforced concrete structure of 80cm thick and eastern tunnel entrance will be more rigid structure to cope with the ground pressure acting on it.

As for the emergency parking zones with which the cross sectional area is very large, the parking zones shall be designed in Detail Design stage to locate them in the area of better geotechnical condition.

Table 9.4-1 shows a list of support patterns.

TABLE 9.4-1 LIST OF SUPPORT PATTERNS

Support Pattern	Excavation area m2	Advance per cycle	Applicable geological condition	Excavation method	Auxiliary method	Rock bolt	Shotcrete thickness	Steel-rib	Lining thickness
C Ⅱ	89.16	1.2m	Thinly bedded fractured rock mass Alt. of Sst&shale	Micro bench mechanical		3m long, 1.5m(p), 1.2m(l),	10cm		30cm
D Ⅰ	91.26	1.0m	Highly fractured and weathered rock mass (+ Fault zone)	Ditto		3m long, 1.2m(p),1.0m(l)	15cm		30cm
D Ⅰ-a	101.97	1.0m	Heavily fractured, weathered rock	Ditto	Fore-poling 3m long	Same as above	15cm	125H	30cm(arch) 45cm(inv.)
D Ⅰ-b	101.97	1.0m	Ditto with groundwater (under the valleys)	Ditto	Fore-piling (12m) with chemical injection	Same as above	15c	125H	30cm(arch) 45cm(inv.)
D Ⅱ	105.06	0.75-1.0m	Highly weathered rock mass with thin rock cover	Ditto	Fore-poling 3m long	4m long, 1.2m(p) 0.75-1.0m(l)	20cm	150H	35cm(arch) 50cm(inv.) Steel reinforced
D Ⅱ-a	105.06	0.75-1.0m	Ditto with groundwater (eastern portal area)	Ditto	Fore-piling (12m) with chemical injection	Same as above	20cm	150H	35cm(arch) 50cm(inv.) Steel reinforced

Note: (p) means peripheral, (l) means longitudinal

Important notice on water proofing by chemical injection

In the design chemical injection is intended to be used with AGF in tunnel in order to minimize the lowering of groundwater level. However, our intention is not to make the tunnel perfectly watertight but to reduce the water inflow into the tunnel. Thus tunnel is not designed as watertight tunnel.
When geological structure is taken into consideration, that the strike of the strata is generally sub-parallel to the tunnel axis and dip of the strata is considerably high to the north or to the south due to occasional folding and that permeability of the rock mass across the bedding planes in thin alternation of slates and sandstones is generally low because slates are impermeable and sandstones are permeable and groundwater passes in the fissures of sandstone layers, area of the chemical injection to be carried out with AGF may possibly be limited to along the arch periphery of the tunnel. This shall be further studied in detailed design study.
During tunneling whenever groundwater inflows from the excavated side walls through shotcrete chemical injection shall be done to reduce the rate of inflow.
Groundwater inflow from the face area if any can be accepted because groundwater comes from far front of the face and when tunnel periphery is closed all the way after the completion of tunneling groundwater cannot enter into the tunnel and groundwater level may recover gradually.

9.4.3 Longitudinal profile of the tunnel

Longitudinal profile of the tunnel including geotechnical condition and distribution of type of support are shown in the **Sheet NO. 9 of the Preliminary Design Drawings**.

9.5 METHOD OF TUNNELING

9.5.1 Geology, geotechnical and hydrological condition of the tunnel

(1) Geology and geotechnical condition

Tunnel ground to be excavated mainly consists of thin alternation of sandstone and shale. Their geotechnical condition seems to be of poor nature and are classified into CⅡ, DⅠ and DⅡ. To some extent it is anticipated that considerably thick hard sandstones occasionally appear in the excavation face area beneath the ridge areas and in the selection of tunneling method it is taken into account. Because the bedding planes of the strata are sub-parallel to the tunnel axis cares shall be taken to the stability of excavated side walls.

(2) Hydrological condition

With regard to hydrological condition of the tunnel ground, groundwater may infiltrate into the tunnel where rock mass is sheared or near the portal area and under the Thosne Khola where tunnel is covered by basement rock with thin cover and water-bearing unconsolidated sediments develop above the basement rock.

Surface water flows and groundwater are widely utilized in the eastern portal and valley areas not only for agricultural use but also for domestic use and decrease in groundwater level due to tunneling may induce serious problem. Necessary measures are designed to preserve the groundwater level as much as possible in this study.

9.5.2 Excavation method of tunneling

(1) Method of tunneling

There are two methods of tunneling, Drill & Blasting and mechanical excavation. Drill & Blasting method is generally applied in hard rock mass and when the rock mass is fractured significant overbreaks occur and heavier support is required compared to mechanical excavation.

Geology of the Nagdhunga Tunnel consists mainly of thin bedded alternation of shale and sandstone with many cracks in it and is generally classified as poor rock mass. Thus, the tunnel shall be excavated mechanically by Road-Header (see **Figure 9.5-1 and TABLE 9.5-2**).

- Mechanical excavation has a great merit when it comes to excavate soft rock or hard rock of poor nature where many planes of discontinuities develop. Overbreaks are much smaller, support patterns are lighter and the rock mass surrounding the tunnel remains more intact after excavation than D&B. However, when the rock mass is hard and intact it cannot excavate the rock mass economically. In Nagdhunga Tunnel occasionally road-header may encounter hard massive sandstone and utilization of giant breaker may be required in such a case.

FIGURE 9.5-1 ROAD-HEADER AS TUNNELING MACHINE

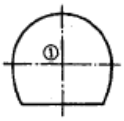
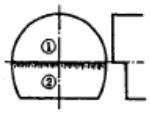
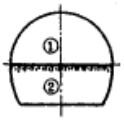
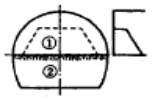
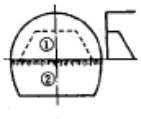
TABLE 9.5-1 COMPARISON OF EXCAVATION METHOD

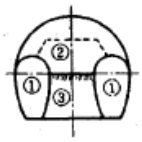
Tunneling Method		Drill & Blasting		Mechanical	
Features		➢ This method is generally applied in hard rock mass and soft rock mass. ➢ In order to use explosives, it is necessary to exercise caution in the application of this method. ➢ Noises and vibrations generated by blasting method is not small. ➢ Overbreaks is large and ground is likely to be loose.		➢ This method is generally applied in middle hard rock mass, soft rock mass and sand/soil layer. ➢ Noise and vibration generated by tunnel excavation is small. ➢ Overbreaks and loose of ground is small.	
Evaluation Indexes	Applicability	➢ Geology of Nagdhunga Tunnel is mainly of thin bedded alternation of shale and sandstone with many cracks, and it is possible to apply Drill & Blasting method. But excessive overbreaks and loose of ground will be occurred.	△	➢ Geology of Nagdhunga Tunnel is mainly of thin bedded alternation of shale and sandstone with many cracks, and it is possible to apply Mechanical method. It is possible to excavate effectively because loose of ground and overbreaks are small.	○
	Environmental	➢ It is necessary to consider the countermeasures of noises and vibrations reduction for residents around west tunnel portal.	△	➢ Noises and vibrations generated by tunnel excavation is small.	○
	Safety	➢ Safety measures for application of explosives are needed.	△	➢ Necessity safety measures for Mechanical method are less than that for Drill & Blasting method.	○
Total Evaluation		△		○	

(2) Excavation method

Tunnel excavation method is classified as shown in エラー! 参照元が見つかりません。. Depending upon the geotechnical condition excavation face area is sometimes divided into sections and when geotechnical condition is of extremely poor center diaphragm method or side drift method are employed. However, geotechnical condition of the Nagdhunga Tunnel is deemed to be of poor nature, not extremely poor, and owing to the merit of mechanical excavation, excavation shall be done by nearly full face excavation method. It is called micro-bench method (it is named *full face method with auxiliary bench cut* in the Table), which leaves the lower bench by few meters from the upper bench excavation face. The lower half section is excavated simultaneously or continuously with the excavation of upper half section. This method can maintain the stability of the face more easily than full face excavation.

TABLE 9.5-2 CLASSIFICATION AND CHARACTERISTICS OF STANDARD EXCAVATION METHOD

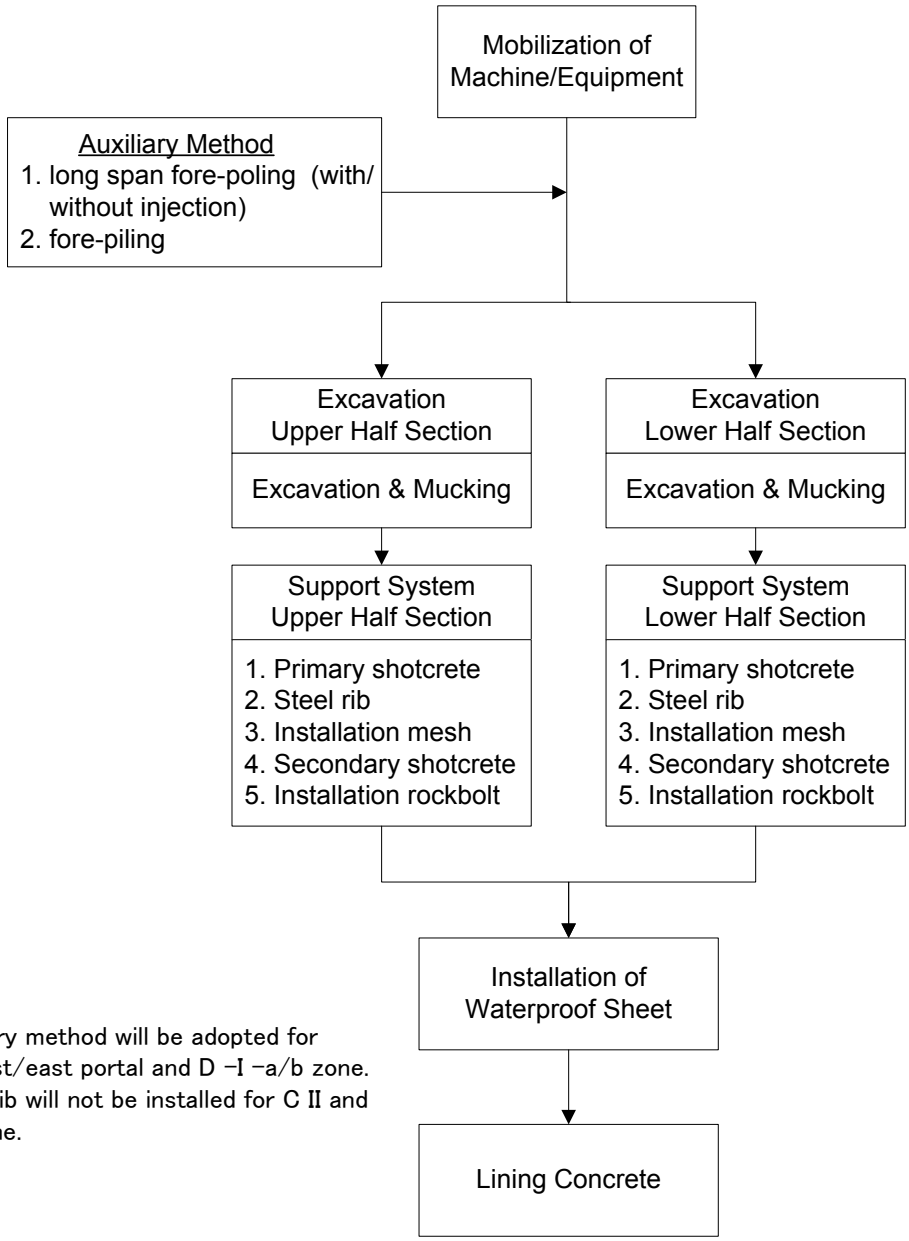
Excavation Method		Division of Section of Heading	Applicable Ground Condition	Advantages	Disadvantages
Full Face Method			Common excavation method for small section tunnel Very stable ground for large section tunnel (A=30m^2) Fairly stable ground for medium section tunnel (A>50m^2) Unfit for good grounds interspersed with poor ground that may require the change of the excavation method	Labor saving by mechanized construction Construction Management including safety control is easy because of the single-face excavation.	Full tunnel length cannot necessarily be excavated by full face alone. Auxiliary bench cut will be adopted as required. Fragment rocks from the top of the tunnel may fall down with increased energy & additional safety measure are required.
Full Face Method with Auxiliary Bench Cut		 Bench length = 2~4m	Comparatively stable ground, but difficult using the Full Face Method. Full-face excavation is made difficult during construction. Presence of some poor ground in fairly good ground.	Labor saving due to mechanized construction Construction management including safety control is easy because of the single-face excavation.	Difficult to switch to other excavation method when the face does not stand up.
Bench Cut Method	Long Bench Cut	 Bench length>50m	Ground is fairly stable, but Full-face excavation is difficult.	Alternate excavation of top heading and lower bench reduces equipments and manpower needs.	Alternate excavation system elongates the construction period.
	Short Bench Cut	 D < Bench length≤ 50m	Applicable to various ground such as softly ground, swelling ground, and medium to hard rock ground. (The most fundamental and popular method.)	Adaptable to change in the ground condition.	Parallel excavation makes difficult the balancing of cycle time for top heading and bench.
	Mini Bench Cut	 Bench length <D.	Deformation control of the excavated inner section is more urgently required than in the case of the Short Bench Cut. Squeezing ground that require an early closure of the excavated section	Easy to make early closure of the invert.	Scaffolding is required for the top heading excavation. Selection for construction machine tends to be limited for top heading
Center Diaphragm Method		 One method is to provide a diaphragm only to	Ground of shallow overburden where ground surface settlement is required to be kept at a minimum. Comparatively poor ground condition for a large section tunnel.	Face stability is secured by dividing into small sections. Ground Surface settlement can be significantly reduced. Divided sections of heading are larger than	Displacement or settlement during the removal of the diaphragm shall be checked. Time for diaphragm removal is added to the construction period. The adoption of a special

Excavation Method	Division of Section of Heading	Applicable Ground Condition	Advantages	Disadvantages
	the top heading, while the other is to provide both a top heading and a bench.		those used in the Side Drift Method, and larger machines can be used.	auxiliary method in the tunnel is difficult.
Side Drift Method		Bearing capacity of the ground is not sufficient for adopting the Bench Cut Method. Ground of shallow overburden where ground surface settlement is required to be kept at a minimum.	Ground surface settlement can be reduced. Temporary diaphragms can be more easily removed than those of center diaphragm method.	Small machines have to be used for drift excavation.

Tunnel excavation is designed to be commenced from both portals. Excavation from the western portal is in ascending direction. This eases the excavation by providing natural drainage downward towards the portal. On the contrary excavation from the eastern portal is in descending direction and drainage of groundwater shall be done by pumping.

9.5.3 Sequence of Tunneling

Figure 9.5-2 shows the overall flow chart of procedure of micro bench-cut excavation and **Figure 9.5-3** illustrates the sequence of excavation.



Note
①. Auxiliary method will be adopted for the west/east portal and D −I −a/b zone.
②. Steel rib will not be installed for C II and D I zone.

FIGURE 9.5-2 PROCEDURES OF MICRO BENCH-CUT EXCAVATION

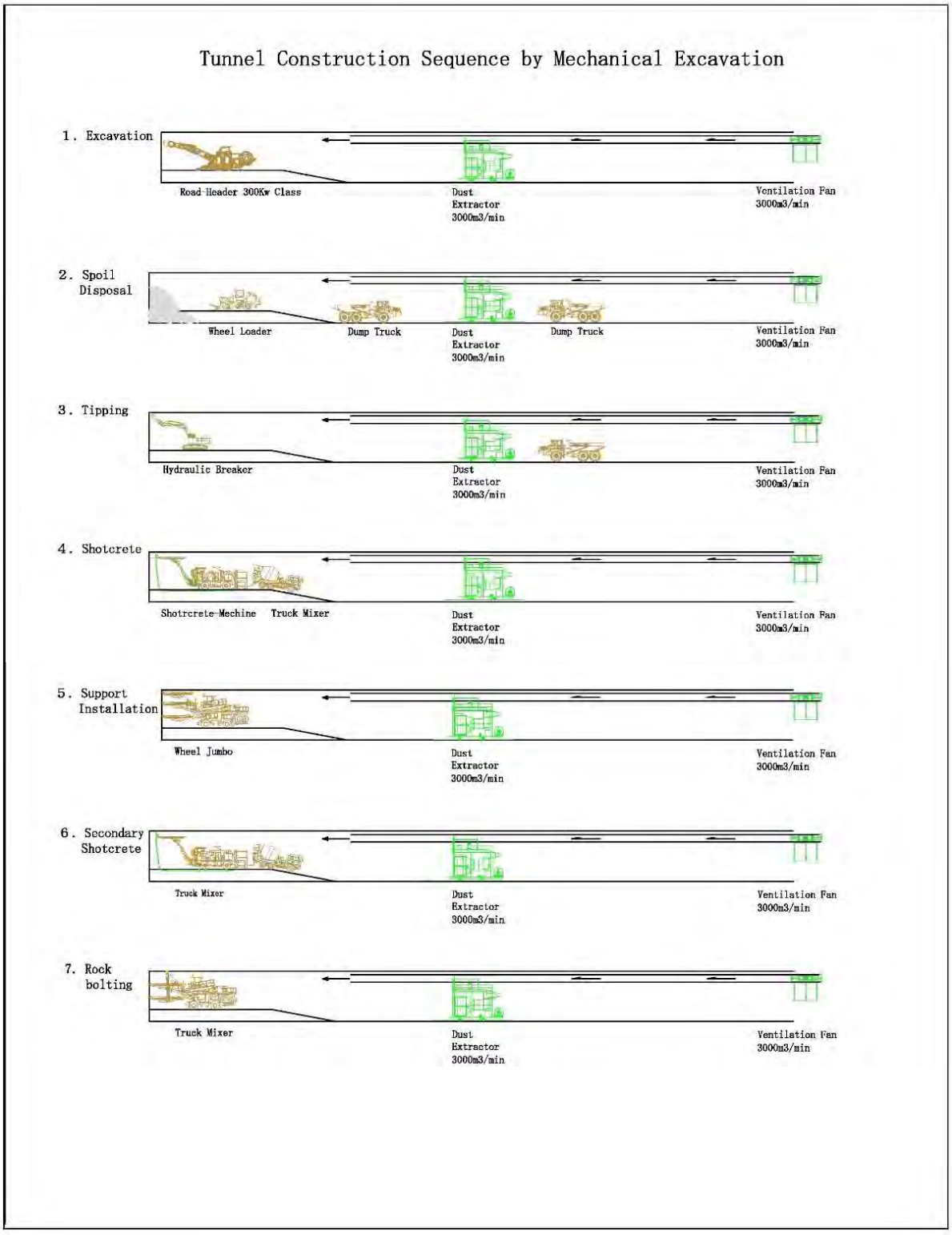


FIGURE 9.5-3 SEQUENCE OF MECHANICAL EXCAVATION

(1) Tunnel excavation and support installation

Excavation from western portal

After finishing mobilization and preparation work at western portal area, which include construction of water channel along small valleys at both sides of the tunnel and along a valley in front of the tunnel, preparation of temporary yards at both sides of the tunnel and installation of temporary facilities start. During this period slope in front of the portal shall be cut and

protected by shotcrete and rockbolts or by free-flame and provide yards for tunneling operation.

Portal excavation then starts. First 17.5m long section is to be excavated by applying DⅡ Support Pattern with fore-poling. Fore-poling, 3m long, is constructed at first from the portal slope and mechanical excavation starts at upper half section by the length of 0.75m to 1.0m and immediately after excavation primary shotcrete is applied to stabilize the excavated surface. Steel support, H150, is installed then and secondary shotcrete is carried out. Rockbolts are drilled and fixed and mechanical excavation continues in lower half section and supports are installed continuously. Then next cycle fore-piling is constructed and upper-half excavation starts.

Thin shotcreting may be required for the excavation face area to stabilize the poor rock mass. Tunneling continues till 17.5m long from the portal and then tunneling continues by applying Support Pattern CⅡ towards eastern portal.

Whenever fore-poling or fore-piling is required it is executed before commencement of next cycle excavation utilizing the H-steel support as a guidance. Fore-poling is 3m long and is executed in every excavation cycle where required by designated support pattern. On the contrary fore-piling is 12m long and after execution of fore-poling tunnel is excavated by 9m long continuously through applying designed support. After excavation of 9m is completed next fore-piling starts.

Fore-piling is generally installed in arch section with injection of cement material to reinforce the area surrounding fore-piling. However, when it is required to provide water-tight zone around the whole tunnel periphery fore-piling is installed with chemical injection to all the periphery of tunnel including invert.

When mechanical excavation encounters hard sandstones giant breaker is to be used or several holes are drilled by drilling jumbo to ease the mechanical excavation.

Excavation from eastern portal

In the eastern portal area construction activity can be started independently from tunneling in western portal. Gentle slope is to be cut till about 8m coverage above the tunnel is ensured. During the open cut activity existing village road shall be diverted. As for the groundwater treatment in the portal area to minimize the groundwater level shall be referred to 9.7.1 (2).

After finishing preparatory work tunnel excavation starts. Support Pattern DⅡ shall be applied till the zones where chemical injection from surface has been carried out. Afterwards tunneling continues by applying DⅡ-a Pattern which accompanies installation of fore-piling with chemical injection to establish watertight structure. Tunneling in descending gradient is scheduled to continue till about 520m from the portal. When tunneling from western portal delays tunneling from eastern portal should be continued to further west.

(2) Lining Concrete

Secondary lining concrete, to be commenced from both portals, follows the excavation about several hundred meters to thousand meters apart. Behind the lining concrete water-proofing sheets are fixed in order to prevent the groundwater entering into the tunnel through joints and cracks of the lining concrete.

In portal area where non-uniform overburden loads acting permanently lining concrete shall be reinforced by steel bars but in other section steel reinforcement is not required. Arch shaped steel-form is to be used for secondary lining concrete.

(3) Muck Disposal

Excavated material is loaded onto the dump trucks by shovel and is transported inside the tunnel till portal area. Muck then shall be transported by dump-cars to the spoil disposal area. In western portal muck is transported by dump truck to the disposal area in the valley in front of portal. In the eastern portal muck will be transported by dump cars to the temporary storage

yards within the ROW area in approach road.

(4) Observation and Measurement

Observation and measurement is the key monitoring activity in NATM to confirm the stability of the tunnel.

Observation of geotechnical condition of the excavated face and condition of already supported tunnel are to be carried out as a daily activity and are to be recorded on the sheets and stored for later review.

Measurement of the rate of deformation of the tunnel is to be carried out once a day at the face area to confirm the adequacy of the support installed. If deformation rate of tunnel is larger than expected then additional support is installed to confine the deformation. With the progress of tunnel measurement behind the face area is to be done once a week or once a month and when deformation is confirmed to have finished measurement is no more required there.

Measurement is generally done by electro-optical distance measuring instrument. It measures the deformation of the tunnel by measuring the displacement of the monitoring pins fixed on the shotcrete. Results of measurements are recorded in the data sheets and are analyzed after each measurement whether tunnel is getting stability or not and are stored for later review.

Figure 9.5-4 shows the flow chart of observation and measurement.

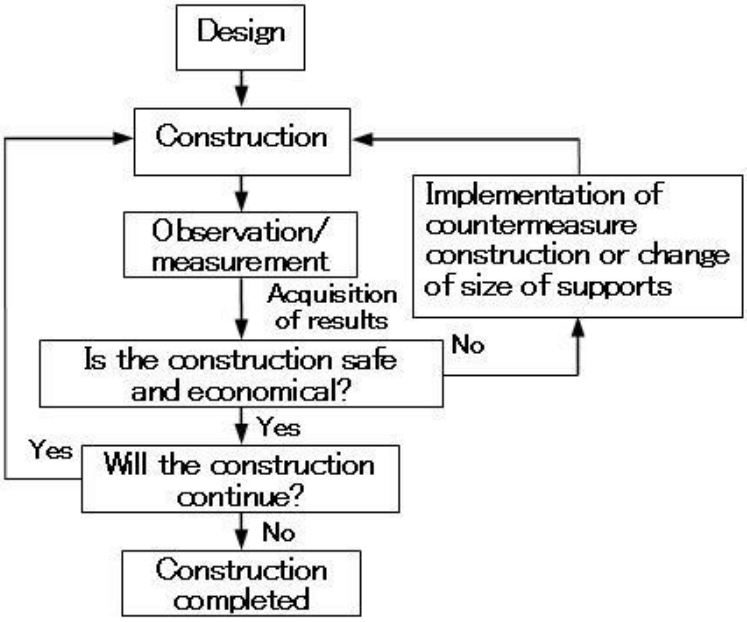


FIGURE 9.5-4 FLOWCHART OF OBSERVATION AND MEASUREMENT

(5) Preservation of Groundwater Level

Along the tunnel alignment surface water flow and groundwater are utilized for various purpose by inhabitants. Especially in the eastern portal area and Thosne Khola area tunnel passes in thin rock cover and preservation of groundwater level shall be very important.

To preserve the groundwater level in the eastern portal area as much as possible, about 100m long section of the tunnel from the portal is designed to be watertight. Chemical injection from the surface ground or by the use of long- span fore-piling shall be done for this section of the tunnel.

As for Thosne Khola area about 200m long tunnel section will be excavated using long span fore-piling with chemical injection.

Whenever significant water ingress from the shotcrete surface is observed additional chemical injection shall be carried out by drilling holes for injection.

(6) Drainage Inside the Tunnel

The tunnel is descending to the west and parts of the eastern approach road descends to the tunnel. Thus it is important to manage the rainfall water adequately. Drainage system shall have enough capacity for the future climate change also. Some of the rainfall water from the approach road shall be drained off before entering into the tunnel adequately.

In the tunnel at both sides of the bottom of tunnel shall be equipped with U-shaped water channel other than center drain. Water from the tunnel then shall be gathered at outside the western portal into water storage tank and then discharged to the drainage system to be provided in the valley in front of the tunnel or used for other purposes.

Details of drainage system shall be suitably studied and designed in Detail Design Stage.

9.6 AUXILIAR METHODS

Some of the auxiliary methods are already explained and being designed in the support patterns such as fore-poling and fore-piling in Type D Ⅰ-a and b and Type D Ⅱ and D Ⅱ-a.

When tunneling encounters very poor ground where excavation face is very difficult to self-supporting, shotcreting for the face and rock-bolting for the face are required. Support pattern D Ⅱ requires long span fore-piling with or without chemical injection depending on the rate of ingress of groundwater. When tunneling encounters fault zones extra auxiliary measures such as injection grouting to improve the strength of the poor ground is required. These auxiliary measures shall be selected adequately in accordance with the nature of the ground encountered during tunneling.

FIGURE 9.6-1 LONG SPAN FORE-PILING IN DIFFICULT GROUND

FIGURE 9.6-2 IMAGE OF EXECUTION OF LONG SPAN FORE-PILING

Figure 9.6-1 and **Figure 9.6-2** shows the schematic view of long span fore-piling. **Figure 9.6-3** shows the procedure of typical long span fore-piling, named AGF (All Ground Fastening).

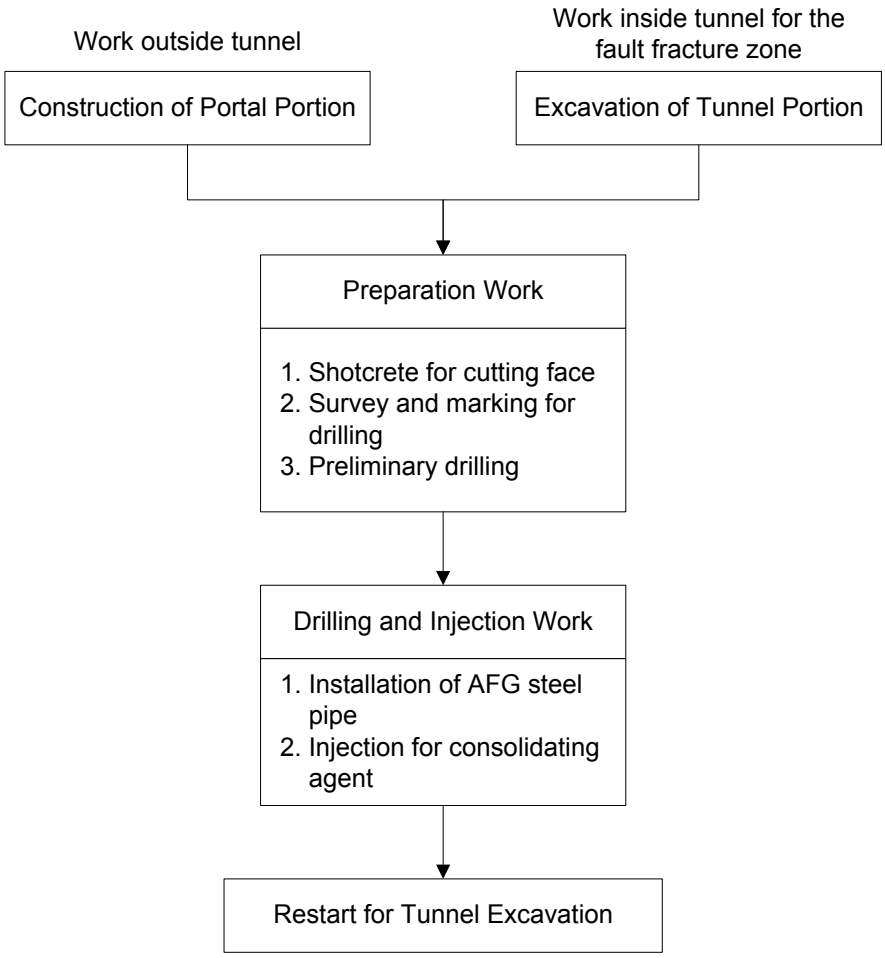


FIGURE 9.6-3 PROCEDURE OF AGF

9.7 DESIGN OF TUNNEL PORTALS

Tunnel portal shall be located where slope is stable and natural drainage system is not harmful for the structure. Preservation of natural environment is also required. Considering these issues tunnel portals are fixed.

9.7.1 Eastern portal

Eastern portal is located in a very gentle slope where several houses exist and land is used for agriculture. To reduce numbers of houses to be demolished or affected by tunneling as much as possible, portal is fixed in the foot of the slope. Construction of the portal requires cutting of the gentle slope to some extent. Cut slopes are protected permanently by shotcrete and rockbolts or other slope protection measures and decorated by terraced flowers or grasses.

(1) Protection of houses near tunnel portal in eastern portal area

There are several houses near the tunnel portal. However, nearest house to the portal situates at about 60m apart from the tunnel portal. Adequate slope protection is designed at the portal area and tunnel excavation is to be done mechanically houses are not affected by tunnel construction activities.

At No.2 + 700 there are two houses which are about 35m from the periphery of the tunnel. Mechanical tunnel excavation at this distance has no influence to the stability of the houses and very small level of vibration and noises are felt by the inhabitants.

Thus tunnel excavation as well as open cut excavation at the eastern portal area may not be a harmful activities to the houses and residents.

(2) Treatment of groundwater at eastern portal area

Basic concept of the design (see Sheet NO. 21 of the Preliminary Design Drawings)

To minimize lowering of groundwater level at eastern portal area series of chemical injection is designed. Objective of the chemical injection is to minimize the lowering of groundwater level but not to get perfect watertight structures in the area.

In this concept and for the ease of open cut excavation in the area, groundwater level is to be lowered to some extent along the slope above and east of tunnel.

- Open cut from No.2 + 880 to the east shall use gravity dewatering pumping well to lower the groundwater level by about 3m.
- Zones from No.2 + 790 to No.2 + 880 shall be grouted by chemical injection from the surface to the depth 3m deeper than finished grade of tunnel and road.
- Dimension of chemical injection is determined by the hypothesis that groundwater level may be lowered by about 3m from the existing one through dewatering by gravity well pump and dewatering by the weep holes in the retaining wall in the future.

Sequence of chemical injection is as following;

- Chemical injection from the surface at No.2 + 790 to No.2 + 820 where open cut of the slope for tunnel portal starts.
- Chemical injection area is extended from here to both sides to cover the open cut excavation of north and south walls.
- Chemical injection continues till No.2 + 880
- After completion of chemical injection works, open cut excavation starts from several locations, from tunnel portal area and from east of it.

Longitudinal cross section and profile of the area for chemical injection from the surface is shown in the **Sheet NO. 21 of the Preliminary Design Drawings**.

In the commencement of portal excavation long span fore-piling is to be carried out with chemical injection. **Figure 9.7-1** shows the typical example of the method.

Tunnel entrance structure will be similar to that shown in **Figure 9.7-2**.

(3) Drainage of the surface water

The small stream at southwest of the tunnel portal flowing to southeast shall be reconstructed into new water channel in order not to inundate into the portal area during heavy rainfall. On the cut slope in portal area water channels are designed to drain the rainfall to the outside of the structure.

Rainfall waters from the approach road is designed to be drained by the water channels along both sides of the road and are led to the underground water tank in the tunnel entrance and then drained to western portal area through water channels fixed at both sides of the tunnel.

FIGURE 9.7-1 TYPICAL EXAMPLE OF PORTAL EXCAVATION USING LONG SPAN FORE-PILING

FIGURE 9.7-2 TUNNEL ENTRANCE STRUCTURE

9.7.2 Western portal

(1) Slope stability

Western portal situates in the foot of cut slope beneath the moderately steep slope. Cut slope

shall be protected by shotcrete and rockbolts or by free-flame for permanent stability. Thus required width of space is provided for the working space for tunneling. Tunnel is to be connected to the existing road which is to be partially relocated.

Strikes of the strata in the slope in front of the tunnel are sub-parallel to the tunnel axis with high dip angles, slope is generally stable here. However, the slopes at both sides of the tunnel are rather instable due to the strikes of the strata which requires adequate protection measures during construction.

While the rock mass in the tunnel portal area is deemed to be of Class CⅡ owing to the slope cut, excavation of the portal area, 17.5m long, is designed to be constructed by D-Ⅱ pattern.

(2) Drainage system

In the small valleys at both sides of the tunnel which are scheduled to be used as temporary construction yard for installation of temporary facilities and stock yard, water channels are designed and led to the valley in front of portal where continuous channels, composed of 2m diameter corrugate pipes, are designed which have enough capacity for the future climate change (see **Sheet App.10 of the Preliminary Design Drawings**). Tunnel portal and new road shall be protected by debris flow from these two small valleys and debris flow prevention dams are designed accordingly.

Entrance structure of the tunnel may be similar to that shown in **Figure 9.7-3**.

FIGURE 9.7-3 TUNNEL ENTRANCE STRUCTURE

9.8 TEMPORARY FACILITIES AND EQUIPMENT NECESSARY FOR TUNNEL CONSTRUCTION

Major temporary facilities consist of water treatment plant for contaminated water from the tunnel, concrete batching plant for shotcrete and lining concrete, diesel generators for electric supply, air compressors for shotcrete and other activities, ventilation fan and dust collector to keep inside the tunnel clean and temporary houses for office and labor camps and so on. Detail is shown in the **Table 15.5.3-1 in Chapter 15**.

9.9 FACILITIES NECESSARY FOR INSIDE AND OUTSIDE TUNNEL

9.9.1 General

Those mentioned below are facilities to be installed for the road tunnel (inside and outside) to secure the safe and smooth traffic flow.

- Ventilation Facilities
- Lighting Facilities
- Emergency Facilities
- Others

(1) Facilities for the Inside of Tunnel

The facilities to be installed inside of tunnel are shown on **Table 9.9-1**.

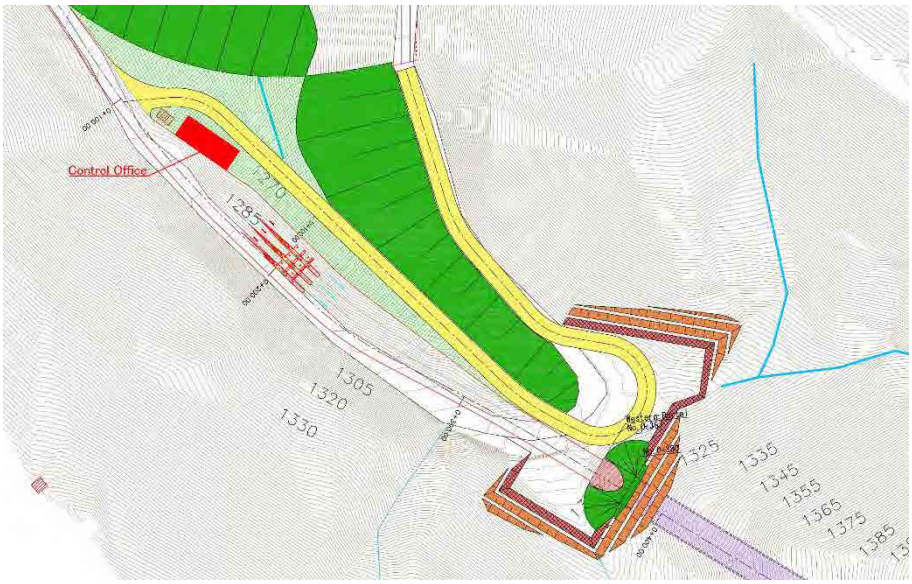
TABLE 9.9-1 FACILITIES TO BE INSTALLED TUNNEL INSIDE

Facilities	Name of Equipment
Tunnel Ventilation	Jet fan, CO meter, VI meter, AV meter
Tunnel Lighting	Interior Lighting, Entrance Lighting, Emergency Lighting
Emergency Facilities	Emergency Telephone, Push Button Alarm, Fire Detector, Fire Extinguisher, Fire Hydrant, Evacuation guide panel, Hydrant, leaky coaxial cable, CC TV Camera, etc.

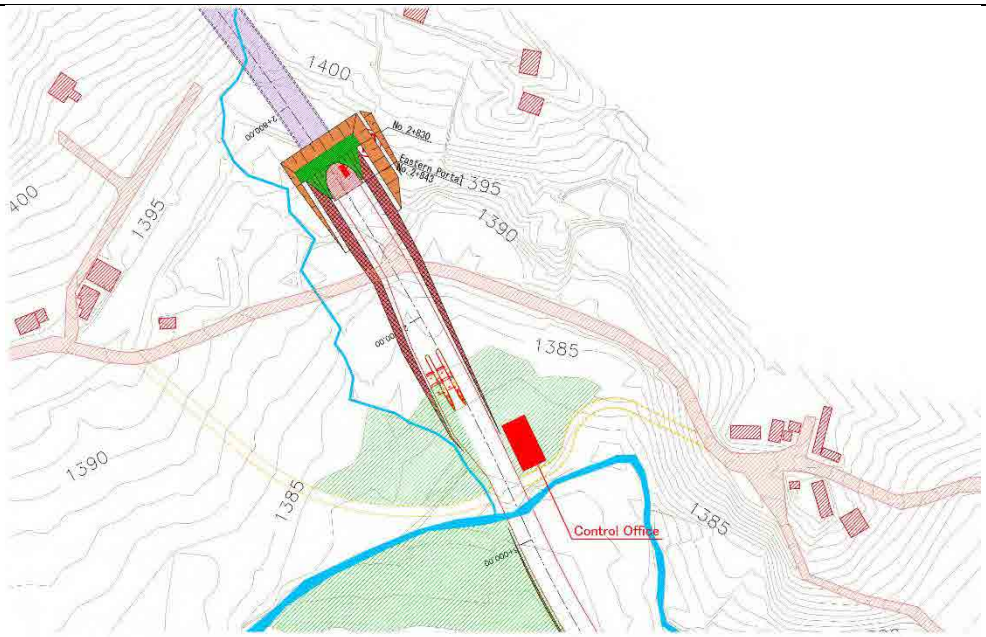
(2) Facilities for the Outside of Tunnel

Control Office will be constructed at West and East Portal Sites shown in **Figure 9.9-1**.

Control Office	**Detail of the Control Office**
Control Office-1 (West Portal Side)	**Sub-control Office** Office Area: 390m^2 **Function:** - Administration building for toll-collection-related staffs - Administration building for emergency staffs (support for main control office) - Parking area of emergency vehicles **Facilities:** -Building ✓ Sub-Monitoring room and control room ✓ Equipment room ✓ Toll management room ✓ Staff room (Multiuse room) ✓ Others (Toilet, Kitchen, Nap room) -Parking space (2 lots)
Control Office-2 (East Portal Side)	**Main Control Office** Office Area: 300m^2 **Function:** - Administration building for tunnel operation, monitoring, and maintenance staffs (installation of related facilities) - Administration building for toll-collection-related staffs - Parking area of tunnel maintenance vehicles and emergency vehicles **Facilities:** -Building ✓ Main-Monitoring and Main-Control room ✓ Equipment room (Control panel etc..) ✓ Toll management room ✓ Staff room (Multiuse room) ✓ Others (Toilet, Kitchen, Nap room) -Parking space (10 lots)



Control Office-1 (West Portal Side)



Control Office-2 (East Portal Side)

FIGURE 9.9-1 LOCATION MAP OF CONTROL OFFICE

The facilities to be installed outside of tunnel are shown on **Table 9.9-2**.

TABLE 9.9-2 FACILITIES TO BE INSTALLED TUNNEL OUTSIDE

Facilities	Name of Equipment
Tunnel Ventilation	Local control panel
Tunnel Lighting	Lighting outside the Tunnel Entrance, Local control panel, etc.
Emergency Facilities	Local control panel, Water supply Pump, Water tank, Pump panel, Information board at tunnel entrance, Outside hydrant, Emergency Telephone, Wireless terminal box, etc.
Others	Electrical room, Management office, Power supply system, Back up generator, UPS Tunnel facilities remote control system, Remote monitoring system, Transmission system, , Building Facilities

9.9.2 Ventilation Facilities

(1) Purpose of Ventilation

The ventilation system is very much necessary to secure the safe and comfortable driving inside tunnel; also it shall contribute for the better circumstance for the superintendants that are used to manage the tunnel maintenance work. For that purpose, the important factor is to alleviate the harmful substances from the emission of vehicles, which may cause the instinctive dislike, and to make the good visual field.

(2) Design Criteria

It is recommendable to apply "Japan Road Tunnel Ventilation Standard on 2001" for Nagdhunga Tunnel, in consideration of environment criteria and social conditions in Nepal.

(3) Design Conditions

The design conditions is described as mentioned below. It is considered upon the basis of "Japan Road Tunnel Ventilation Standard on 2001" and some factor is added in taking account of environment/social situation in Nepal.

- Length of Tunnel: 2,450m
- Longitudinal gradient: ＋3.22%（rising gradient from West to East）
- Tunnel altitude: average altitude is 1,340m
- Cross section of tunnel: 72.3m^2
- Hydraulic diameter: 8.5m
- Traffic conditions: Two way traffic
- Designed velocity inside tunnel: 40km/h
- Expected traffic volume and mix rate of big-sized car

Year 2020：Traffic volume = 7,400 unit/day, Mix rate of big-sized car = 55.4%

Year 2025：Traffic volume = 8,100 unit/day, Mix rate of big-sized car = 55.6%

Year 2030：Traffic volume = 9,500 unit/day, Mix rate of big-sized car = 55.8%

Year 2035：Traffic volume = 8,100 unit/day, Mix rate of big-sized car = 49.4%

The factors used for making Design Conditions are shown on the **Table 9.9-3**.

TABLE 9.9-3 FUTURE TRAFFIC VOLUME (WITH SINDHULI RD: 2025, FAST TRACK RD: 2031)

Future traffic volume (with Sindhuli Rd : 2025, Fast Track Rd. : 2031) ①=②+③ (veh/day)

Year	2020			2025			2030			2035		
Direction	Eastbound	Westbound	Total	Eastbound	Westbound	Total	Eastbound	Westbound	Total	Eastbound	Westbound	Total
Passenger Car	1,100	1,300	2,400	1,400	1,400	2,800	1,500	1,700	3,200	1,500	1,700	3,200
Micro Bus	500	700	1,200	500	700	1,200	600	900	1,500	600	900	1,500
Mini Bus	300	400	700	300	500	800	400	500	900	300	500	800
Large Bus	900	1,000	1,900	1,000	1,100	2,100	1,200	1,400	2,600	1,100	1,300	2,400
Light Truck	600	200	800	600	200	800	700	200	900	600	200	800
Heavy truck	1,200	1,800	3,000	1,300	1,900	3,200	1,600	2,100	3,700	1,000	1,400	2,400
Total	4,600	5,400	10,000	5,100	5,800	10,900	6,000	6,800	12,800	5,100	6,000	11,100
% Large	45.7%	51.9%	49.0%	45.1%	51.7%	48.6%	46.7%	51.5%	49.2%	41.2%	45.0%	43.2%

Number of Vehicles on Tunnel Section ② (veh/day)

Year	2020			2025			2030			2035		
Direction	Eastbound	Westbound	Total	Eastbound	Westbound	Total	Eastbound	Westbound	Total	Eastbound	Westbound	Total
Passenger Car	900	900	1,800	1,100	1,000	2,100	1,200	1,200	2,400	1,200	1,200	2,400
Micro Bus	400	500	900	400	500	900	500	600	1,100	500	600	1,100
Mini Bus	0	0	0	0	0	0	0	0	0	0	0	0
Large Bus	800	800	1,600	900	900	1,800	1,100	1,100	2,200	1,000	1,000	2,000
Light Truck	500	100	600	500	100	600	600	100	700	500	100	600
Heavy truck	1,100	1,400	2,500	1,200	1,500	2,700	1,400	1,700	3,100	900	1,100	2,000
Total	3,700	3,700	7,400	4,100	4,000	8,100	4,800	4,700	9,500	4,100	4,000	8,100
% Large	51.4%	59.5%	55.4%	51.2%	60.0%	55.6%	52.1%	59.6%	55.8%	46.3%	52.5%	49.4%

Number of Vehicle on Existing road ③ (veh/day)

Year	2020			2025			2030			2035		
Direction	Eastbound	Westbound	Total	Eastbound	Westbound	Total	Eastbound	Westbound	Total	Eastbound	Westbound	Total
Passenger Car	200	400	600	300	400	700	300	500	800	300	500	800
Micro Bus	100	200	300	100	200	300	100	300	400	100	300	400
Mini Bus	300	400	700	300	500	800	400	500	900	300	500	800
Large Bus	100	200	300	100	200	300	100	300	400	100	300	400
Light Truck	100	100	200	100	100	200	100	100	200	100	100	200
Heavy truck	100	400	500	100	400	500	200	400	600	100	300	400
Total	900	1,700	2,600	1,000	1,800	2,800	1,200	2,100	3,300	1,000	2,000	3,000
% Large	22.2%	35.3%	30.8%	20.0%	33.3%	28.6%	25.0%	33.3%	30.3%	20.0%	30.0%	26.7%

(4) Type of Ventilation System

There are several types of ventilation system i.e. longitudinal ventilation system, semi-transverse ventilation system, transverse ventilation system and a combination of these types. Longitudinal ventilation system, which is typified by the jet fan, is the most economical and widespread system. Use of jet fans in particular is effective in terms of low running cost, providing ventilation even if vehicles are queuing in the tunnel and removal of smoke in the event of a fire.

(5) Required Air Volume

Required air volume in the tunnel and number of ventilation (jet fan) is calculated based upon the factors described below.

1) Traffic volume per hour

The factor of calculation of ventilation system is dependent upon the time zone of peak hour for the “traffic volume per hour” through the year.

The traffic volume per hour is calculated as follows;

Traffic volume per hour = 9,500 unit/day × K = 9,500 ×10% = 950 vehicles/hr

K = 7~15% in general, so 10 % is adopted for Nagdhunga Tunnel

9,500 unit/day = Traffic volume of Year 2030 (see 9.8.2-(3)), which contains Mix rate of big sized car, γL=55.8%

2) Design value of Co and visibility

Acceptable environment design value of pollutants in the tunnel are shown in the **Table 9.9-4** below.

TABLE 9.9-4 DESIGN VALUES FOR CO AND VISIBILITY

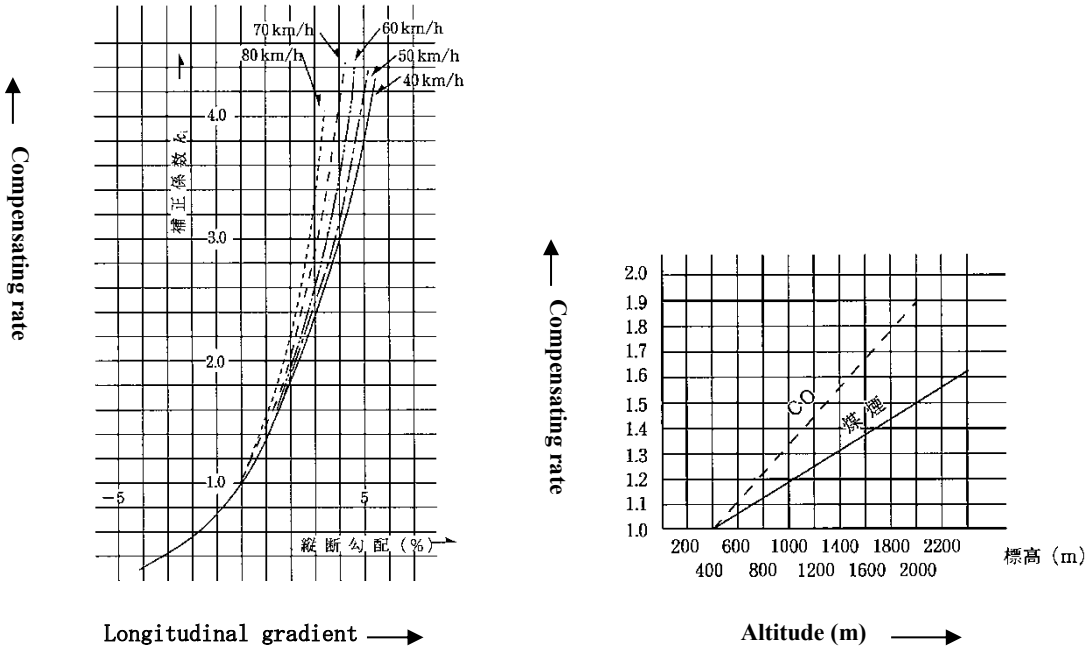
Item	Design Velocity	CO	Visibility Transmissions (beam length: 100 m)
Design Criteria	Above 80km/hr	100ppm	50%
	Below 60km/hr		40%
Nagdhunga tunnel	40km/h	100ppm	40%

3) Basic emission factor, speed & gradient factor and altitude factor

Table 9.9-5 indicates the basic-emission factor, speed and graduation compensating rate and altitude compensating rate.

TABLE 9.9-5 BASIC EMISSION FACTORS

Cars	Particle matter (opacity)		CO
	Average (m^2/km)	Standard valuation (m^2/km)	Average (m^3/km)
Big-sized car	5.1	2.3	0.007
Normal size car	0.5	0.7	



Speed & Gradient compensation factor for PM Altitude compensation factor for PM&CO

FIGURE 9.9-2 SPEED & GRADIENT COMPENSATION FACTOR AND ALTITUDE COMPENSATION FACTOR

4) Required air volume and number of jet fan

The number of jet fans calculated by the figure of CO and visibility are shown on **Table 9.9-6**.

TABLE 9.9-6 REQUIRED AIR VOLUME AND NUMBER OF JET FAN

year	Traffic (no/hr/h)	Mix rate of Big-sized car (%)	Required air volume (m3/s)		Number of Jet Fan (unit)	
			CO	Visibility	CO	Visibility
2020	740	55.4	54	353	3	17
2025	810	55.6	58	388	3	21
2030	950	55.8	69	456	4	28
2035	810	49.4	58	353	3	17

The maximum number of jet fan shall be adopted; therefore, the number of jet fans shall be twenty-eight (28) units in case of Nagdhunga Tunnel in consideration of 2030. Jet fan shall be "JFX-1250" and those will be set at a distance of 160 m from the tunnel portal and at intervals of 160 m in the tunnel.

It is considered that the traffic volume in Nagdhunga Tunnel will be reduced after 2030, because the traffic will be diverted to the other new road, which is expected to construct by that time.

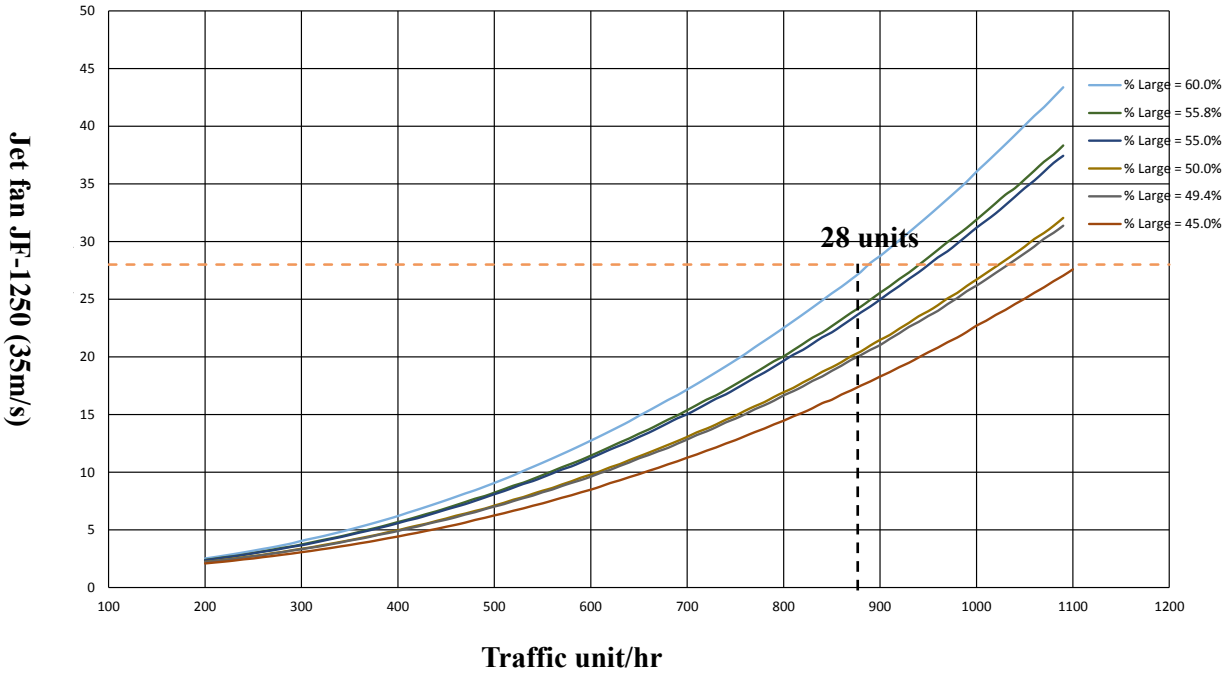


FIGURE 9.9-3 CORRELATION DIAGRAM FOR TRAFFIC VOLUME AND NUMBER OF JET FAN

5) Specification of jet fan

Standard specification of selected jet fan (JFX-1250) is described on **Table 9.9-7**.

TABLE 9.9-7 STANDARDS SPECIFICATION OF JET FAN (JFX-1250)

Specification		JFX-1250
Jet Fan	Diameter of Fan (mm)	1250
	Average Wind Speed (m/s)	More than 35
	Efficiency (%)	More than 75
	Noise (dB(A)	Less than 95
	Length (mm)	4250
	Diameter (mm)	1450

Specification		JFX-1250
	Flow rate (m^3/s)	More than 43
	Air flow area (m^2)	1.23
	Blow direction	Both Side
Motor	Type	Three phase induction, drip proof type
	Voltage (V)	400
	Motor Power (kW)	Less than 50

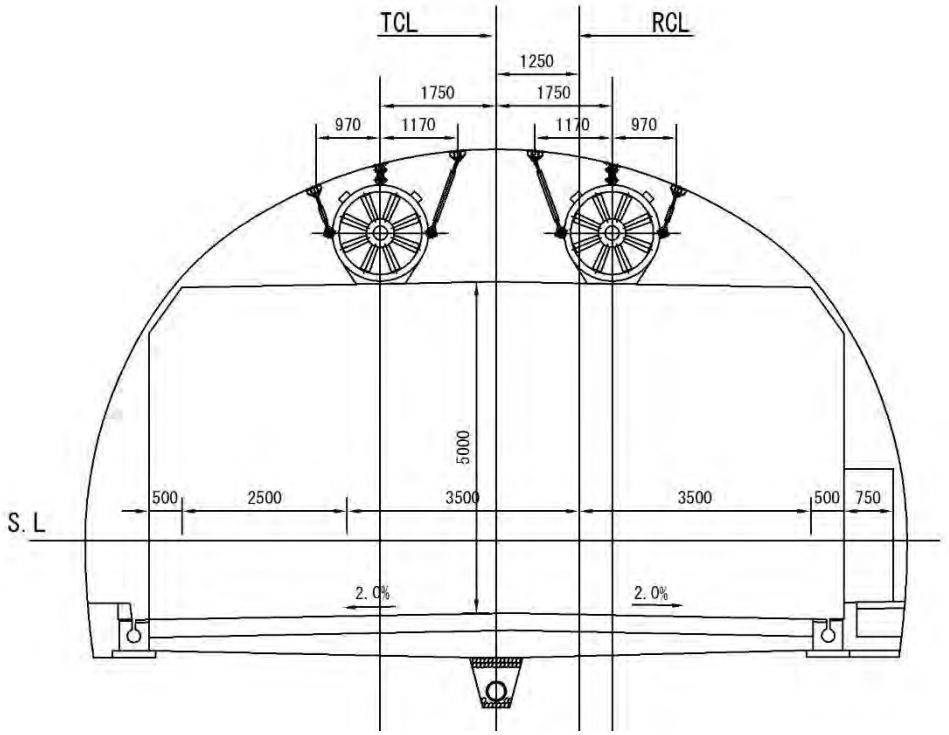


FIGURE 9.9-4 INSTALLATION OF JET FAN

PHOTO 9.9-1 JET FANS INSIDE TUNNEL

(6) Operation of Ventilation for 24 hours（Estimation for 2030）

The 28 units of jet fan shall be installed against the traffic volume per hour at the time of peak hour. The operation frequency of 24 hours on someday of 2030 is estimated on **Table 9.9-8**.

However, the 0～11 units of jet fans may be enough with maneuvering the jet fans in opposite current or vice versa when the traffic flow is not busy. In this case, the accumulated electric energy for one day shall be 5,850 kWh.

TABLE 9.9-8 OPERATION FREQUENCY OF 24 HOURS (IN CASE 2030)

Direction	*East bound*		*West bound*		*Total (East + West)*		*Nos. of JFX-1250*	
Time	*Traffic [veh/h]*	*Large size [%]*	*Traffic [veh/h]*	*Large size [%]*	*Traffic [veh/h]*	*Large size [%]*	*Ventilation Direction*	
							East bound	*West bound*
7	270	77.4	182	44.8	452	64.3	9	15
8	198	70.6	325	41.2	523	52.3	9	8
9	238	56.0	365	44.0	603	48.8	10	8
10	319	47.9	283	42.7	602	45.5	9	11
11	295	35.6	266	42.9	561	39.1	7	7
12	233	40.8	304	47.2	537	44.4	8	5
13	227	43.4	323	50.3	550	47.4	8	5
14	240	36.1	281	51.0	521	44.1	7	5
15	310	37.1	283	51.6	593	44.0	8	8
16	262	33.3	313	59.1	575	47.3	9	5
17	270	33.8	270	60.4	540	47.1	8	5
18	283	22.0	304	69.2	587	46.4	9	3
19	237	34.1	241	81.7	478	58.1	8	4
20	186	46.2	226	91.0	412	70.8	9	4
21	102	36.4	264	94.6	366	78.4	9	0
22	64	35.7	138	90.4	202	73.1	5	1
23	92	53.0	91	89.9	183	71.4	3	2
0	44	48.9	26	81.9	70	61.1	2	2
1	49	61.7	16	96.1	65	70.3	2	2
2	57	70.9	7	27.2	64	66.2	1	3
3	71	65.6	4	75.9	75	66.2	1	3
4	168	86.2	20	69.9	188	84.4	2	9
5	297	97.6	50	83.6	347	95.6	10	24
6	287	95.3	117	67.1	404	87.1	11	22

9.9.3 Tunnel Lighting Facilities

The lighting of the tunnel is very important for securing traffic safety inside the tunnel.

(1) Lighting Composition

Tunnel lighting is composed of Primary Lighting, Entrance Lighting, Back Up Lighting (in case of power cut), and Approach Lighting.

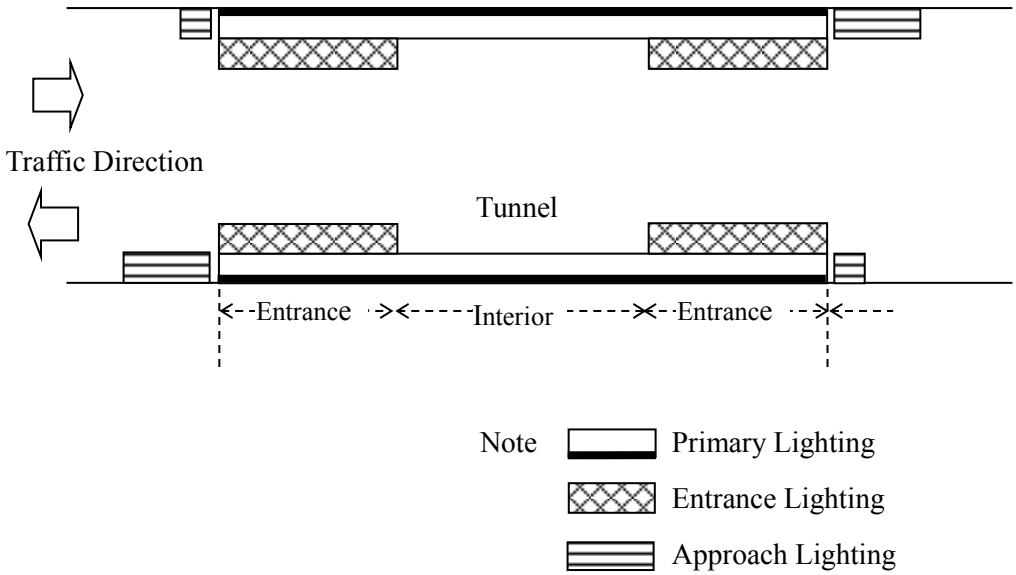


FIGURE 9.9-5 COMPOSITION OF TUNNEL LIGHTING

(2) Light Source

The following factors shall be considered for the selection of lighting sources.

- High efficiency with long life
- Accommodating against to high temperature, durability and humidity
- Appropriate luminescent color
- High luminous flux to meet the required high lighting level
- Easy maintenance
- Low running cost

1) Interior Lighting

Basic lighting levels are determined by the visual distance for the safety driving and not feeling discomfort under the certain velocity, and it shall be provided whole length of the tunnel.

2) Entrance Lighting

Entrance lighting is provided to adjust the difference between the brightness outside tunnel and relatively dark area inside tunnel, especially it happens in day time. Therefore, the lighting at entrance area shall be more luminous than inside of tunnel, so that the driver shall be able to adopt the difference of brightness.

3) Emergency Lighting during Power failure

In case of a sudden loss of power, emergency lighting is required to prevent visual obscuration for the drivers already running in the tunnel. Power shall be supplied from the UPS immediately as uninterruptible power source, and subsequently it shall be connected to the back-up generator.

4) Lighting outside the Tunnel Entrance

The street ramp at the exit of tunnel shall be installed adequately to guide the drivers coming up from the tunnel, especially in nighttime. No street ramp at the exit road may cause the constriction of the visual field of drivers, and may lead the accidents. This street ramp may be applicable with the same type of street ramp used in Kathmandu City.

5) Selection of Light Source

LED lighting is used in common against the conventional light fixtures, because the overall cost is less in respect of durability and power consumption. Therefore, it is recommended to use LED lightings.

Interior Lighting(LED)		
Back Up Lighting (lighting system in case of power cut)		
Entrance lighting		
Lighting outside the Tunnel Entrance		

PHOTO 9.9-2 TUNNEL LIGHTING (LED)

9.9.4 Tunnel Emergency Facilities

(1) General

Tunnel Emergency Facility is the equipment and devices to prevent the accidents caused by the fire inside of tunnel. Counter disaster measures for tunnel are divided into two objectives,

which are:

- Prevention of accident
- Minimization of damage from accident

Prevention measures are basically composed of education of tunnel users such as i) to learn the potential of accident in tunnel, ii) cooperation to the tunnel administrators with using the emergency services, and iii) provision of a comprehensive safety and surveillance control system. Counter disaster measures will be carried out not only by the staff of the tunnel management office, but also by the tunnel users themselves. Therefore, public involvement is very important.

(2) Classification of Tunnel and Installation of Emergency Facilities

The tunnel length of 2,450m with daily traffic of 9,500 (as of 2030) is classified for "Class A" tunnel as depicted on **Figure 9.9-6**, which is specified on "Japanese Road Tunnel Safety Standard".

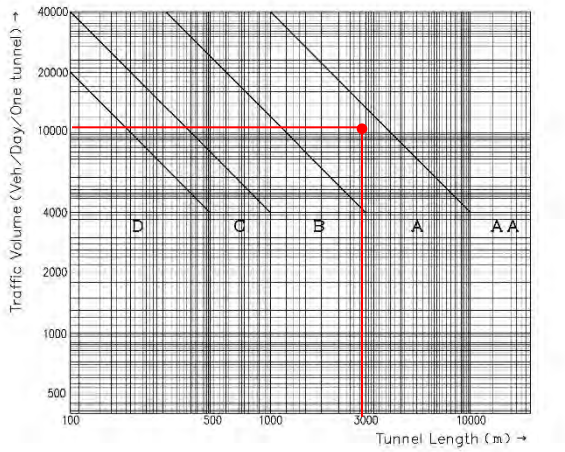


FIGURE 9.9-6 CLASSIFICATION OF TUNNEL

The class A tunnel requires provision of emergency facilities, as shown on **Table 9.9-9**.

TABLE 9.9-9 INSTALLATION STANDARD OF EMERGENCY FACILITIES

Facilities \ Classfication of tunnel		AA	A	B	C	D	Remarks
Information and Alarm Facility	Emergency Telephone	○	○	○	○		
	Push Button Alarm	○	○	○	○		
	Fire Detector	○	△				To be provided in Class A tunnel with Ventilation System or Water sprinkler system.
	Emergency Information board	○	○	○	○		Information board at tunnel entrance
Fire Fighting Facility	Fire Extinguisher	○	○	○			
	Fire Hydrant	○	○				
Evacuation Guide Facility	Guide Board	○	○	○			
	Smoke removal system or Evacuation route	○	△				Ventilation system shall be used for smoke removal. Evacuation tunnel shall be provided for Class A tunnel, 3000m or more in length, bidirectional traffic and longitudinal ventilation system.
Other Emergency Facilities	Hydrant	○	△				To be provided in Class A tunnel with Fire hydrant.
	Radio communication support System	○	△				To be provided in Class A tunnel 3000m or more in length. Required and recommended for tunnel Operation and Maintenance.
	Radio Rebroadcast System	○	△				To be provided in Class A tunnel 3000m or more in length. Required and recommended for tunnel Operation and Maintenance.
	Loud Speaker System	○	△				To be provided in Class A tunnel 3000m or more in length. Class A tunnel with evacuation passage.
	Water sprinkler system	○	△				To be provided in Class A tunnel 3000m or more in length.
	Monitor System	○	△				To be provided in Class A tunnel with Water sprinkler system.

Note : ○ : Mandatory(standard) △ : Recommended

(3) Type of Emergency Facilities

Following emergency facilities will be planed based on “Japanese Road Tunnel Safety Standard”.

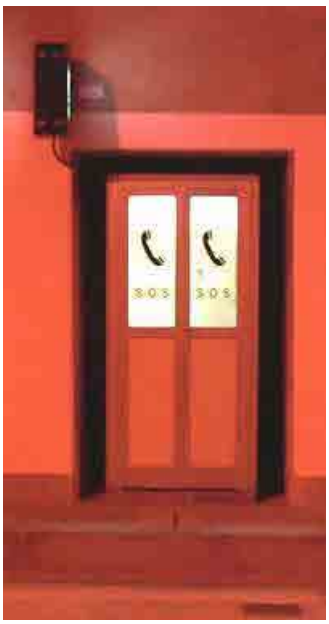
Provision of TV cameras to monitor the traffic conditions inside the tunnel is not required by the Japanese Standard. However, this can enable visual monitoring of traffics for obtaining prompt and reliable information of traffic condition inside and outside the tunnel. Therefore, it is decided to facilitate TV cameras in Nagdhunga Tunnel.

TABLE 9.9-10 EMERGENCY FACILITIES

Safety System	Contents	Detail
Information and Alarm Facility	Emergency Telephone	
	Push Button Alarm	
	Fire Detector	
	Emergency Information board	Information board at tunnel entrance
Fire Fighting Facility	Fire Extinguisher	Portable fire extinguisher
	Fire Hydrant	
Evacuation Guide Facility	Guide Board	Evacuation guide panel(LED)
	Smoke removal system	Ventilation System
Other Emergency Facilities	Hydrant	
	Radio communication support System	Wireless Radio System
	Radio Rebroadcast System	
	Monitor System	CCD TV Monitoring System

1) Emergency Telephone

Emergency Telephones will be set at both entrances and at intervals of 200 m in the tunnel.

Emergency Telephone on wall	Emergency Telephone at entrance	Emergency Telephone Box
		

2) Push Button Alarm

Push button alarm system will be set 1.2 to 1.5m above road surface and at intervals of 50 m. This alarm system will connect with the emergency telephone and fire fighting system.

Push Button Alarm with Extinguisher & Fire Hydrant


3) Fire Detector

Fire Detector will be set in the tunnel for automatic detection of fire and at intervals of 50 m. The tunnel entrance information board, lighting system, fire fighting facilities and ventilation system will be operated automatically or receiving a signal from an automatic fire detector.

Fire Detector	
	

4) Emergency Information board

Emergency alarm system will include both visual signals and audible alarm. Flashing lights instructions given by loudspeaker will be effective for aiding evacuation of user.

The information boards must have sufficient communication ability to inform users of conditions inside the tunnel. Information boards shall be set at appropriate locations to avoid any disturbance to fire fighting and/or evacuation of users.

Information board at entrance	Control panel
	

5) Extinguishers

Extinguishers shall be set at intervals of 50m.

6) Fire Hydrants

Setting interval of Fire hydrants is the same as extinguishers, 50m.

Extinguisher & Fire Hydrant	
	

7) Guide Boards

Guide boards are illuminated signs to inform the location of Tunnel portal to road users. Guide board shall be set at t intervals of 200m.

Guide Board (LED)


8) Smoke removal system

The tunnel ventilation system shall be used both as a Smoke removal and tunnel ventilation. Jet fan will act to extract smoke in the event of fire in the tunnel.

Smoke removal system (Jet Fans)


9) Hydrants

Hydrants shall be set at intervals of 200m in the tunnel inside the fire hydrant box. Outdoor Hydrants for use outside the tunnel shall be set at both tunnel entrances.

Outdoor Hydrant


10) Wireless Radio System

Coaxial cable shall be set under the tunnel lighting system or the tunnel center wall to allow for use of radios by tunnel staff and the emergency services.

Wireless terminal box	Coaxial cable
	

11) Radio Re-broadcasting System

Radio re-broadcasting system is secure radio broadcast in tunnel using lead antenna at tunnel entrance. When an emergency occurs in the tunnel, the system shall be used to transmit emergency information radio signals to car users in the tunnel.

Guide Wire for AM Radio


AM aerial wire	Radio Receiving Panel
	

12) Monitor System

The monitor camera system is designed based on the tunnel plan and profile, focal length of cameras, and the size of objectives. Camera shall be installed at 2.8m above road surface, and those shall be installed at Emergency Parking Bay and 150～200m intervals of tunnel.

Arrangement of tunnel equipment is shown in the **Sheet NO.22 of the Preliminary Design Drawings**.

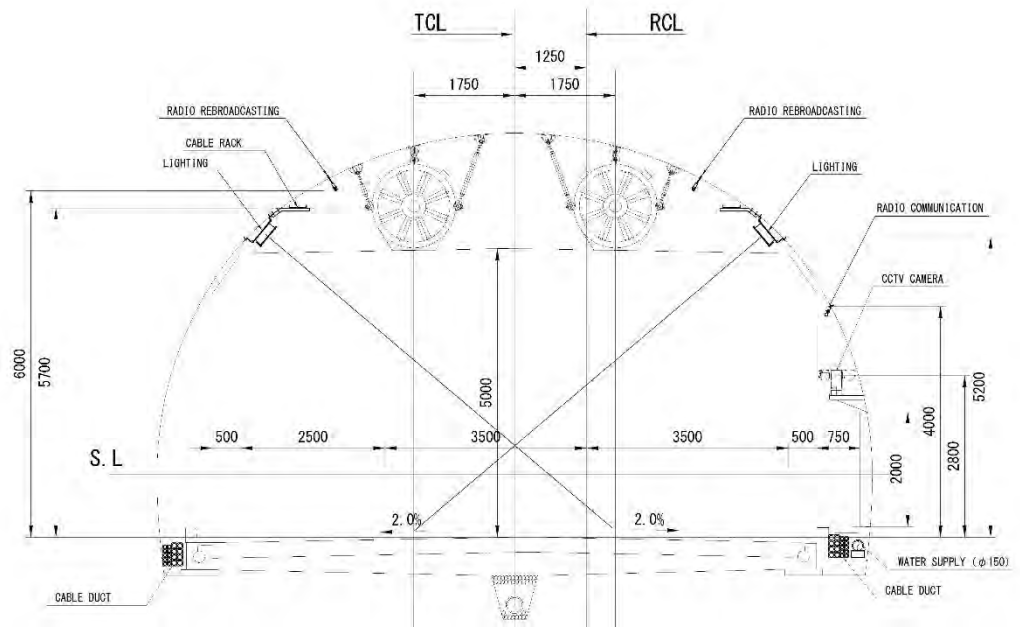


FIGURE 9.9-7 INSTALLATION OF CABLE, WATER SUPPLY, CCTV CAMERA, ETC.

9.9.5 Power Supply System

(1) General

This section is summarizing power supply and back-up system. The back-up system will cover the lighting, 4 units of ventilation fan, water supply and others, which is required minimum function to secure the safe and adequate driving.

(2) Design condition

- Frequency: 50Hz
- Location of Power Supply System: East Electrical room
  West Electrical room

(3) Design Load

The following table shows loads of each system.

TABLE 9.9-11 LIST OF LOADS AT EAST ELECTRICAL ROOM

	Total Load (kVA)	Capacity of Transformer (kVA)
Ventilation 1	523.2	750
Ventilation 2 & Power	431.6	750
Lighting & Others	202.0	300
Total	1156.8	1,800

TABLE 9.9-12 LIST OF LOADS AT WEST ELECTRICAL ROOM

	Total Load (kVA)	Capacity of Transformer (kVA)
Ventilation 1	523.2	750
Ventilation 2	392.4	750
Lighting & Others	202.0	300
Total	1117.6	1,800

TABLE 9.9-13 LIST OF LOAD FOR EAST ELECTRICAL ROOM

Application	Source / Voltage	Capacity	
		kW	kVA
Jet Fan-1	AC 3φ3W 415V	50	65.4
Jet Fan-2	AC 3φ3W 415V	50	65.4
Jet Fan-3	AC 3φ3W 415V	50	65.4
Jet Fan-4	AC 3φ3W 415V	50	65.4
Jet Fan-5	AC 3φ3W 415V	50	65.4
Jet Fan-6	AC 3φ3W 415V	50	65.4
Jet Fan-7	AC 3φ3W 415V	50	65.4
Jet Fan-8	AC 3φ3W 415V	50	65.4
Sub-total			**523.2**
Jet Fan-9	AC 3φ3W 415V	50	65.4
Jet Fan-10	AC 3φ3W 415V	50	65.4
Jet Fan-11	AC 3φ3W 415V	50	65.4
Jet Fan-12	AC 3φ3W 415V	50	65.4

Application	Source / Voltage	Capacity	
		kW	kVA
Jet Fan-13	AC/GC 3φ3W 415V	50	65.4
Jet Fan-14	AC/GC 3φ3W 415V	50	65.4
Fire Fighting Pump	AC/GC 3φ3W 415V	30	39.2
Spare	AC 3φ3W 415V		-
Sub-total			**431.6**
Lighting control	AC 3φ3W 415V		1.0
Entrance Lighting -1	AC 3φ3W 415V		13.0
Entrance Lighting -2	AC 3φ3W 415V		12.5
Entrance Lighting -3	AC 3φ3W 415V		12.0
Entrance Lighting -4	AC 3φ3W 415V		11.5
Interior Lighting -1	AC 3φ3W 415V		5.0
Entrance Lighting -5	AC 3φ3W 415V		13.0
Entrance Lighting -6	AC 3φ3W 415V		12.5
Entrance Lighting -7	AC 3φ3W 415V		12.0
Entrance Lighting -8	AC 3φ3W 415V		11.5
Interior Lighting -2	AC 3φ3W 415V		5.0
Interior Lighting -3	AC 3φ3W 415V		5.0
Lighting outside TN -1	AC 3φ3W 415V		0.5
Lighting outside TN -2	AC 3φ3W 415V		0.5
Spare	AC 3φ3W 415V		-
Spare	AC 3φ3W 415V		-
Sub-total	**AC 3φ3W 415V**		**115.0**
Interior Lighting -4	AC/GC 3φ3W 415V		2.0
Guide Board -1	AC/GC 3φ3W 415V		2.0
Guide Board -2	AC/GC 3φ3W 415V		1.0
Spare	AC/GC 3φ3W 415V		-
Sub-total	**AC/GC 3φ3W 415V**		**4.0**
Interior Lighting -5	INV 3φ3W 415V		2.0
Interior Lighting -6	INV 3φ3W 415V		2.0
Emergency Information board	INV 3φ3W 415V		2.5
Others	INV 3φ3W 415V		6.0
Spare	INV 3φ3W 415V		-
Sub-total	**INV 3φ3W 415V**		**12.5**
CCTV Camera in TN	INV 1φ2W 210V		2.5

Application	Source / Voltage	Capacity	
		kW	kVA
CCTV Camera outside TN	INV 1φ2W 210V		0.5
Spare	INV 1φ2W 210V		-
Spare	INV 1φ2W 210V		-
Subtotal	**INV 1φ2W 210V**		**3.0**
Control Panel -1	INV 1φ2W 105V		2.5
Control Panel -2	INV 1φ2W 105V		2.0
Control Panel -3	INV 1φ2W 105V		1.5
Control Panel -4	INV 1φ2W 105V		1.0
Control Panel -5	INV 1φ2W 105V		0.5
Control Panel -6	INV 1φ2W 105V		1.0
Spare	INV 1φ2W 105V		-
Subtotal	**INV 1φ2W 105V**		**8.5**
Power -1	AC/GC 3φ3W 210V		5.0
Power -2	AC/GC 3φ3W 210V		5.0
Power -3	AC/GC 3φ3W 210V		3.5
Power -4	AC/GC 3φ3W 210V		5.0
Power -5	AC/GC 3φ3W 210V		25.0
Power -6	AC/GC 3φ3W 210V		3.5
Power -7	AC/GC 3φ3W 210V		1.0
Spare	AC/GC 3φ3W 210V		-
Subtotal	**AC/GC 3φ3W 210V**		**48.0**
Panel -1	AC/GC 1φ2W 105V		1.0
Panel -2	AC/GC 1φ2W 105V		1.0
Panel -3	AC/GC 1φ2W 105V		1.0
Panel -4	AC/GC 1φ2W 105V		1.0
Panel -5	AC/GC 1φ2W 105V		1.0
Panel -6	AC/GC 1φ2W 105V		1.0
Panel -7	AC/GC 1φ2W 105V		1.0
Panel -8	AC/GC 1φ2W 105V		2.0
Panel -9	AC/GC 1φ2W 105V		2.0
Spare	AC/GC 1φ2W 105V		-
Subtotal	**AC/GC 1φ2W 105V**		**11.0**
Total			**202.0**

TABLE 9.9-14 LIST OF LOAD FOR WEST ELECTRICAL ROOM

Application	Source / Voltage	Capacity	
		kW	kVA
Jet Fan-1	AC 3φ3W 415V	50	65.4
Jet Fan-2	AC 3φ3W 415V	50	65.4
Jet Fan-3	AC 3φ3W 415V	50	65.4
Jet Fan-4	AC 3φ3W 415V	50	65.4
Jet Fan-5	AC 3φ3W 415V	50	65.4
Jet Fan-6	AC 3φ3W 415V	50	65.4
Jet Fan-7	AC 3φ3W 415V	50	65.4
Jet Fan-8	AC 3φ3W 415V	50	65.4
Sub-total			**523.2**
Jet Fan-9	AC 3φ3W 415V	50	65.4
Jet Fan-10	AC 3φ3W 415V	50	65.4
Jet Fan-11	AC 3φ3W 415V	50	65.4
Jet Fan-12	AC 3φ3W 415V	50	65.4
Jet Fan-13	AC/GC 3φ3W 415V	50	65.4
Jet Fan-14	AC/GC 3φ3W 415V	50	65.4
Spare	AC 3φ3W 415V		-
Spare	AC 3φ3W 415V		-
Sub-total			**392.4**
Lighting control	AC 3φ3W 415V		1.0
Entrance Lighting -1	AC 3φ3W 415V		13.0
Entrance Lighting -2	AC 3φ3W 415V		12.5
Entrance Lighting -3	AC 3φ3W 415V		12.0
Entrance Lighting -4	AC 3φ3W 415V		11.5
Interior Lighting -1	AC 3φ3W 415V		5.0
Entrance Lighting -5	AC 3φ3W 415V		13.0
Entrance Lighting -6	AC 3φ3W 415V		12.5
Entrance Lighting -7	AC 3φ3W 415V		12.0
Entrance Lighting -8	AC 3φ3W 415V		11.5
Interior Lighting -2	AC 3φ3W 415V		5.0
Interior Lighting -3	AC 3φ3W 415V		5.0
Lighting outside TN -1	AC 3φ3W 415V		0.5
Lighting outside TN -2	AC 3φ3W 415V		0.5
Spare	AC 3φ3W 415V		-
Spare	AC 3φ3W 415V		-

Application	Source / Voltage	Capacity	
		kW	kVA
Subtotal	**AC 3φ3W 415V**		**115.0**
Interior Lighting -4	AC/GC 3φ3W 415V		2.0
Guide Board -1	AC/GC 3φ3W 415V		2.0
Guide Board -2	AC/GC 3φ3W 415V		1.0
Spare	AC/GC 3φ3W 415V		-
Subtotal	**AC/GC 3φ3W 415V**		**4.0**
Interior Lighting -5	INV 3φ3W 415V		2.0
Interior Lighting -6	INV 3φ3W 415V		2.0
Emergency Information board	INV 3φ3W 415V		2.5
Others	INV 3φ3W 415V		6.0
Spare	INV 3φ3W 415V		-
Subtotal	**INV 3φ3W 415V**		**12.5**
CCTV Camera in TN	INV 1φ2W 210V		2.5
CCTV Camera outside TN	INV 1φ2W 210V		0.5
Spare	INV 1φ2W 210V		-
Spare	INV 1φ2W 210V		-
Subtotal	**INV 1φ2W 210V**		**3.0**
Control Panel -1	INV 1φ2W 105V		2.5
Control Panel -2	INV 1φ2W 105V		2.0
Control Panel -3	INV 1φ2W 105V		1.5
Control Panel -4	INV 1φ2W 105V		1.0
Control Panel -5	INV 1φ2W 105V		0.5
Control Panel -6	INV 1φ2W 105V		1.0
Spare	INV 1φ2W 105V		-
Subtotal	**INV 1φ2W 105V**		**8.5**
Power -1	AC/GC 3φ3W 210V		5.0
Power -2	AC/GC 3φ3W 210V		5.0
Power -3	AC/GC 3φ3W 210V		3.5
Power -4	AC/GC 3φ3W 210V		5.0
Power -5	AC/GC 3φ3W 210V		25.0
Power -6	AC/GC 3φ3W 210V		3.5
Power -7	AC/GC 3φ3W 210V		1.0
Spare	AC/GC 3φ3W 210V		-
Subtotal	**AC/GC 3φ3W 210V**		**48.0**

Application	Source / Voltage	Capacity	
		kW	kVA
Panel -1	AC/GC 1φ2W 105V		1.0
Panel -2	AC/GC 1φ2W 105V		1.0
Panel -3	AC/GC 1φ2W 105V		1.0
Panel -4	AC/GC 1φ2W 105V		1.0
Panel -5	AC/GC 1φ2W 105V		1.0
Panel -6	AC/GC 1φ2W 105V		1.0
Panel -7	AC/GC 1φ2W 105V		1.0
Panel -8	AC/GC 1φ2W 105V		2.0
Panel -9	AC/GC 1φ2W 105V		2.0
Spare	AC/GC 1φ2W 105V		-
Subtotal	**AC/GC 1φ2W 105V**		**11.0**
Total			**202.0**

Total load demand in MW shows below.

2MW (East Electrical Room:1MW, West Electrical Room:1MW)

1.Ventilation Jet-fan 28 unit* 50kW	=1,400kW
2. Tunnel Lighting	=300kW
3. Others	=less than 300kW
	Total 2,000kW

(4) Transformer Capacity

Transformer capacity of each Electrical room is as follows:

1) East Electrical room

- Ventilation Transformer No.1: 750kVA
- Ventilation Transformer No.2: 750kVA
- Transformer for Lighting: 300kVA

2) West Electrical room

- Ventilation Transformer No.1: 750kVA
- Ventilation Transformer No.2: 750kVA
- Transformer for Lighting: 300kVA

(5) Un-Interruptible Power Supply System

Un-Interruptible Power Supply System shall be installed for the following systems which need electricity all the time.

- Tunnel Information Board
- CCTV System
- Safety system control panel

- Remote control system

Capacity of Battery is as follows:

1) East Electrical room

- UPS: 30kVA

2) West Electrical room

- UPS: 30kVA

(6) Back Up Generator

Capacity of back-up generator is as follows:

1) East Electrical room

- Generator Capacity: 300kVA

2) West Electrical room

- Generator Capacity: 300kVA

The back-up generator system can provide the minimum functions of tunnel lighting, emergency facilities' operation in case of power cut. The back-up generator will be installed for 300 kVA at each Electrical room.

The planed back-up system will cover the quarter of lighting (only one side, alternating on and off), 4 units of jet-fan, fire hydrant, CCTV camera and control systems, which is required minimum function to secure the safe and adequate driving. Based on the estimation of ventilation, 4 units of jet-fan will handle 14hours operation in year 2030.

Un-Interruptible Power Supply System shall be also needed to maintain the minimum functions of tunnel lighting and emergency facility's operation during unstable condition of back-up system after just power cut (approximately 10 minutes).

9.10 DISPOSAL AREAS OF EXCAVATED MATERIAL

For shortening the construction period, the tunnel excavation is planned to excavate from the east and west portals. Excavated material of about 52,000 cubic meters comes out from the eastern portal and about 176,000 cubic meters from the western portal.

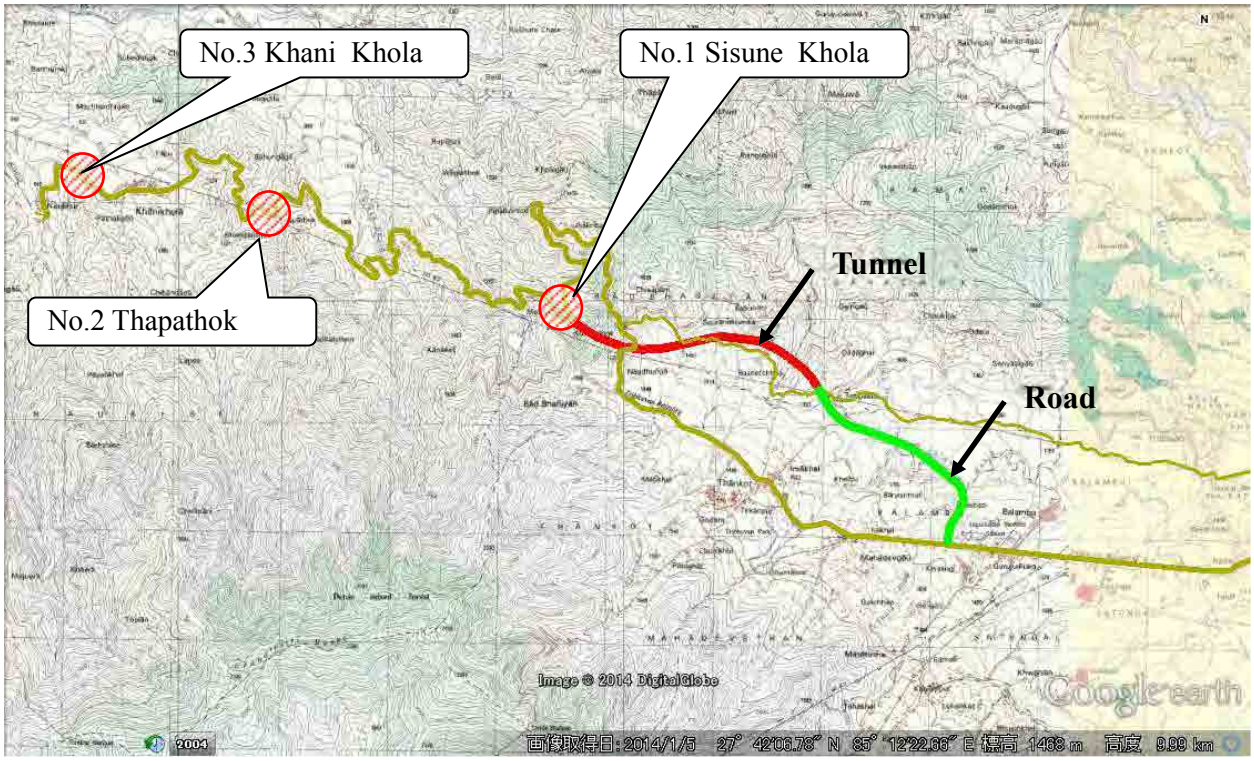


FIGURE 9.10-1 LOCATION MAP OF DISPOSAL AREA

Excavated material out of the eastern portal is planned to be used as fill material for road. Excavated material from western portal is about 176,000 cubic meters and after reviewing several conditions as below listed Sisune Khola valley was selected as spoil disposal site among the three candidate sites shown in the **Figure 9.10-1**.

1. Disposal site shall be close to the tunnel portal for the economy of transportation
2. Disposal site that can contribute to the improvement of the road
3. Disposal site becomes a meaningful place for local residents and road users
4. Compensation for agricultural land is less

Three candidate sites shown in **Table 9.10-1** were compared from above points of view.

TABLE 9.10-1 COMPARISON OF DISPOSAL SITE

No.	Place	Distance	Volume	Feature	Comparison
1	Sisune khoka	100m	300,000	• Close to the tunnel • Secure the land required for the road improvement • Installation of tunnel management facility • Effective use of the tunnel drainage	◎
2	Thapathok	5.3km	140,000	• Substantially horizontal land can be used • Current road can be shortened by 150m • Shortage in capacity	△
3	Khanikhola	8.3km	125,000	Nice view, agricultural products gather from near village, useful for such as Road Station • 5 houses • Shortage in capacity	△

9.11 PLANNING OF POWER TRANSMISSION SUPPLY FACILITY

9.11.1 Identification of NEA grid Substation for Power Supply to the Tunnel

For Power supply to the tunnel operation the nearest located Nepal Electricity Authority (NEA) Grid Substation is 132/11kV Substation at Matatirtha.

NEA has already started construction of 60 MW Trishuli 3A, 38 MW Trishuli 3B, 14.6 MW Upper Sanjen, 42.5MW Sanjen , 111MW Rasuagadhi, 5MW Tadi khola, 4.2 MW Tharpek, 102 MW Upper Trisuli -2 and 5 MW Upper Mailung-A are some other projects being considered connected to the National Grid.

A new 220/132/33kv Substation is being built nearby Upper Trishuli 3B HEP which acts a Hub for the evacuation of Hydro Electric Power generated in Trishuli 3B Hub 220/132kV Substation Project in the Trishuli region. This Substation will be connected with 220 /132kV Matatirtha S/S in Kathmandu by 220 kV double Circuit Distribution line which is in construction stage.

The existing space at 132/11 kV substation at Matatirtha is congested and to house the 220/132kV substation the substation area has to be extended and accordingly NEA has initiated the land acquisition procedure for its extension and for this NEA has published public notice to acquire the required land, on 26 September 2014 and the whole Project work of expansion is expected to be complete within 2016.

With this extension of Matatirtha Substation area, it is easier to plan the route alignment for the outgoing 11kV feeders from the Matatirtha substation, compared to the present condition. But still the problem of fast urbanization causes public grievances for Distribution line alignment. Because of this extension of Substation area in Matatirtha, Distribution line outlet from this Substation to Tribhuvan Highway has been easily possible through cable trenching.

A 22 MVA, 132/11kV, 3 Phase Transformer is installed in Matatirtha Substation to supply the local feeders.

For 11kV Power Supply to Tunnel Operation a separate reliable and dedicated 11kV double circuit transmission System is required and accordingly two separate 11kV feeders are planned from 132/11kVMata Tirtha Substation to the east control room located at tunnel portal and from here by 11kVcable laid on the cable tray anchored on the one side of the tunnel the 11kV Power will be fade to the west control room located at tunnel out let portal.

i) Principally it is possible to have dedicated Power Supply system for the tunnel operation as the ventilation fans and light loads should be fed without any frequent Power outage are vital for movement of vehicles inside the tunnels. For obtaining dedicated 11kV double circuit Distribution line for tunnel operation necessary procedure and applications will be submitted as per NEA Electricity Act at the tunnel construction time.

At Matatirtha Substation 11kV VCBs of ABB Italy made are installed for supply to local feeders and its panel drawings are shown **Figure 9.11-1**.

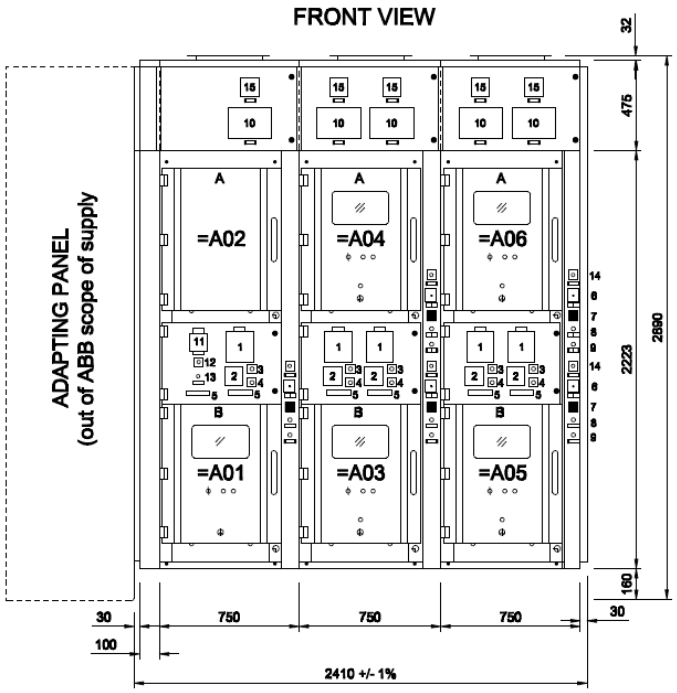


FIGURE 9.11-1 PANEL DRAWING AT MATATIRTHA SUBSTATION

For Power supply to tunnel operations two VCBs of the same make is proposed to install by extending the 11kV bus and by doing so no adaptation panel will be required.

9.11.2 Power Supply to Tunnel Operation

To supply Power to the tunnel, two control rooms one near to the west wide tunnel portal (West Control Room) and another near the east side tunnel portal (East Control Room) are planned.

Basically the tunnel length is 2.45KM long and have jet-fans for ventilation and lights among other facilities. For supply of power to these facilities, an estimated total of 3600 KVA, 11/4.0 kV is required. Two 750KVA, 11/0.4kV and one 300KVA, 11/0.4kV transformers are planned to be installed at the west side control room. Similarly, two750KVA, 11/0.4kV and one 300KVA, 11/0.4kV transformers are planned for installation at the east side control room.

The basic concept to design two control room each of them housing 2x750 kVA transformers and 300kVA transformers of voltage 11/0.4kV at each tunnel portal is that, the one set of ventilation and light loads is fed from east control room and other set of ventilation and light loads is fed from west control room and doing so it minimizes the voltage loss in 400Volt cables, as the length of cable will be halved.

9.11.3 Transformer Capacity

Transformer capacity of each Electrical room is as follows:

(1) East Electrical room

- Ventilation Transformer No.1: 750kVA
- Ventilation Transformer No.2: 750kVA
- Transformer for Lighting: 300kVA

(2) West Electrical room

- Ventilation Transformer No.1: 750kVA
- Ventilation Transformer No.2: 750kVA
- Transformer for Lighting: 300kVA

9.11.4 Un-Interruptible Power Supply System

Un-Interruptible Power Supply System shall be installed for the following systems which need electricity all the time.

- Tunnel Information Board
- CCTV System
- Safety system control panel
- Remote control system

Capacity of Battery is as follows:

(1) East Electrical room

- UPS: 30kVA

(2) West Electrical room

- UPS: 30kVA

9.11.5 Selection of 11kV Cable size for Power Supply

Calculation for 11kV Cable size :

Total Transformer Capacity

East Control room 1800KVA
West Control room 1800KVA
Total load 3600 KVA
Current (I) =236.195675Amps
XLPE Cable size for 3600 KVA shall be
a) 240Sq.mm(resistance =0.1618Ohm/km) or
b) 300 Sq.mm size (resistance= 0,1302Ohm/KM)
Voltage drop =199.7268 V
Receiving end voltage =10654.06 V

240Sq.mm (resistance =0.1618Ohm/km) Aluminum Cable can be selected but for safe margin Aluminum cable is preferably 300 Sq.mm is selected.

Hence two Nos. of 300 Sq.mm, Aluminum Cable are selected for two 11kV Distribution line circuits to be tapped to feed each of the 2x750 kVA and 300 KVA ,11/0.4kV transformers located at east and west control rooms for tunnel operation.

9.11.6 11kV Power supply feeder from 132/11kV Matatirtha Substation to East and West Control rooms for Tunnel operation.

Matatirtha Substation is located near to densely populated area of Thankot a lot of congested houses are seen and the roads are narrow and the no free space available to locate the 11kV Distribution line poles. Moreover the NEA has constructed cable trench for outgoing 11kV distribution feeders from this substation and the cable duct is full and no space is left for new cables in it. For future outgoing Distribution line feeder a new Distribution line route alignment or cable duct route is to be planned.

An extensive site survey to identify a viable 11kV outgoing Distribution line feeder alignment from this 132/11kV substation to Naghdhunga Power supply system was conducted. The information of upgrading program of 132/11kV Substation to accommodate the 220/132kV substation in the same substation premises with extension of the substation area and the progress of land acquisition was collected.

The 132/11kV Matatirtha Substaion is seen in the Google map. The proposed extended substation area is shown in **Figure 9.11-3** and the boundary line is shown in red. The land acquisition to extend the substation is under process.

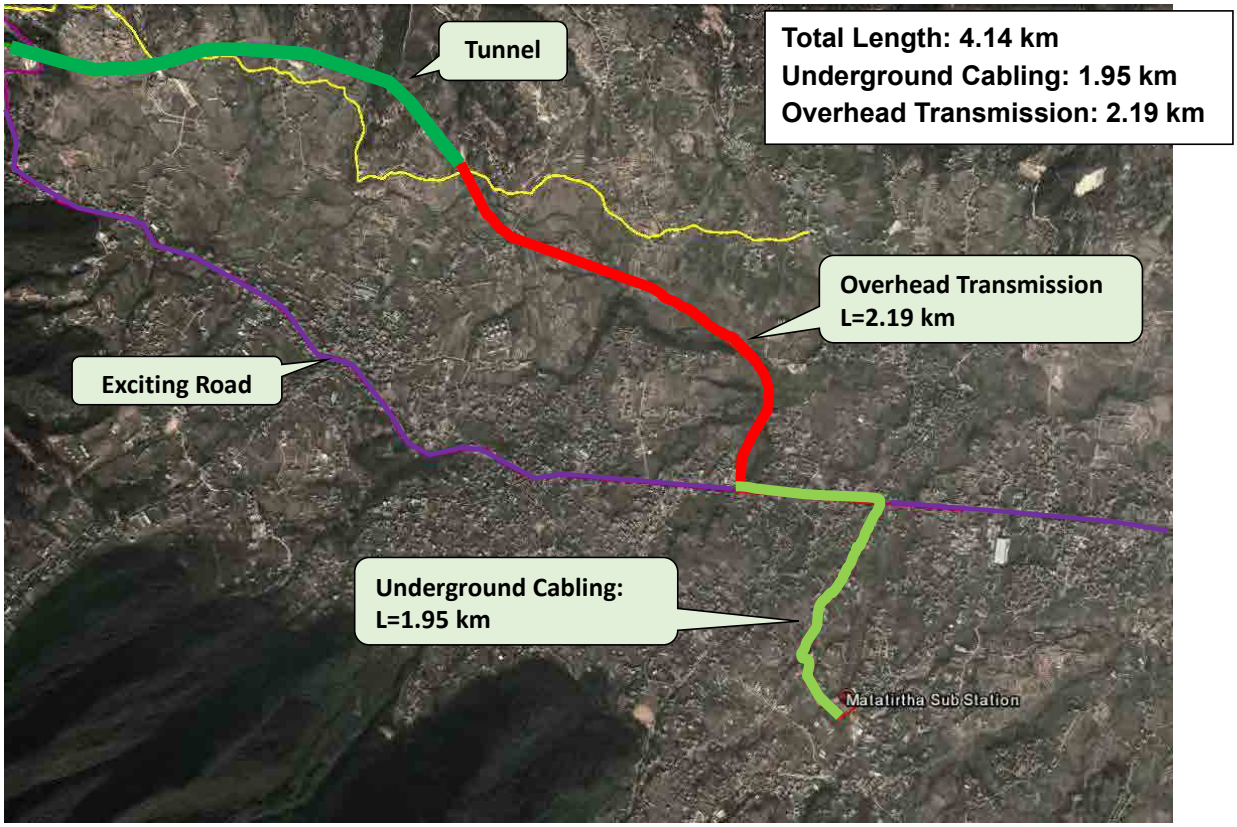


FIGURE 9.11-2 ENTIRE DISTRIBUTION LINE FROM MATATIRTHA SUBSTATION TO TUNNEL EAST PORTAL

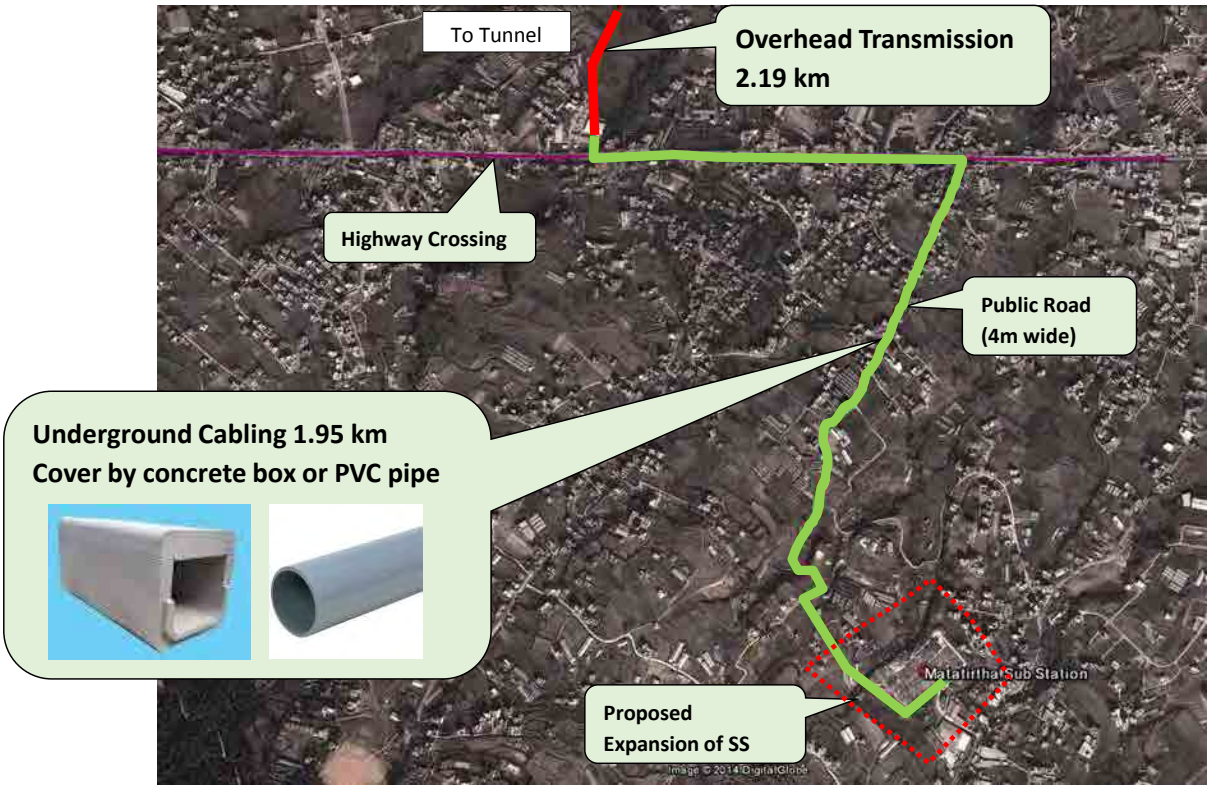


FIGURE 9.11-3 DISTRIBUTION LINE FROM MATATIRTHA SUBSTATION TO HIGHWAY CROSSING POINT

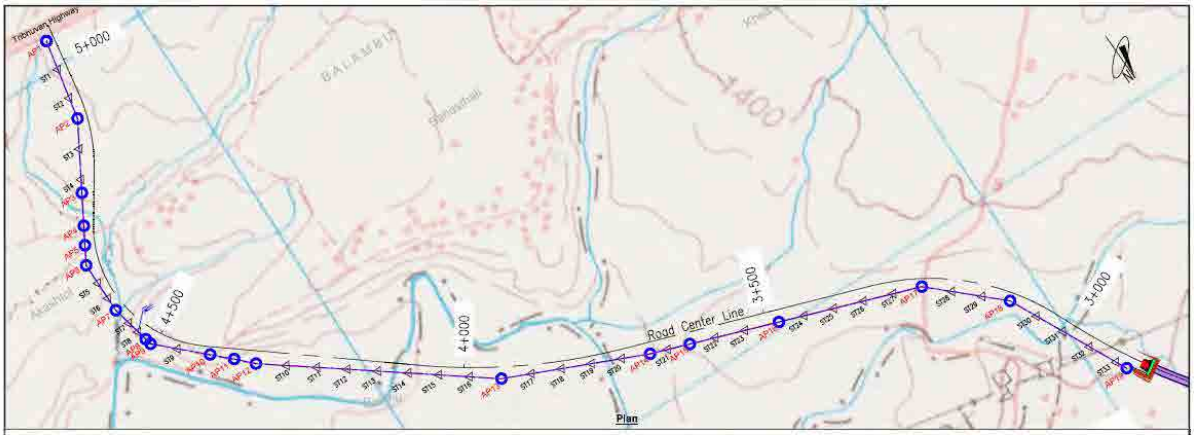


FIGURE 9.11-4 DISTRIBUTION LINE FROM HIGHWAY CROSSING POINT TO TUNNEL EAST PORTAL (WITH TOWER LOCATION)

9.11.7 Transformers

To supply 11kV to the 2x750 and 300KVA Transformers installed in the

a) East control room

b) West control room

The following measures shall be taken

1) From 132/11kV Matatirtha Substation two outgoing 300Sq.mm, 3 core aluminum, armored cables for 11kV double circuit Distribution line feeder shown in green color in the Google map will be buried in cable duct of 1.95Km long
The path of the 11kV cable duct 1.95 Km long is shown in the Google map and is described as follows

a) The 11kV cable duct starts from Matatirtha Substation

b) passes through a narrow road between the houses in both sides

c) reaches to a point near to the highway from where it follows parallel to the road

d) and it crosses the road

2) After crossing the road the each of the two cables will be connected to its relevant 11kV circuit of overhead Distribution line circuit. The double circuit Distribution line is 2.19 KM long and follows along the approach road to the tunnel portal where the east control room is located. The route map is attached.

3) Both circuits of the 11kV Distribution line shall be connected to 11kV bus in east control by respective cables. To supply to the west control room from the 11kV bus located in easrt control room an outgoing nearly 2.35 KM long, 240Sq.mm, 3core, armored Aluminum cable will be laid in the cable rack anchored on one side of the tunnel wall and then after passing out from the tunnel the cable will be connected to 11kV bus of east control room to supply power to 2x750 and 300 KVA transformers located here to supply Power to the tunnel operation.

4) SLD

A SLD for Power supply containing all the equipments from the interconnection Substation to the control rooms located at Tunnel inlet and out let portals

9.11.8 Brief description of the VCBs in the SLD

a) From 132/11kV Matairtha Substation for double circuit 11kV outgoing Distribution line feeder following arrangements are necessary:

1) 3core, 300sq.mm, Armored, Aluminum cable for each of the outgoing feeders for tunnel operation

2) 2Nos of VCBs of 1250 A rating for the outgoing feeders to be installed at Matatirtha Substation

3) 2 Nos. of VCBs of 1250 A rating for the outgoing feeders to be installed at East Control room
4) One sectionalizing VCB of 1250 A to be installed at East control room 11kv bus
5) 11kV double circuit overhead Distribution line
6) 3 Nos. of VCBs of 630 A for protection of the distribution transformers for east control room
7) 3 Nos. of VCBs of 630 A for protection of the distribution transformers for west control room
8) Estimation

9.11.9 Cost Estimation

Based on the equipments shown in the SLD and the design philosophy described above the cost estimation is prepared and attached herewith.

The Bill of quantities for Power Supply to Tunnel operation prepared includes basically following costs

a) The cost of the equipments to be incurred at the NEA interconnecting substation at 132/11kV Matatirtha Substation ,

b) The cost of 11kV cables laid on the cable trench from Matatirtha substation to the road crossing , HDPE Pipes and joints pipes for 11kV cables installation works,

c) Cost of civil works of cable trench ,

d) Cost of overhead 11kV double circuit Distribution line starting from the end point of cable trench and following the approach road to tunnel portal ,

e) Cost of equipments to be installed in east and west control rooms

f) Cost of 11kV cable to be laid at the cable rack on tunnel side wall for supply of Power to west control room from east control room

g) The cost of the backup 300KVA diesel engine considered in the design is not included in the BOQ as the information received is the diesel engines used in construction will be utilized for operation time of tunnel to save cost.

The BOQ is prepared and attached herewith revel that for Power Supply to the tunnel operation at least a fund of USD 1,499 thousands is required.

The Summary Table of the Cost breakdown is shown in the **Table 9.11-1**.

TABLE 9.11-1 COST ESTIMATION OF THE ELECTRICAL WORKS FOR POWER SUPPLY TO TUNNEL VENTILATION AND LIGHTING

Item No	Description	Totals US$
1	11kV ABB Italy made Vacuum Circuit Breakers (VCB)	171,800
2	Other VCBs	146,880
3	Distribution Transformers	204,975
4	11kV double circuit Distribution line	204,564
5	Air Circuit Breakers (ACBs)	19,217
6	Aluminum Cable, HDPE Pipes and Pipe Joints (from Matathirtha SS to East Control Room)	252,252
6.2	HDPE Pipes 140mm 5 inches diameter 6kg/sq.cm	63,063
6.3	HDPE Pipe Joints	7,453
7	Aluminum Cable, HDPE Pipes and Pipe Joints (from East Control Room to West Control Room)	131,576
8	Civil works of cable trench (from Matathirtha SS to Highway Crossing)	107,388
9	11kV Cabling works on cable racks installed on left side wall of the tunnel for supply of Power to west control room from east control room . from East Control Room to West Control Room.	30,030
10	Others	160,000
	Total Costs	1,499,198

Refer to **Annex 9.11-1** for details of the Cost Estimation.

9.12 FACILITIES NECESSARY FOR TUNNEL O & M

(1) Tunnel Management Office

Safe operation of a tunnel require the creation of a Tunnel Management Office, thorough discussion of this can be found in **Section 14.2**.

(2) Toll Collection Facility

In order to secure the tunnel O & M cost, toll collection facilities was designed.

1) Required Toll Booth Number

In accordance with traffic demand forecast (see section 5.2), the required toll booth was calculated. Toll Booth will be installed at each tunnel entry point to check dangerous car, over weight car and etc.

TABLE 9.12-1 PEAK HOUR TRAFFIC VOLUME AT TUNNEL SECTION

	AADT 2030 (a)	Peak hour (b)	Peak Traffic Volume(c= a × b)
Eastbound	5,000 veh /day	6.3 %	315 veh/hr
Westbound	4,800 veh/day	6.3 %	302 veh/hr

In Japan, the average service time at toll gate is 8 second in case of flat rate. But study team assumed the average service time at toll gate is 10 second for this project. **Table 9.12-2** shows the required toll booth, service time and average waiting vehicle at gate. As peak traffic volume is 302 ~ 315, the minimum required toll gate is two (2) booths for average one waiting vehicle level. The study team recommended three (3) booths for eastbound (west-side) considering one spare booth.

TABLE 9.12-2 SERVICE TIME, AVERAGE WAITING VEHICLE AT TOLL GATE AND NO. OF TOLL GATE

Service Time / Ave. Waiting Vehicle at Toll Gate / No. of toll gate	6 sec		8 sec		10 sec		14 sec		18 sec		20 sec	
	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0
1	300	450	230	340	180	270	130	190	100	150	90	140
2	850	1,040	640	780	510	620	360	440	280	350	250	310
3	1,420	1,630	1,070	1,230	850	980	610	700	480	550	430	490
4	2,000	2,230	1,500	1,670	1,200	1,340	860	960	670	740	600	670
5	2,590	2,830	1,940	2,120	1,550	1,700	1,110	1,210	860	940	780	850
6	3,180	3,430	2,380	2,570	1,910	2,060	1,360	1,470	1,060	1,140	950	1,030
7	3,770	4,020	2,830	3,020	2,260	2,410	1,620	1,720	1,260	1,340	1,130	1,210
8	4,360	4,630	3,270	3,470	2,620	2,780	1,870	1,980	1,450	1,540	1,310	1,390
9	4,960	5,220	3,720	3,920	2,980	3,130	2,130	2,240	1,650	1,740	1,490	1,570
10	5,560	5,820	4,170	4,370	3,330	3,490	2,380	2,490	1,850	1,940	1,670	1,750
11	6,150	6,420	4,610	4,820	3,690	3,850	2,640	2,750	2,050	2,140	1,850	1,930
12	6,740	7,020	5,050	5,270	4,040	4,210	2,890	3,010	2,250	2,340	2,020	2,110
13	7,340	7,620	5,510	5,720	4,400	4,570	3,150	3,270	2,450	2,540	2,200	2,290
14	7,940	8,220	5,954	6,170	4,760	4,930	3,400	3,520	2,650	2,740	2,380	2,470
15	8,530	8,820	6,400	6,620	5,120	5,290	3,660	3,780	2,840	2,940	2,560	2,650

Source: NEXCO EAST Highway Design Manual, 2005

2) Toll Booth Layout

Figure 9.12-1 shows the toll booth layout for this project.

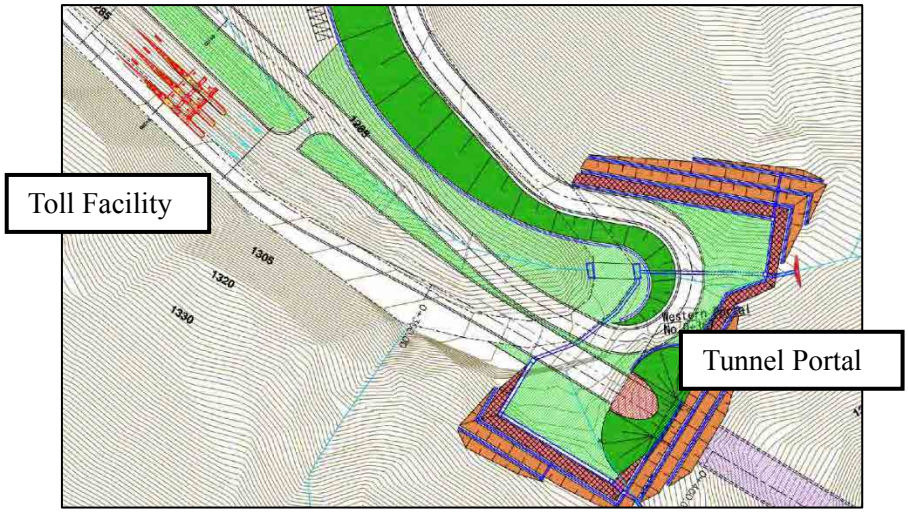


FIGURE 9.12-1 (1) TOLL BOOTH LAYOUT AT WESTSIDE

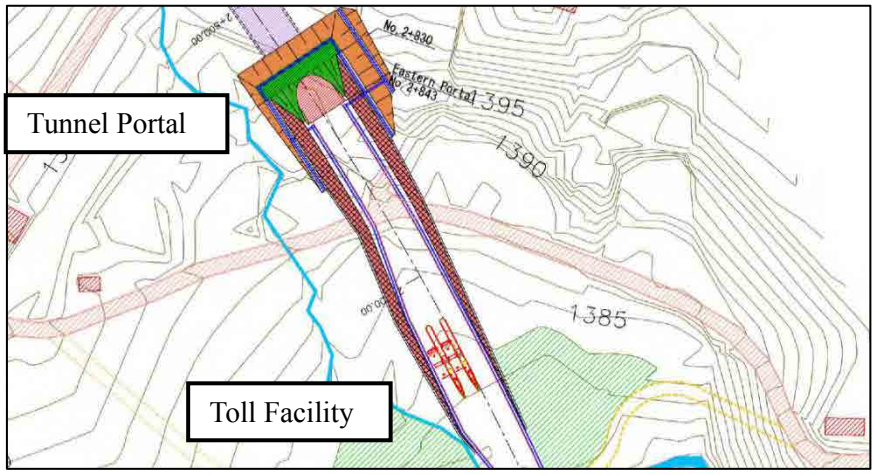


FIGURE 9.12-1 (2) TOLL BOOTH LAYOUT AT EASTSIDE

General outline of toll facilities

- 3 lane@3.0m (West Side), 2 lane@3.0m (East side)
- 3 simple booth (West Side), 2 simple booth (East side)
- Information sign & pavement-marking
- Roof
- Lighting

9.13 DISPOSAL AREA DEVELOPMENT PLAN (MICHI-NO EKI[1])

9.13.1 Objective

The expected volume from excavation of tunnel is approximately 176,000 m2. The JICA-assisted Data Collection Survey proposed three locations as candidates for disposing the excavated soil. It further proposed several method such as, use of space for control office of the tunnel, to improve existing road alignment at hair-pin curves if required and to provide a "Michi-no-Eki".

The objective for the plan of Michi-no-Eki is to promote the road service facility for the safe

1 Michi-No-Eki is a facility developed in Japan, which literally means "road station", provided on National Highways and arterial roads for the purpose to integrate parking area, rest rooms (toilets), information facilities and community facilities provided by local governments.

driving and comfortable service for road users such as truck, tourist bus and private vehicles, and contributing tourism promotion and local economy.

9.13.2 Existing Rest Facilities along Tribhuvan Highway

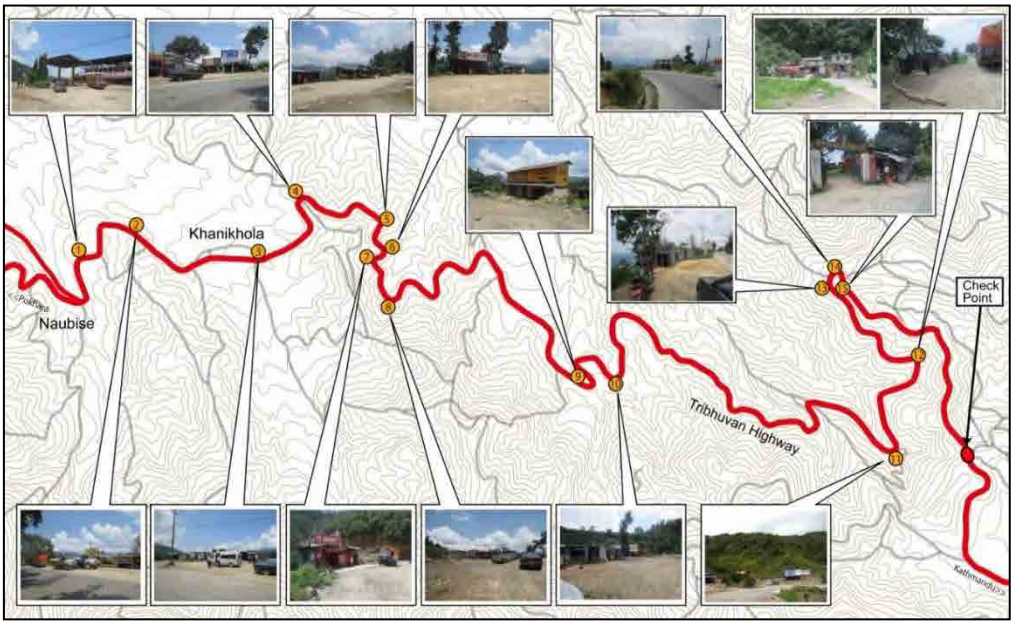
(1) Location of Existing Rest Facilities

The JICA Survey Team carried out the existing rest facilities survey along Tribhuvan Highway between Naubise and Nagdhunga Pass. Sixteen (16) rest facilities are located as shown in **Figure 9.13-1**.

These rest facilities expect No.1 are illegally operated by the private companies. DOR has ordered to these facilities to move out of ROW of DOR. Car drivers, truck drivers and tourist buses are using these illegal rest facilities, it is understood that there are high demands for rest facilities.

(2) Average Distance between Rest Facilities

The average distance between rest facilities is shown in **Table 9.13-1**. The average distance is approximately 0.82 km.



Source: JICA Survey Team

FIGURE 9.13-1 LOCATION OF EXISTING REST FACILITIES ALONG TRIBHUVAN HIGHWAY

TABLE 9.13-1 AVERAGE DISTANCE BETWEEN EXISTING REST FACILITIES

Location	No.	Distance (km)		Note
		between point	from base point	
Westside from West Portal	1	0.62	8.80	Legal
	2	0.85	8.18	Illegal
	3	0.47	7.33	Illegal
	4	0.58	6.86	Illegal
	5	0.25	6.28	Illegal
	6	0.10	6.03	Illegal
	7	0.26	5.93	Illegal
	8	2.16	5.67	Illegal
	9	0.54	3.51	Illegal
	10	2.97	2.97	Illegal
	11	0.00	0.00	Illegal

Location	No.	Distance (km)		Note
		between point	from base point	
Eastside from West Portal	12	0.74	0.74	Illegal
	13	0.81	1.55	Illegal
	14	0.06	1.61	Illegal
	15	0.16	1.77	Illegal
	16	1.79	3.56	Check Point (Naagdhunga), Legal
Average		0.82	-	

Source: JICA Survey Team

(3) Typical Type of Existing Rest Facilities

The existing rest facilities have various problems as follows;

1) Parking space is provided very close to the existing road and not paved, thus in very bad condition.

2) Toilets are provided at most rest facilities, however, they are very dirty and unhealthy.

3) Some stores are doing business.

4) There is no stores which sell local products.

Parking space and situation

Toilet situation

Multiple shop facilities

Shops sells some snacks, drinks and fruits

PHOTO 9.13-1 TYPICAL FACILITIES IN THE AREA

9.13.3 Tourism Spots and Local Products

(1) Tourism Spots

This project provides vital access to the famous tourism spots which are located in Kathmandu, Pokhara, Chitwan National Park and others. Therefore, this Michi-no-Eki will be utilized by local and foreign tourists.

1) Kathmandu

Kathmandu tourist sports are Patan area, Bhaktapur area and Thamel area where many tourists are visiting.

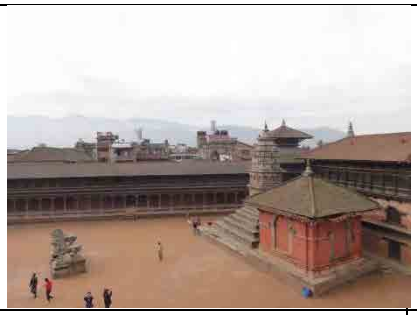
		
Patan Area	Bhaktapur Area	Thamel Area

PHOTO 9.13-2 TOURISM SPORTS IN KATHMANDU

2) Pokhara

Pokhara is very famous lakeside resort in Nepal. Many tourists enjoy trekking in and around Pokhara.

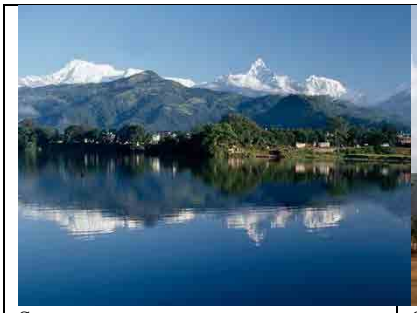
		
Source: http://www.explorehimalaya.com/	Source: http://www.nepallinktravel.com/	Source: http://www.pokharapalacehotel.com/
Lakeside	Temple	Trekking Mountain

PHOTO 9.13-3 TOURISM SPORTS IN POKHARA

3) Chitwan National Park

This park is located in south central Nepal. Tourist can enjoy safari wildlife tour.

	
Park Tour	Wild Animals

Source: Department of National Parks and Wildlife Conservation

PHOTO 9.13-4 TOURISM SPORTS IN CHITWAN NATIONAL PARK

(2) Local Products in Project Area

Major local products are paddy rice, maize, wheat, tomato and mushroom etc, in project area and shown in **Table 9.13-2**. These products are basically provided for their consumption and are not for sale. Michi-no-Eki can provide opportunities to sell local products and farmers will bi inspired to produce more to sell products at Michi-no-Eki for their additional income.

TABLE 9.13-2 LOCAL PRODUCTS

District	VCD[2]s	Major Agricultural Products
Kathmandu	Mahadevsthan	Paddy Rice, Maize, Wheat, Tomato, Mushroom and Cauliflower
	Balambu	Paddy Rice, Maize, Wheat and cauliflower
	Dahachowk	Paddy Rice, Maize, Wheat, Tomato and Mushroom
	Thankot	Paddy Rice, Maize, Wheat, Tomato and Mushroom
	Baad Bhanjyang	Paddy Rice, Maize, Wheat, Potato and Tomato
Dhanding	Naubise	Paddy Rice, Maize, Wheat, Potato, Tomato, Cauliflower and Cabbage

Source: JICA Survey Team

9.13.4 Candidate Locations of Disposal Area and Rest Facilities

Candidate locations of disposal area/rest facilities are shown in **Figure 9.13-1**.

Alternative-1: Located adjacent to the West Portal of a tunnel, thus excavated material can be disposed at the cheapest cost. About 150,000 – 200,000 cubic meters of excavated material can be disposed.

Alternative-2: Located at about 3.00 km away from the West Portal, and about 150,000 – 200,000 cubic meters of excavated material can be disposed.

Alternative-3: Located at about 0.00 km away from the West Portal, and not advantageous as a disposal area. This site is located near Naubise, thus convenient for people to sell local products.

Source: JICA Survey Team

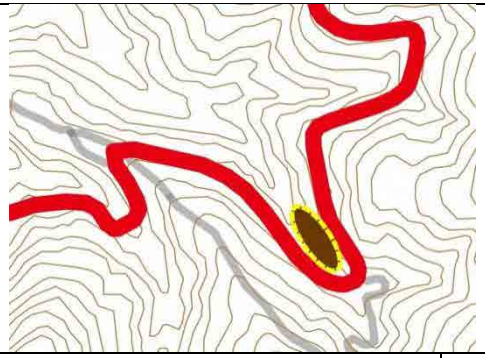
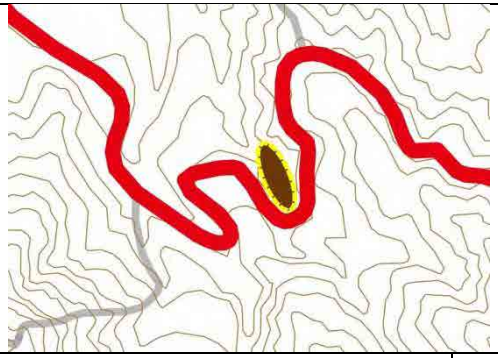
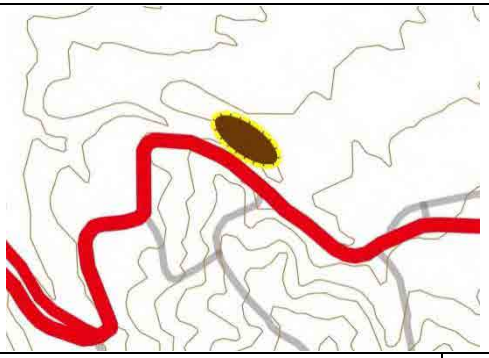
FIGURE 9.13-2 PROJECT SITE

9.13.5 Comparing with the Disposal Area

Three candidate locations are compared from the viewpoint of 1) Site Condition, 2) Filling Cost 3) Environment Impact and 4) Impact on Tunnel Project and shown in **Table 9.13-3**.

2 Village Development Committee: VDC is the lower administrative part of its local development ministry. Each district has several VDCs, similar to municipalities but with greater public-government interaction and administration.

TABLE 9.13-3 COMPARISON OF DISPOSAL AREA

Evaluation Item	Alternative-1		Alternative-2		Alternative-3	
Location						
Site Condition	・ This site is located adjacent to West Portal of a Tunnel. ・ About 150,000 – 200,000 cubic meters of excavated material can be disposal	A	・ This site located at about 3.00 km away from the West Portal of a Tunnel. ・ About 150,000 – 200,000 cubic meters of excavated material can be disposal	B	・ This site located at about 8.00 km away from the West Portal of a Tunnel. ・ This site located near Naubise.	C
Filling Cost	Landfill is near, cost is cheap.	A	Landfill is middle, Cost is expensive.	B	Landfill is far, Cost is more expensive.	C
Environment Impact	・ Firm land ・ Stream	B	・ Firm land ・ Stream	B	・ Firm land and residencies	C
Effect on Tunnel Project	・ Transfer length of evacuated material is shortest for disposal area.	A	・ Transfer length of evacuated material is 3.00 km away from the West Portal of a Tunnel is high cost.	B	・ Transfer length of evacuated material is 3.00 km away from the West Portal of a Tunnel is highest cost of alternative.	C
Total Evaluation	**Recommendation**	1	**Not Recommendation**	2	**Not Recommendation**	3

Notes: Evaluation of compatibility, A: Good, B: Tolerable
Source: JICA Survey Team

9.13.6 Layout of Typical Michi-no-Eki

(1) Estimation of Demand of Parking Lots on Michi-no-Eki

The parking area will be arranged in each zones like car, mini bus, large bus and truck, and then the large truck will be parked at the Michi-no-Eki not to make a traffic jam with other vehicle. Therefore, estimation of demand of parking lot on Michi-no-Eki is calculated as followings;

1) Calculation Condition

Demand of parking lots is resolved based on 1) target interval of Michi-no-Eki, 2) design daily volume and 3) utilization factor. In principle, it is calculated by traffic classifications in older to calculation items are shown in **Table 9.13-4**.

TABLE 9.13-4 CALCULATION ITEMS

Items		Figure	Remarks
Target Interval of Roadside Station (L)		**10**	**km**
Design Daily Volume (N)	Small Vehicles	4,824	Year 2025
	Large Vehicles	6,045	
Stop Ratio at Michi-no-Eki (S)	Small Vehicles	0.007	
	Large Vehicles	0.008	
Peak Hour Ratio (P)	Small Vehicles	0.08	
	Large Vehicles	0.08	
Parking Occupy Ratio (O)	Small Vehicles	0.25	
	Large Vehicles	0.20	

Source: Design Guidelines of Road (Chubu Regional Development Bureau in Japan, 2014)

2) Calculation for Demand of Parking Spaces

Formulation of demand of parking spaces and calculation formula is shown in below.

$$N = L\,(km) \times S \times P \times O \qquad (1)$$

Where,

N – Demand of Parking Spaces
L – Target Interval of Michi-no-Eki
S – Stopping Ratio at Michi-no-Eki,
P – Peak Hour Ratio
O – Parking Occupy Ratio

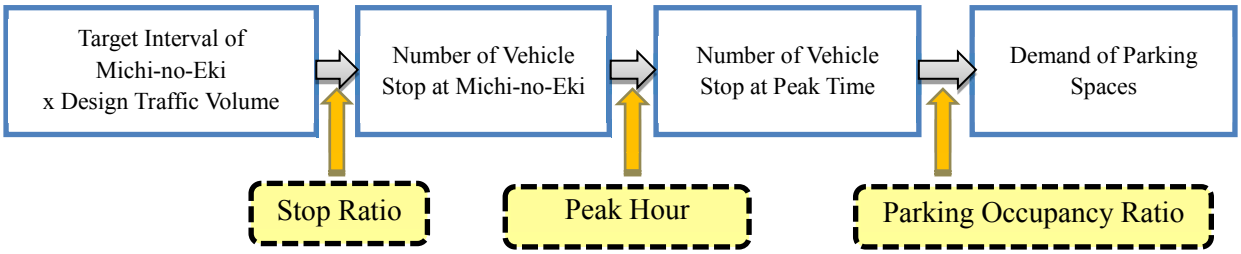


FIGURE 9.13-3 FORMULATION OF DEMAND OF PARKING SPACE

3) Result of Number of Parking Spaces

Result of number of parking spaces at proposed Michi-no-Eki are shown in below,

- Small Vehicles: 7 (nos)
- Large Vehicles: 10 (nos)

Although parking spaces were calculated based on above formula, sufficient land required of large vehicles parking lots cannot be secured in this area consideration for driveway. Thus, large vehicles parking lots are planned depending on available land required.

(2) Infrastructure Plan for Custom Facility

The plan for the infrastructure of the Michi-no-Eki will be designed based on the analysis of present condition in terms of 1) water supply facility, 2) sewage facility, 3) energy and electric power facility and 4) communication facility. Table 9.13.6-2 shows the present condition and plan strategy for the infrastructure plan.

TABLE 9.13-5 PRESENT CONDITION AND PLAN STRATEGY FOR INFRASTRUCTURE PLAN

Infrastructure	Present Condition	Plan Strategy
1) Water supply facility	• Water supply facility is not existing in the project area because of disposal area.	• The facility of water supply will be used, according to constructing water tank. • New deep well in the site will be developed if necessary.
2) Sewage facility	• Sewage disposal system by discharging to stream. • Sanitary sewage disposal system by direct stream.	• The sewage facility and sanitary sewage system by septic tank will be constructed for public toilet and restaurant.
3) Energy and electric power facility	• Middle-voltage line on the mountain • Fire power supply by propane gas and charcoal	• The existing high-voltage line in the site will be used by a lead-in cable from the Tunnel. • The existing system for fire power supply will be used.

(3) General Layout of Facilities

1) Basic Concept for Facilities at the Michi-no-Eki

General layout of some facilities at the Michi-no-Eki is considered by basic concepts as shown in below;

- From a hygiene standpoint, the public toilet and the restaurant should be separated buildings.
- The public toilet and the restaurant will be applied water place, they should be located at grand floor. And, water tank has to locate between building of toilet and restaurant.
- The septic tank should be constructed in the Michi-no-Eki for sanitary environment.
- The management office and the information center are located restaurant in a corner.
- The trash cans should be located at various places in the Michi-no-Eki.
- The shop facility will be located at 2nd floor within same building of the restaurant, which will sell some snacks, drinks and local productions.

2) General Layout of Facility

The layout of general and typical facilities is shown in **Table 9.13-6** and **Figure 9.13-4** to **Figure 9.13-5**. A compact style facility will be made an appeal of "Festivity" and "Amenity" to the road user without felling of pressure, and will be also made an appeal of "Landmark". The total area of site will be estimated at 4,650 m^2, which is comprised of parking area at 471.5 m^2, plaza area at 442 m^2, building area at 329 m^2 and green area at 290 m^2.

TABLE 9.13-6 VALUE OF PROPOSED FACILITIES

Items	Units	Value	Contents
Plaza area	m^2	442 m^2	Including pedestrian aisle
Toilet	Male	32.5 m^2 (6.5m x 5.0m)	Washstand: 3 pieces Urinal: 6 pieces Water closet: 3 pieces
	Female	32.5 m^2 (6.5m x 5.0m)	Washstand: 3 pieces Water closet: 8 pieces
	Access Aisle	7.5 m^2 (1.5m x 5.0m)	-
	Total	78 m^2 (13.0m x 6.0m)	-
Restaurant (1F)	Restaurant	154 m^2 (11.0m x 14.0m)	Table: 9 sets
	Kitchen	40 m^2 (4.0m x 10.0m)	Wash place, cooking table, shelf, refrigerator, etc
	Total	194 m^2	-
Management Office and Information Center (1F)	m^2	16 m^2 (4.0m x 4.0m)	Working table, PC, shelf, etc
Shop (2F)	m^2	135 m^2 (15.0m x 9.0m)	Shelf, casher, table
Parking	Small and Middle	25 nos (5.0m x 2.3m)	-
	Large	8 nos (15.0m x 2.3m)	-
	Total	552.0 m^2	-
Green Area	m^2	290 m^2	-
Others	m^2	116.25 m^2	Water tank, septic tank, dump yard

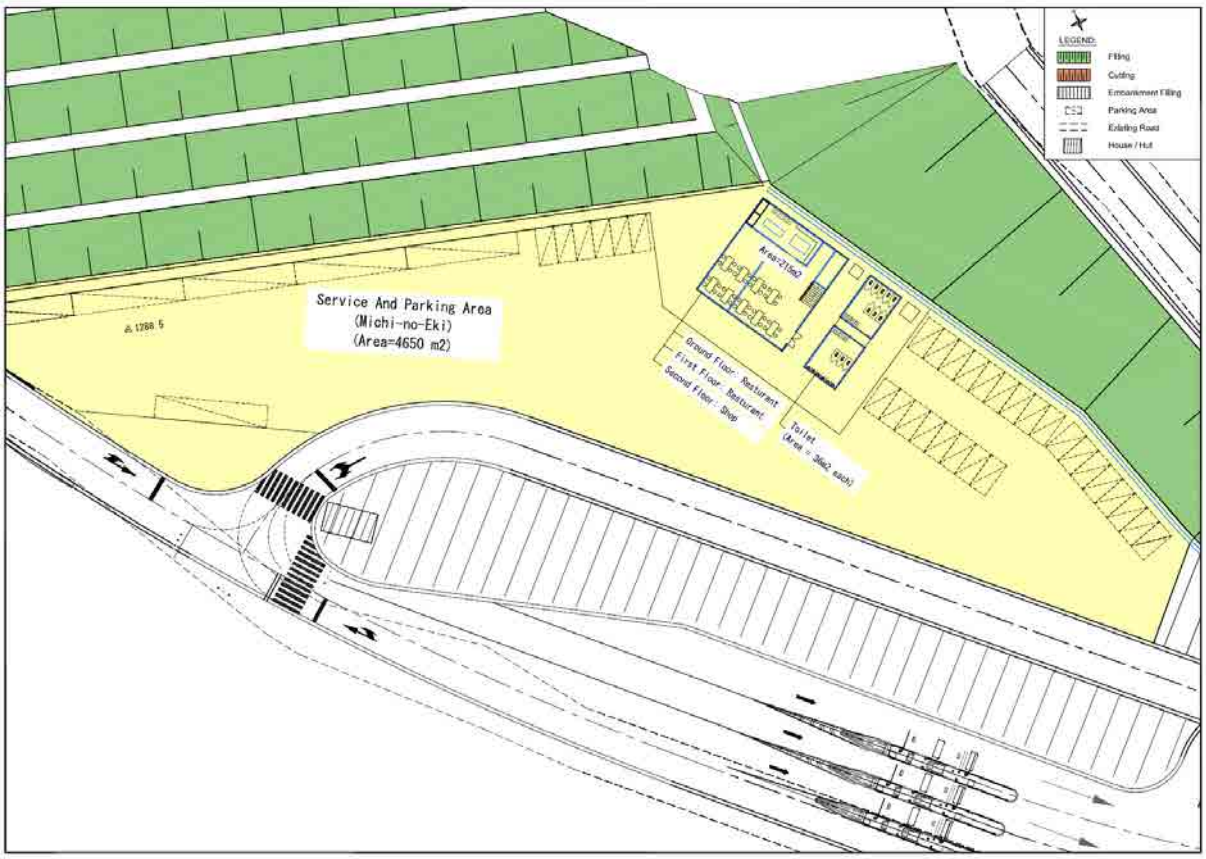
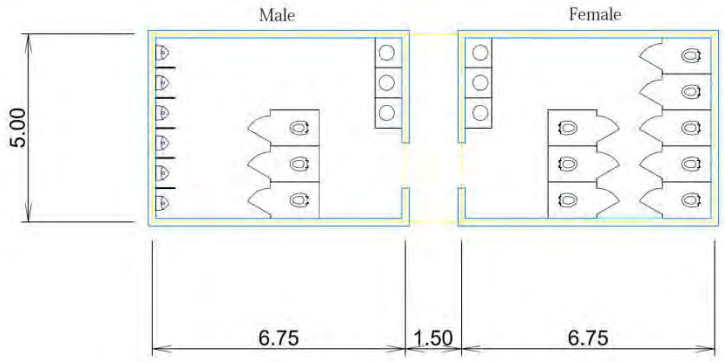
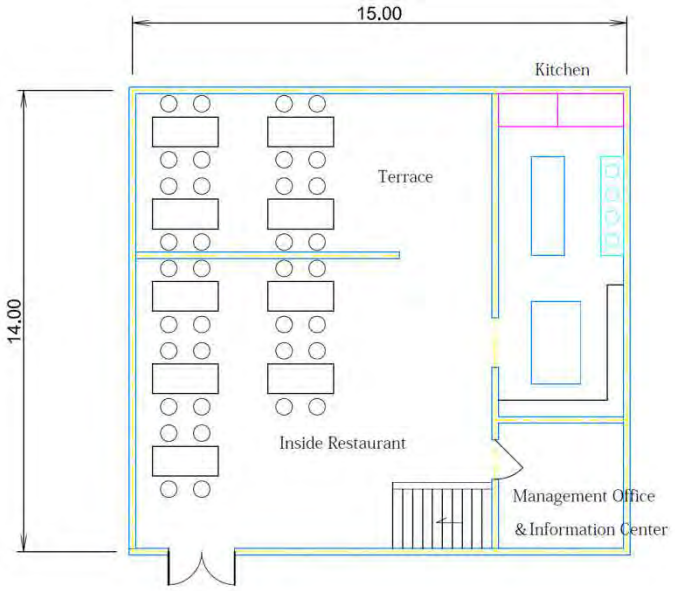


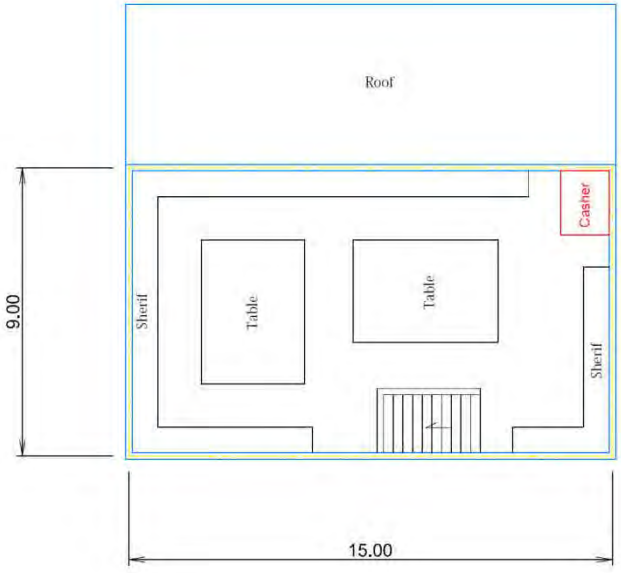
FIGURE 9.13-4 LAYOUT OF THE MICHI-NO-EKI IN THIS PROJECT



Toilet



Restaurant, the Information Center and the Management Office



Shop

FIGURE 9.13-5 LAYOUT OF FACILITIES

9.13.7 Operation and Maintenance for the Michi-no-Eki

Scheme of administrative organization for the Michi-no-Eki and part of O&M is considered as followings;

1) Based on the new regulation of MoPIT, DOR will be submitted the application document to MoPIT which are permitted for bidding and sub-contract under DOR.
2) After submission the application document, MoPIT will judge this document and accept for undertaking the bidding and selection private company under DOR.
3) DOR-PMU will conduct the bidding for private company to operate the rest facility depending on fair evaluation.
4) Private company will operate and maintain the rest facility (Restaurant, Toilet, Shop). And, revenue collected from the facility will be used for the O&M of the facility. However, maintenance of parking space, drive way, information facility and beautification of Michi-no-Eki will be responsibility of Tunnel Management Office.
5) Tunnel Management Office and private company should tie-up to operate and maintenance of Michi-no-Eki.

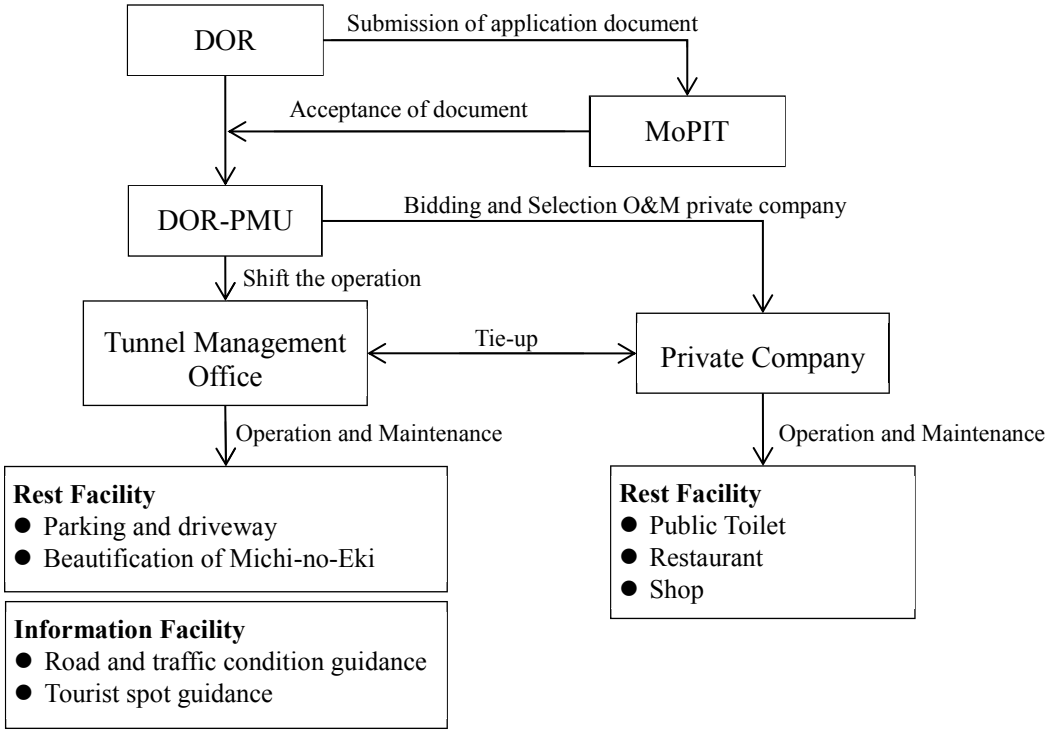


FIGURE 9.13-6 SCHEME OF CONFIGURATION FOR ADMINISTRATIVE ORGANIZATION FOR THE MICHI-NO-EKI

9.13.8 Project Cost Estimate

The project cost for the construction of the Michi-no-Eki is shown in **Table 9.13-7**. The project of a typical the Michi-no-Eki was estimated at 36.3 million Rupees.

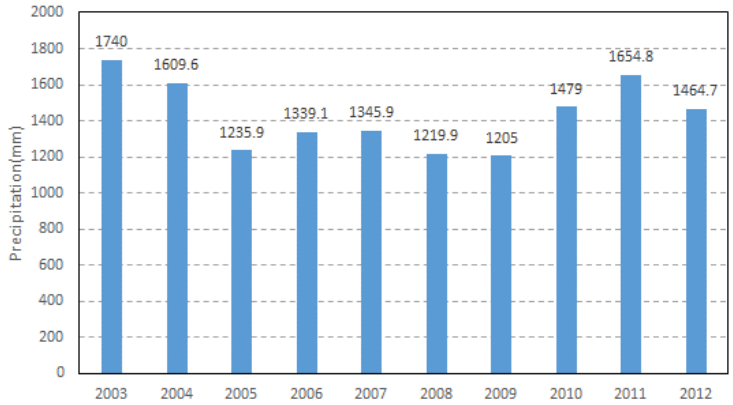
TABLE 9.13-7 PROJECT COST ESTIMATE

No.	Major Item	Cost (Million Rs)
1	Construction Cost	34.5
2	Maintenance Cost (1 year)	1.8
Total		36.3

9.14 POSSIBILITY OF LOWERING OF GROUNDWATER LEVEL

9.14.1 Climate Conditions in the Study Area

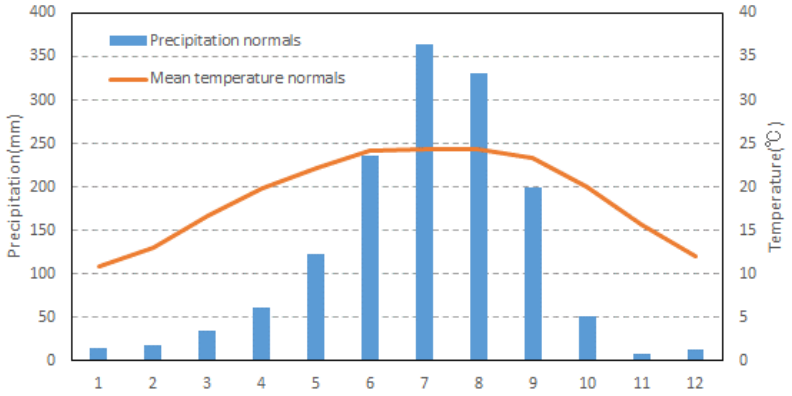
There is a rainfall of about 1400mm per year in Kathmandu. Rainy season and dry season are clearly separated. During the rainy season between May and September nearly 90% of the annual precipitation is observed. Precipitation since June of this year follows that of the normal year.



Source : Department of Hydrology and Meteorology

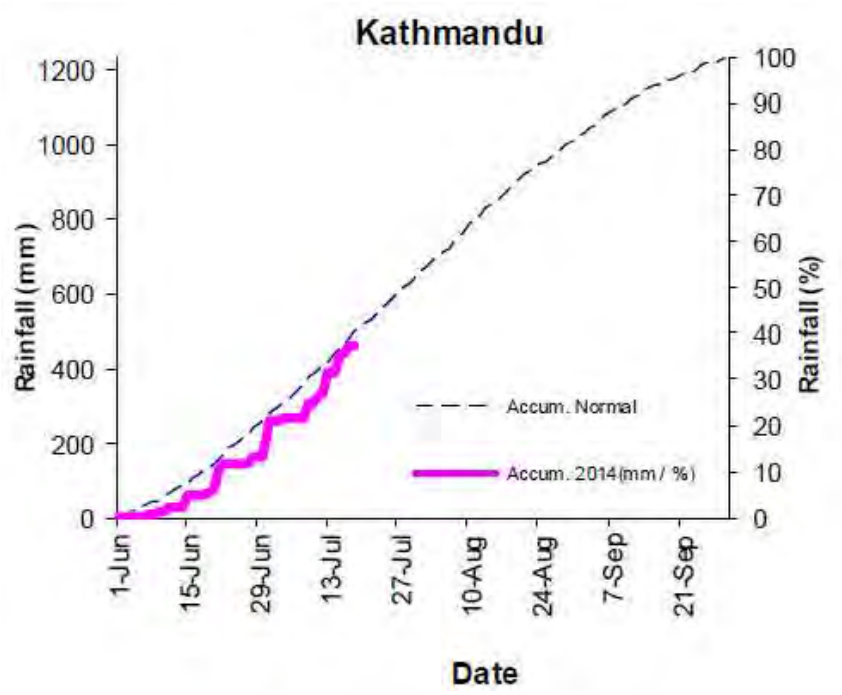
FIGURE 9.14-1 ANNUAL RAINFALL

Month	1	2	3	4	5	6	7	8	9	10	11	12
precipitation normals (mm)	14.4	18.7	34.2	61.0	123.6	236.3	363.4	330.8	199.8	51.2	8.3	13.2
Mean temperature normals (℃)	10.8	13.0	16.7	19.9	22.2	24.1	24.3	24.3	23.3	20.1	15.7	12.0



Source : Department of Hydrology and Meteorology

FIGURE 9.14-2 MONTHLY RAINFALL



http://www.dhm.gov.np/uploads/climatic/1002508489Monsoon Monitoring 18july2014.pdf

FIGURE 9.14-3 CUMULATIVE RAINFALL FROM JUNE 1, 2014

9.14.2 Water Usage in the Study Area

(1) Hydrological investigation results

Hydrological investigation was carried out in the end of July. Water quality and quantity are shown in the **APP NO. 11-a of the Preliminary Design Drawing Sheets**. Because it was carried out during the rainy season, the flow rate was higher relatively.

There are many intake pipes from the stream. They have been used as agricultural water and domestic water. Utilization of many wells has been confirmed in the tunnel route near the top of the valley.（see **NO. 11-b of the Preliminary Design Drawing Sheets**）

PH and EC of wells are shown in **NO.11-c and NO.11-d of the Preliminary Design Drawing Sheets** respectively.

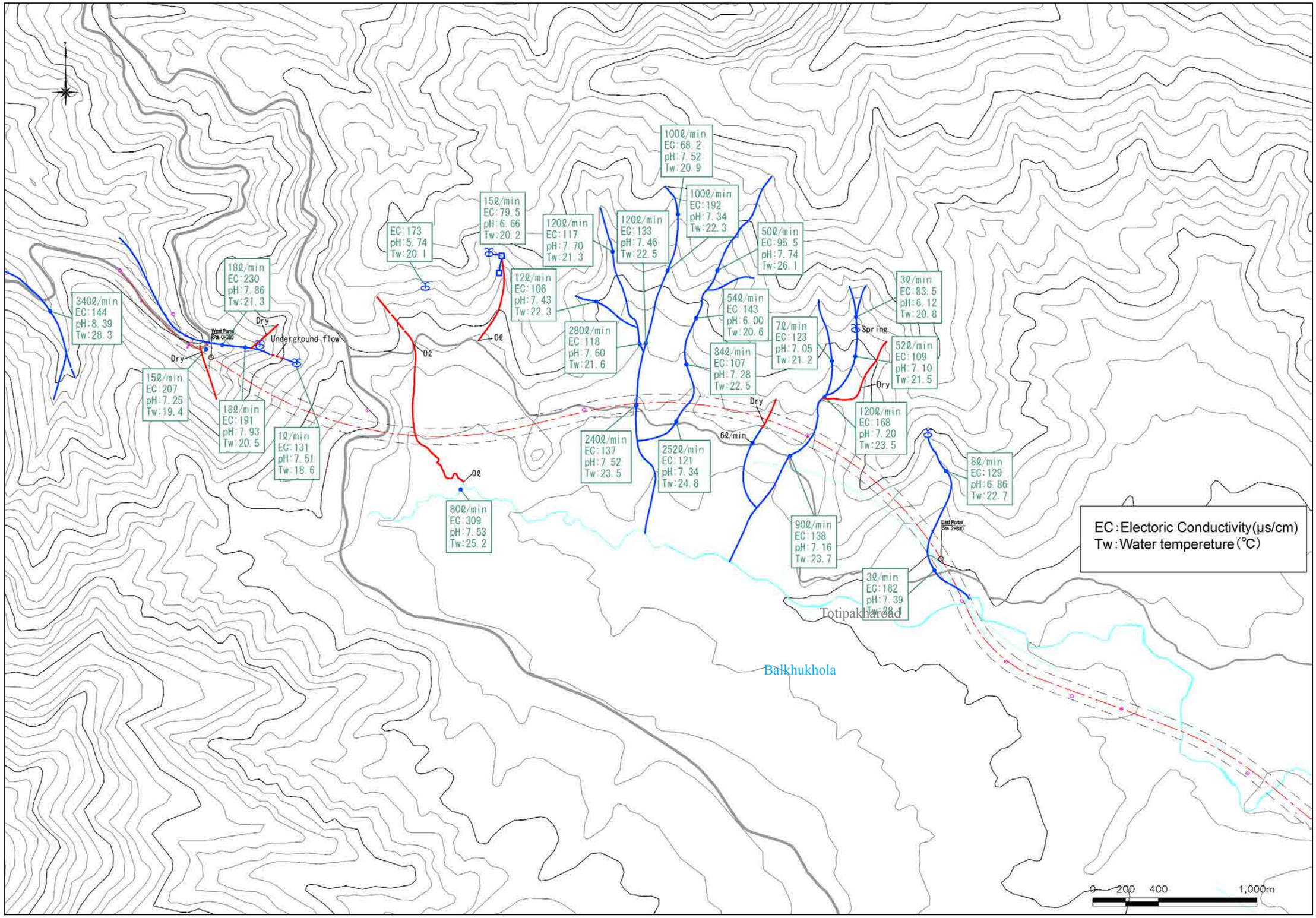
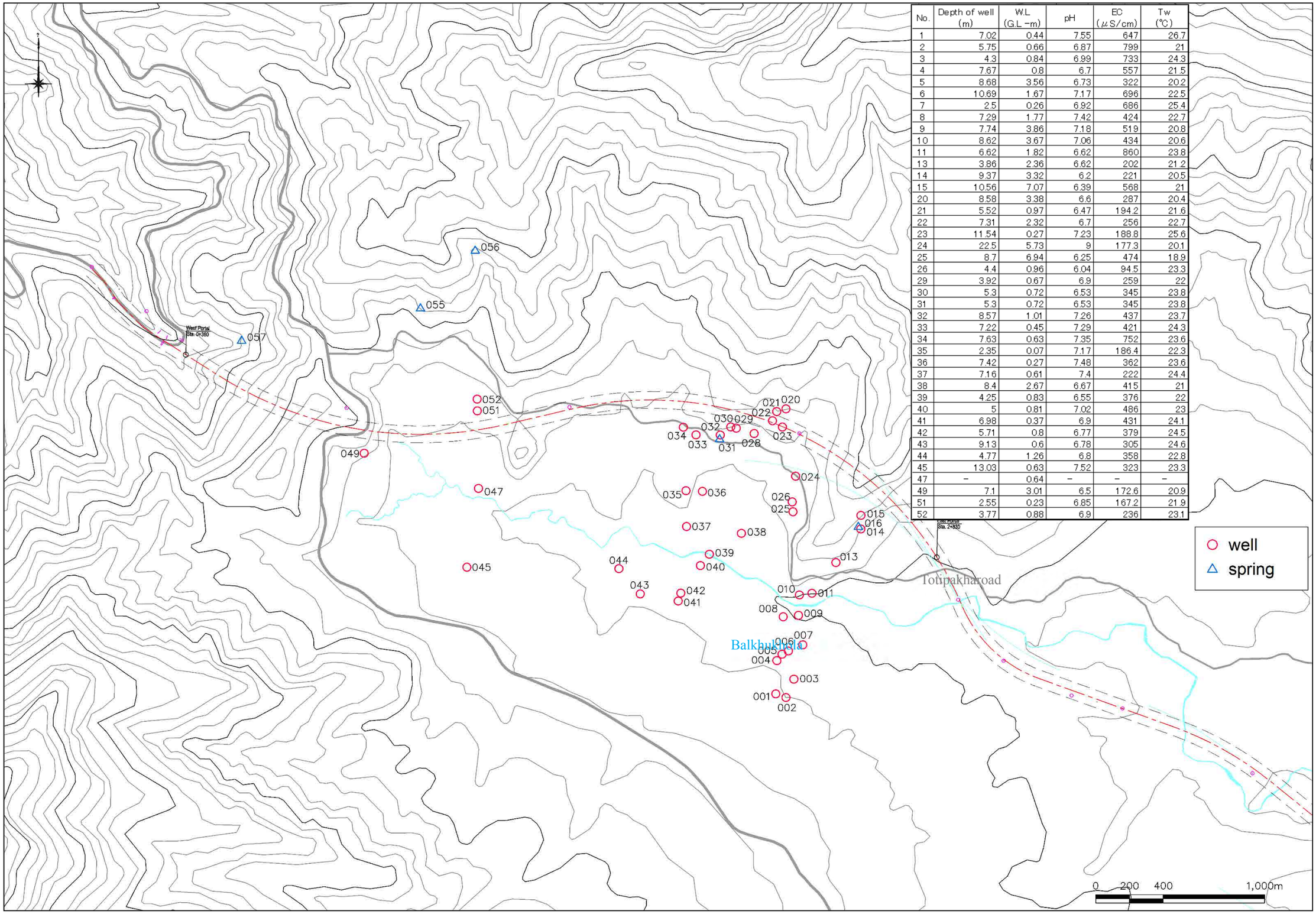


FIGURE 9.14-4 HYDROLOGICAL EXPLORATION RESULTS



No.	Depth of well (m)	W.L (G.L −m)	pH	EC (μS/cm)	Tw (℃)
1	7.02	0.44	7.55	647	26.7
2	5.75	0.66	6.87	799	21
3	4.3	0.84	6.99	733	24.3
4	7.67	0.8	6.7	557	21.5
5	8.68	3.56	6.73	322	20.2
6	10.69	1.67	7.17	696	22.5
7	2.5	0.26	6.92	686	25.4
8	7.29	1.77	7.42	424	22.7
9	7.74	3.86	7.18	519	20.8
10	8.62	3.67	7.06	434	20.6
11	6.62	1.82	6.62	860	23.8
13	3.86	2.36	6.62	202	21.2
14	9.37	3.32	6.2	221	20.5
15	10.56	7.07	6.39	568	21
20	8.58	3.38	6.6	287	20.4
21	5.52	0.97	6.47	194.2	21.6
22	7.31	2.32	6.7	256	22.7
23	11.54	0.27	7.23	188.8	25.6
24	22.5	5.73	9	177.3	20.1
25	8.7	6.94	6.25	474	18.9
26	4.4	0.96	6.04	94.5	23.3
29	3.92	0.67	6.9	259	22
30	5.3	0.72	6.53	345	23.8
31	5.3	0.72	6.53	345	23.8
32	8.57	1.01	7.26	437	23.7
33	7.22	0.45	7.29	421	24.3
34	7.63	0.63	7.35	752	23.6
35	2.35	0.07	7.17	186.4	22.3
36	7.42	0.27	7.48	362	23.6
37	7.16	0.61	7.4	222	24.4
38	8.4	2.67	6.67	415	21
39	4.25	0.83	6.55	376	22
40	5	0.81	7.02	486	23
41	6.98	0.37	6.9	431	24.1
42	5.71	0.8	6.77	379	24.5
43	9.13	0.6	6.78	305	24.6
44	4.77	1.26	6.8	358	22.8
45	13.03	0.63	7.52	323	23.3
47	–	0.64	–	–	–
49	7.1	3.01	6.5	172.6	20.9
51	2.55	0.23	6.85	167.2	21.9
52	3.77	0.88	6.9	236	23.1

FIGURE 9.14-5 WATER SOURCE LOCATION MAP

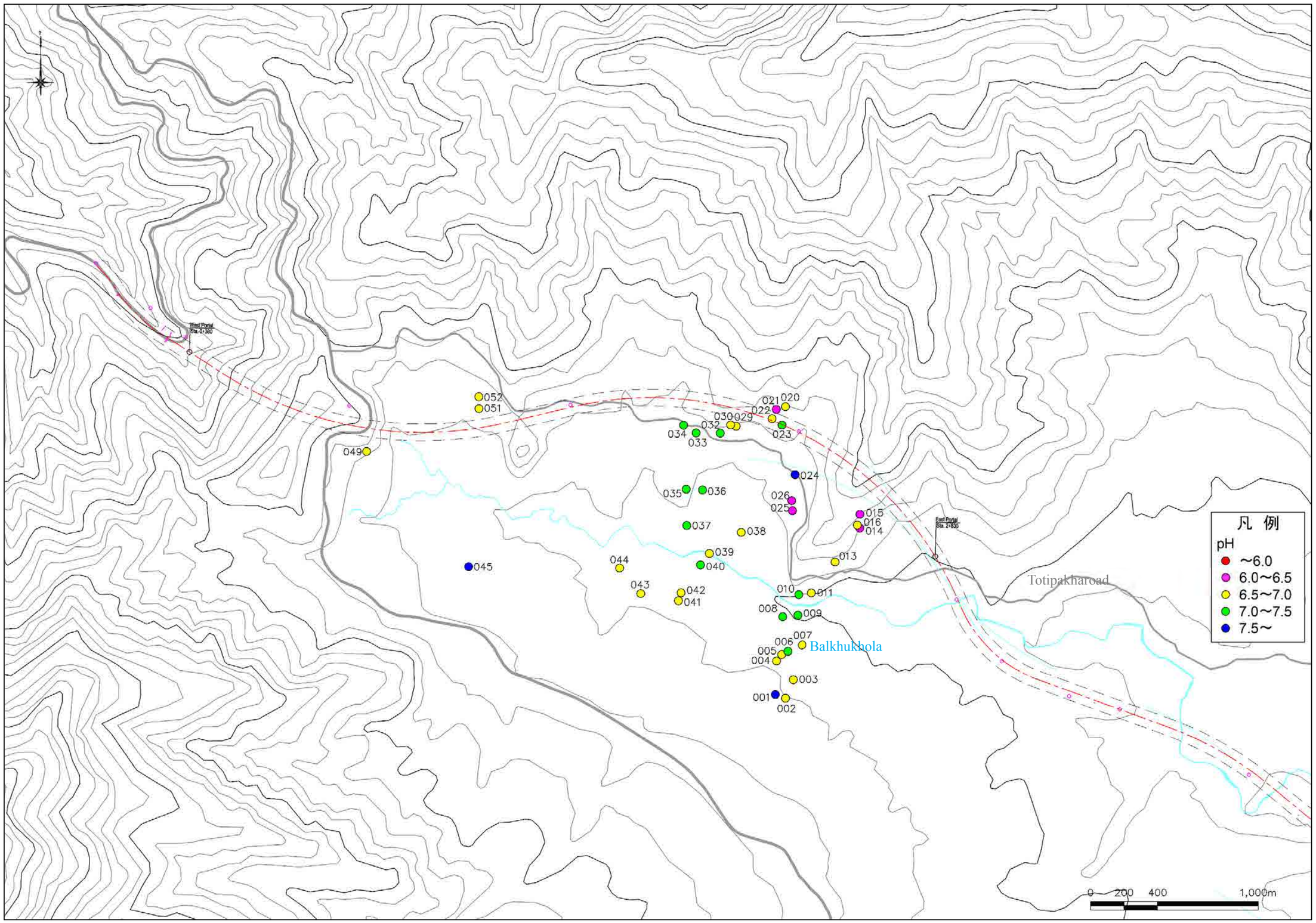


FIGURE 9.14-6 WATER QUALITY OF THE WELL (PH)

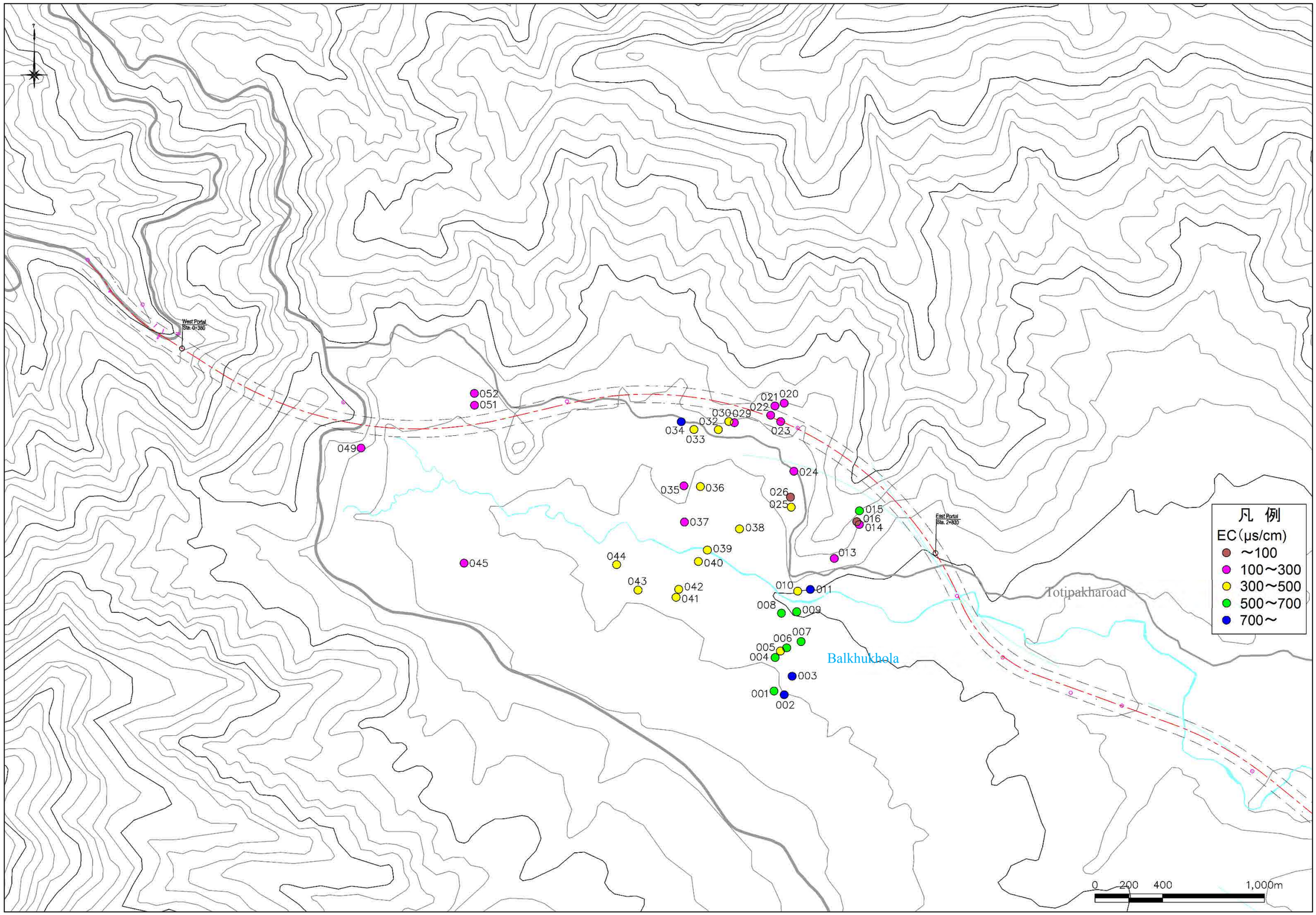


FIGURE 9.14-7 WATER QUALITY OF THE WELL (EC)

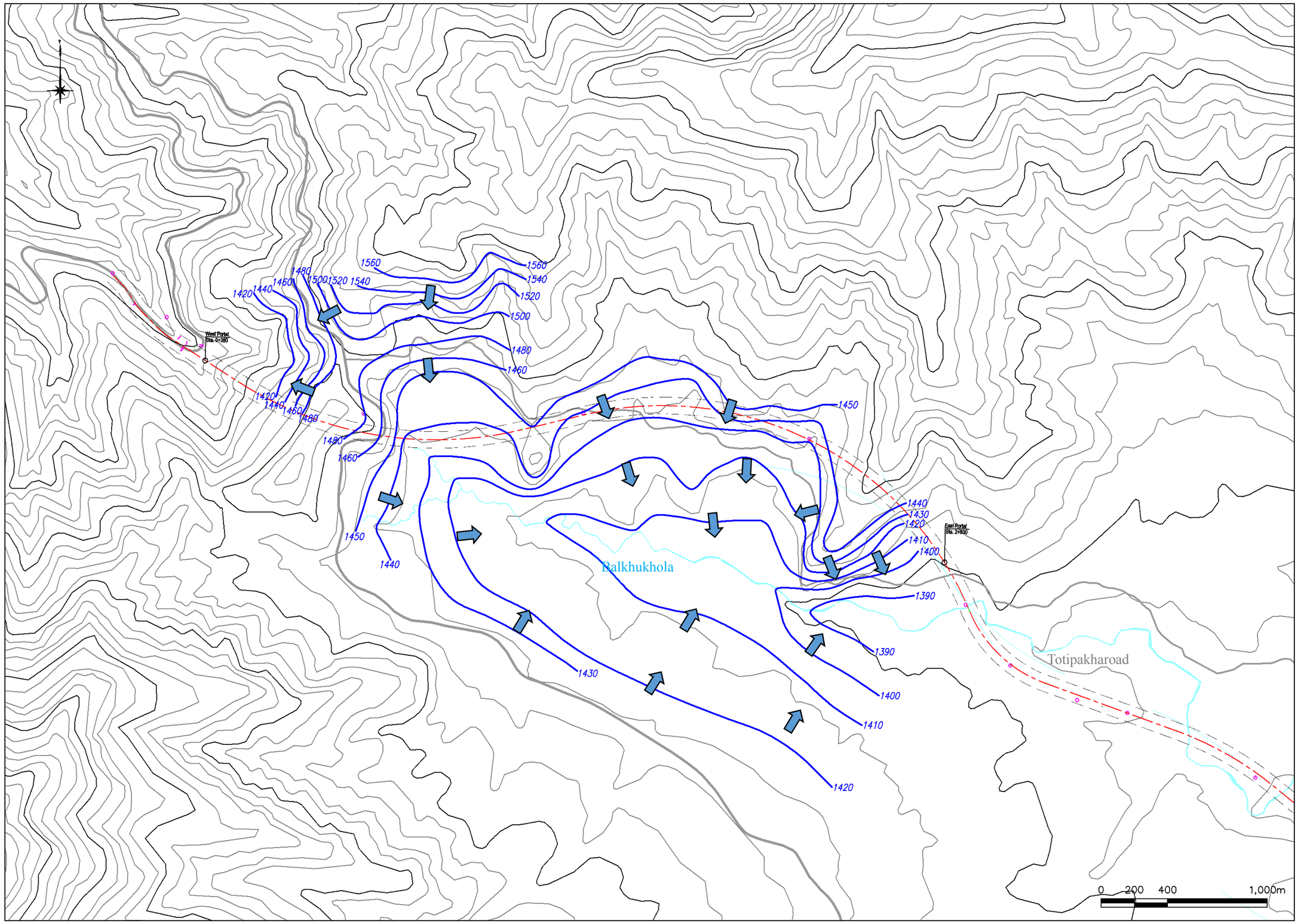


FIGURE 9.14-8 GROUNDWATER LEVEL CONTOUR MAP

(2) Water usage of each basin

Tentatively water basins are divided into 5 locations as is shown in **Figure 9.14-9**.

FIGURE 9.14-9 BASIN CLASSIFICATION

1) A area

【Drinking water】

Drinking water is from well water or spring water.

【Agricultural water】

Due to the utilization of water for domestic use in the upstream area, water does not flow through the streams. Therefore, paddy field is small.

2) B area

【Drinking water】

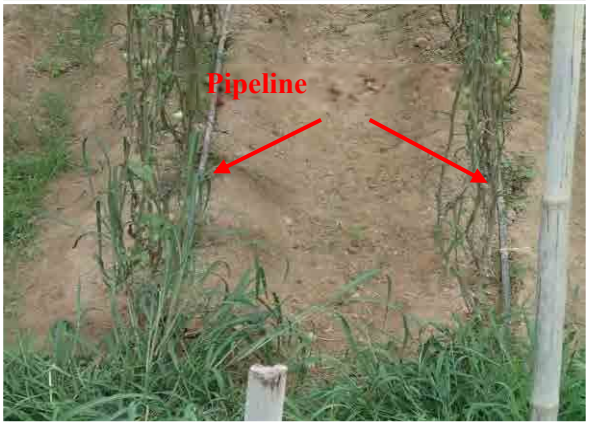
Drinking water is often from wells until near 100m upstream from the Totipakha Road. In the higher locations upstream of it, drinking water is from water of stream.

【Agricultural water】

Tomato cultivation is a thriving place. Tomato cultivation makes use of the water of the stream. There are a lot of paddy fields, there is a water use of the stream.

【Water use of other】

There is a large pond upstream, it is used as a venue for training fish farm.



3) C area

【Drinking water】

Residents of this watershed are using spring water or stream. There is information that has water conveyance from afar.

【Agricultural water】

There is water in the stream, paddies irrigated area is wide.

4) D area

【Drinking water】

They are using the spring water in the upstream of the stream.

【Agricultural water】

Stream water can be seen only after rainfalls. There is a paddy field on the downstream side of the Totipakha road, They are irrigated with rainfall.

5) E area

【Drinking water】

The use of the spring water.

【Agricultural water】

Not farmland.

9.14.3 Study of Groundwater Lowering Range

(1) Hydrological Method of Takahashi

A rough estimation of groundwater lowering due to tunnel excavation was done by using Takahashi's method which is one of Hydrological methods. The catchment area of the tunnel approximates the shape and size of the basin with the flow path length comparable to the tunnel length. This method consists of empirical rules. Hydrological method is represented by the average permeability around the shape of the basin.

$$Kt = R^2/6H \quad (Kt: \text{Average permeability})$$

$$R = A/2L$$

R : Average basin width

A : Basin area (m^2)

L : Flow pass length (m)

H : Relative elevation difference (m)

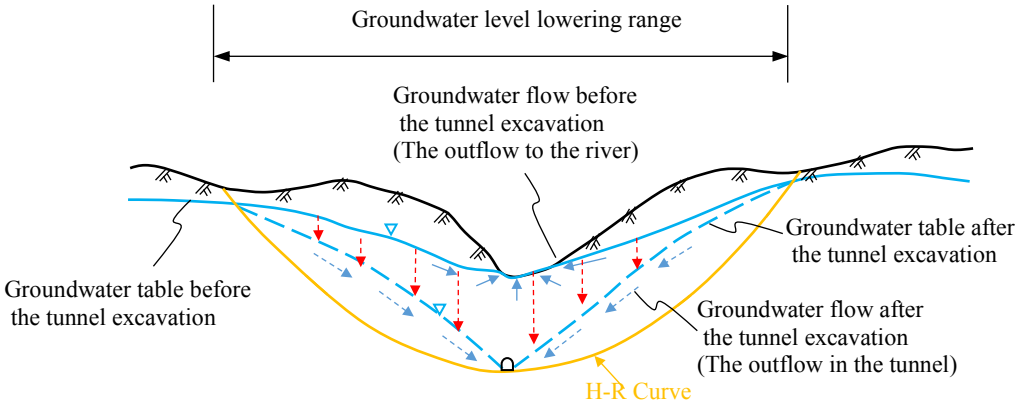


FIGURE 9.14-10 CONCEPT OF GROUNDWATER LOWERING RANGE BY HYDROLOGICAL METHODS

(2) Groundwater lowing range of the tunnel due to hydrological methods

The groundwater lowing range was studied in two representative basin close to the tunnel.

A basin：Kt = 76.2 （L=865m A=253,788m^2 H=47.1m）

B basin：Kt = 82.1 （L=955m A=433,418m^2 H=104.5m）

As is shown in the drawing (**APP NO. 11-d of Preliminary Design Drawing Sheets Preliminary Design Drawing Sheets**) that area of the groundwater lowering are very wide. However, the model is a very simplified model and actual geological condition in the area differs very much from the model. Geological structure is sub-parallel to the tunnel axis and bedding planes of the strata are sub-vertical dipping north or south due to minor foldings. Strata consist of alternation of sandstones and slates where slates are generally impervious. Thus groundwater may infiltrate from the sandstone layers vertically and migration of groundwater in lateral direction which cut the bedding planes hardly occurs. Moreover, as are shown in the **App. 9c and 9d of the Preliminary Design Drawings**, there develop impervious clay layers which limit the movement of the groundwater surrounding the tunnel. Thus order of lowering of groundwater level due to tunnel excavation is supposed to be not so large. The matter shall be further studied in Detail Design Stage because it relates to the manner and quantity of chemical injection during tunneling which significantly affects the tunnel cost and construction time.

9.14.4 The drought management consideration by groundwater lowering

There is a possibility that the groundwater level is lowered by the tunnel excavation. Therefore, it may be necessary to consider beforehand about the drought management. There are permanent measures and emergency measures for drought management.

(1) Measures for drinking water

Water trucks may be used in emergency cases.

As for permanent measures there are several ways;

① Headrace from a nearby stream

→ It is very difficult to design any headrace because there is little water in a nearby stream.

② Development of a new well

→ There is a possibility near Balkhukhola or the opposite bank of the Balkhukhola. It requires pumping up systems and piping systems to distribute the water to wide spread area where inhabitants live.

③ Horizontal boring to the mountain

→ It is very difficult to determine where to make drilling as well as it may affect the present

water use.

The potential is a new well development in the second.

It may be possible to newly develop wells but it should be studied and prepared before construction starts.

(2) Measures for Agricultural water

Flow rate of the stream is less when there is no rainfall. Therefore, paddy irrigation relies on rainfall. It is possible that the flow rate of the stream is reduced by the tunnel excavation. But paddy irrigation may be possible. However, it should be noted that there is a spring water in the paddy fields of the downstream side of the Totipakharoad.

There is an item of some permanent measures.

① Development of a new well---unrealistic

② Pond Construction---very difficult

③ Crop substitution compensation

④ Compensation in money

⑤ Alternate site compensation

It is necessary to examine the measures in accordance with the situation.

(3) PROPOSAL OF PERIODIC OBSERVATION

Periodic monitoring of wells are necessary during construction in order to grasp the lowering of groundwater by tunnel excavation. Periodic observations measure water level, flow rate and water quality. Periodically monitoring points are shown in the **APP NO. 11-d of Preliminary Design Drawing Sheets**. Monitoring shall be done for wells at the left bank of the river.

9.15 PROJECT RISKS AND OTHER ISSUES TO BE STUDIED FURTHER

9.15.1 PROJECT RISKS

(1) Construction risks

1) Tunneling is an underground activity where complete geotechnical conditions generally are not foreseen at the design stage. Moreover, due to the difficulty to carry out seismic refraction survey and the lack of proper equipment for exploration drilling, condition of rock mass and distribution of classes of tunnel types may differ from the supposition in our current design and international design team shall carry out above investigations in their early stage of detail design to make it clearer.

2) It is anticipated that surface water flows in the valley areas and groundwater level are lowered by tunneling to some extent. Groundwater being extracted from wells and surface water are utilized for domestic use and agricultural use and significant shortage of water may cause serious problem for the implementation of the project. Groundwater monitoring shall be continued throughout the detail design stage and construction stage and adequate measures against water shortage when it occurs shall be studied during detail design stage.

3) To minimize construction risks the prequalification of contractors should focus on their technical capabilities in handling similar works. Especially their experience of tunneling in difficult ground with employment of particular auxiliary methods shall be carefully considered.

4) The implementation of the project requires substantial land acquisition and resettlement. On some recent infrastructure projects in Nepal delays in completing resettlement has led to delays in project implementation.

(2) Operation Risks

Characteristics of drivers' driving manners and vehicle characteristics are as follows;

(a) Drivers try to overtake slow moving vehicles, even using space of an opposite direction lane. If this kind of driving is practiced inside the tunnel, there is a high risk of fatal traffic accident.

(b) There are many old trucks and they often stop on the road due to breakdown of vehicle. Breakdown vehicles are particularly observed at up-grade sections. Currently they stop at a shoulder or at an emergency bay.

(c) High rate of old model of vehicles causes high rate gas emission which affects visibility and high contents of CO, NOx, etc. inside a tunnel.

Tunnel cross section and facilities were planned and designed in due consideration of above drivers' and vehicles' characteristics.

During the detailed design, the following should be considered;

1) To cope with (a) and (b) above, study lane width and shoulder width

This Study :	Upgrade direction	3.5m + 2.5m (shoulder) = 6.0m
	Downgrade direction	3.5m + 0.5m (shoulder) = 4.0m

Possible Alternatives to be studied during the detailed design are;

- To specify 2.5m shoulder as a climbing lane and all trucks shall utilize a climbing lane.
- To widen a climbing lane to 3.0m instead of 2.5m (tunnel cross section is to be widened by 0.5m or use carriageway width of 3.25m).
- To install flexible plastic poles at a center line to avoid vehicle to use the opposite lane.

2) To cope with (c) above, review ventilation system

This Study :	In due consideration of present vehicle condition, number of jet fans, visibility meters, CO meters, etc. were planned.
Detailed Design :	Review number of jet fans, etc., carefully in due consideration of vehicle conditions.

3) To operate a tunnel safely, one of the most important issues is to educate the drivers prior to opening of a tunnel. Under the Capacity Development Program, the Traffic Safety Campaign is planned. This campaign should be continuously implemented even after a tunnel opened to traffic by the Tunnel Management Office.

4) Timely implementation of maintenance work such as pavement markings, cleaning of lighting facilities, etc., shall be implemented regularly and whenever identified as necessary. Tolls are collected from tunnel users, thus, Tunnel Management Office must provide high quality of tunnel facilities.

9.15.2 Important issues to be further studied in DD stage

(1) Prevention of lowering of groundwater level

In the preliminary design of the tunnel chemical injection is designed in type D1-b and D2-a by utilizing the AGF method for all the surrounding periphery of the tunnel as well as additional chemical injection from the shotcrete surface where water inflows are observed after excavation.

However, when the geological condition is taken into account that strikes of the strata are sub-

parallel to the tunnel axis and dips are generally in high angle to the north or to the south depending on minor folds, groundwater may perforate into the fissures in the sandstones in vertical direction and due to the thin alternation of sandstone and shale in which shale is impervious groundwater may not migrate to lateral direction across the bedding planes.

If this is the case then waterproofing by chemical injection may be OK to be carried out along the periphery of the tunnel arch instead of along all the periphery of the tunnel. It may reduce the construction cost and time drastically.

It is strongly recommended to the DD designers to further study on this point after getting results of seismic refraction survey and drilling surveys. Seismic survey may reveal the depth of the debris above the rock mass. Some of drilling surveys shall be done in short length in the rock perpendicular to the tunnel axis to confirm the strikes of the rock to be sub-parallel to tunnel axis. Thus, adequate hydrological model can be established and proper chemical injection design can be recommended.

Schematic geologic and hydrologic model is shown in **APP. NO. 9-c and 9-d of Preliminary Design Drawing Sheets**.

(2) Ground treatment at the eastern portal area

Chemical injection from the surface is designed at eastern portal area in order to minimize the lowering of groundwater level here. Along the tunnel and road axis talus deposits distribute above the weathered rock mass. Groundwater is supposed to be trapped in weathered rock mass as pressurized groundwater in the area from the drilling result of TC1 which was carried out at the Data Collection Survey stage. However, in the talus deposit groundwater was hardly detected during auger drilling survey in portal area, which may imply that talus deposits contain high amount of very small particles.

It is recommended in DD stage to excavate a pit near the portal to ensure whether talus deposit is impervious or not and if lower part of talus deposit contains groundwater. If groundwater is supposed to be accumulated and trapped only in the uppermost weathered part of the rock mass, then total length of the chemical injection treatment from the surface can be significantly reduced. The treatment may target the zones from the lower part of talus deposits to weathered rock mass till 3m coverage of treated zones are obtained beneath the tunnel base.

(3) Review of longitudinal geological profile of the tunnel

Due to the difficulty in carrying out seismic survey, dynamites are strictly controlled by the army, and lack of adequate equipment for core drilling there are uncertainties in longitudinal geological profile. Thus in the preliminary design tunnel is designed based on supposition that rock mass may be somewhat inferior than is seen in outcrops. In DD stage seismic survey shall be carried out in very early stage and core drilling shall be carried out equipped with adequate double core tubes to make the longitudinal geological profile more accurate.

(4) Monitoring of groundwater level and preparation of adequate measures for water shortage

Wells and springs to be monitored during construction stage are shown in **APP. NO. 11-d of Preliminary Design Drawing Sheets**. There are 52 numbers of wells and springs in the figure but only the left bank ones of the Ghate Khola shall be monitored. Groundwater level may be lowered to some extent during tunneling due to the water inflow from sandstones, however, owing to the chemical injection accompanied with AGF rate of ingress of groundwater is deemed to be small and after completion of the tunnel construction groundwater level is expected to recover to the original level.

However, during monitoring of groundwater level when significant lowering of groundwater level occurs and it affects domestic water use significantly adequate measures shall be taken to mitigate the situation. DD designers are recommended to prepare adequate temporary water supply measures to be adopted in case of significant water shortage occurrence.

(5) Review of alignment in western portal outlet in view of traffic safety

In the preliminary design road to the western direction is descending by 3.22% in the tunnel till 0+200 followed by about 6.3% from here on to the west and meets a signal location where relocated existing road intersects with the new road.

For the safety of traffic following two points shall be further studied in DD stage.

First one is traffic safety at signal location. New road including tunnel is of very high graded road with much better pavement than is now and traffic is supposed to descend the new road in fairly high speed. However, most of vehicles are of very old ones and most of the drivers has no experience with signaling it is very doubtful whether vehicles can stop properly at the signal. This is also the case for vehicles from existing road.

Second one is that in the vicinity of tunnel outlet vehicles from existing road may occasionally plunge into the new road due to very small descending curve with gradient of 5%.

Due to the short duration for the preliminary study our team only could follow the selected alignment. Above two issues may not be adequately resolved without shifting the tunnel portal and alignment to some other location, which requires additional topographical survey and geological investigations.

(6) Requirement of emergency escape measures

According to Japanese Standards, provision of an evacuation tunnel or escape shelter or similar measures is mandatory for tunnels longer than 3.0km. The length of Nagdhunga Tunnel is 2.5km and fundamentally does not require such provisions. However, the GON requested the Survey Team to conduct a study on the evacuation method as considering the present condition of vehicles and driving manner of Nepal, provision of such facility is inevitable. They said they became aware of the need after observing such facility in one of the tunnels being constructed in Japan during the visit study to Japan in August. In addition GON said provision of such measure also necessitates from the fact that Nagdhunga Tunnel- potentially being the first highway tunnel in the history of Nepal- will hopefully be a model project for other similar projects, such measure are desirable to be undertaken. Following the request from the GON, the Survey Team conducted a study of different methods as shown in **Table 9.15-1**. The Survey Team recommended **Case-4** and suggests further study in the detailed design stage.

9.15.3 Important issues to Construction stage

(1) Flexible Action for Change Order

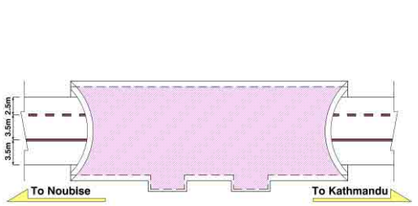
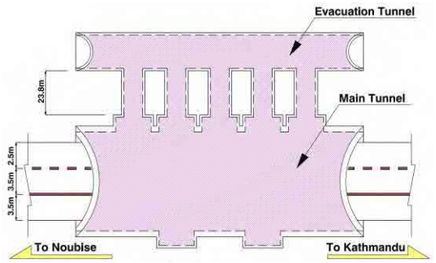
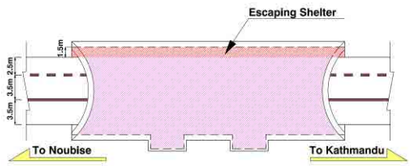
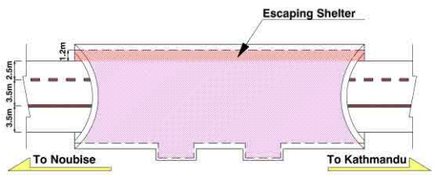
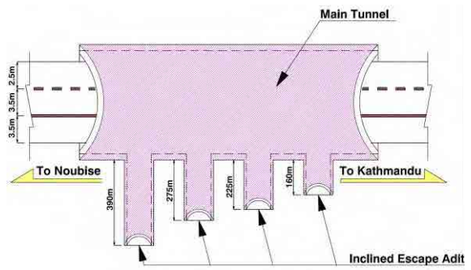
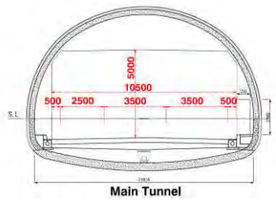
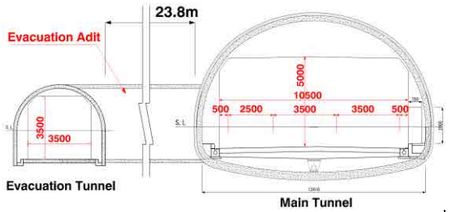
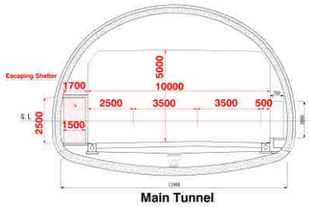
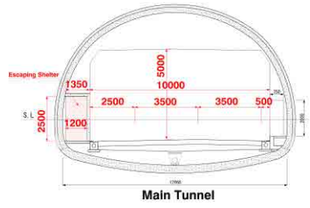
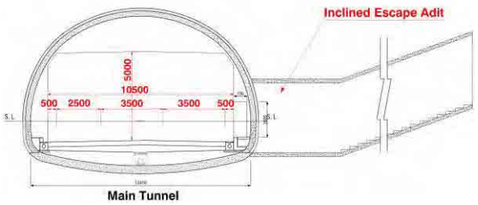
Tunnel construction methods highly depend on the geological conditions, accordingly construction cost varies drastically. Even though detailed geological survey is undertaken, it is impossible to reveal exact geological condition and it can only be known during construction. It is also true that it is quite difficult and unrealistic to stop tunneling work during construction and it should be continued.

In view of above, one of the most important considerations on tunnel construction is that the Government can approve change order(s) based on the recommendations of the Consultant as soon as the unexpected geological conditions are found. The contract of tunnel project should clearly specify the above conditions so that the bidders can be able to bid based on the fare price without taking account of changes of geological condition.

There will be plus or minus change orders. In anticipation of plus change orders, GON shall prepare sufficient budget for the Project with the anticipation of change orders. Price contingency and physical contingency should be included in the annual budget. In case that the allocated budget for the Project is found to be insufficient, DOR shall realign the budget of other projects in order for this tunnel project to be continued even under unexpected geological conditions.

Above these project risks and issues were summarized in **Section 17.6** with other risks.

TABLE 9.15-1 NAGDHUNGA TUNNEL OPTION COMPARISON

Case	**Case-1** **Main Tunnel (Base Plan)** (Road Width=0.5m+2.5m+3.5m+3.5m+0.5m)	**Case-2** **Main Tunnel (Base Plan)** **+Evacuation Tunnel** (Road Width =0.5m+2.5m+3.5m+3.5m+0.5m)	**Case-3** **Main Tunnel (0.5m Expansion)** **+Escaping Shelter(W=1.5m)** (Road Width=2.5m+3.5m+3.5m+0.5m)	**Case-4** **Main Tunnel (Base Plan)** **+Escaping Shelter(W=1.2m)** (Road Width=2.5m+3.5m+3.5m+0.5m)	**Case-5** **Main Tunnel (Base Plan)** **+Inclined Escape Adit** (Road Width=0.5m+2.5m+3.5m+3.5m+0.5m)
Plan					
Cross Section					
Safety Facilities Concept	➢ In case of happening the vehicle trouble, emergency parking bay can be utilized.	➢ In case of happening the vehicle trouble, emergency parking bay can be utilized. ➢ In case of happening serious traffic accidents like fire accident, escape of tunnel users and passing the evacuation vehicles are possible by utilizing evacuation tunnel.	➢ In case of happening the vehicle trouble, emergency parking bay can be utilized. ➢ In case of happening serious traffic accidents like fire accident, escape of tunnel users is possible by utilizing escaping shelter.(Adult two people can run in parallel)	➢ In case of happening the vehicle trouble, emergency parking bay can be utilized. ➢ In case of happening serious traffic accidents like fire accident, escape of tunnel users is possible by utilizing escaping shelter.(A adult and a child can run in parallel)	➢ In case of happening the vehicle trouble, emergency parking bay can be utilized. ➢ In case of happening serious traffic accidents like fire accident, escape of tunnel users is possible by utilizing inclined escape adit.(Evacuation vehicle can not pass)
Main Tunnel Cross Sectional Area	Main Tunnel: 89.25m^2 (Base Case)	Main Tunnel: 89.25m^2 Evacuation Tunnel: 19.56m^2 Total: 108.81m^2 (+19.23m^2) or (1.21)	Main Tunnel: 95.17m^2 (+5.92m^2) or (1.07)	Main Tunnel: 89.58m^2 +0.29m^2) or (1.01)	Main Tunnel: 89.25m^2 Inclined Escape Adit: 19.56m^2 Total: 108.81m^2 (+19.23m^2) or (1.21)
Cost (2014 Price) (Without VAT)	Main Tunnel: 10,626 Million JPY (Base Case)	Main Tunnel: 10,626 Million JPY Evacuation Tunnel: 3,349 Million JPY Total: 13,975 Million JPY (3,349 Million JPY） or (1.32)	Main Tunnel: 12,860 Million JPY Escaping Shelter: 123 Million JPY Total: 12,983 Million JPY (+2,357 Million JPY） or (1.22)	Main Tunnel: 10,626 Million JPY Escaping Shelter: 99 Million JPY Total: 10,725 Million JPY (+99 Million JPY） or (1.01)	Main Tunnel: 10,626 Million JPY Inclined Escape Adit: 4,179 Million JPY Total: 14,805 Million JPY (4,179 Million JPY） or (1.39)
Construction Period	43.0 months（Base Case）	43.0 months（+0.0 month）	44.0 months（+1.0 month）	43.0 months（+0.0 month）	43.0 months（+0.0 month）
Other	– No safety measures are yet considered.	– Evacuation tunnel L=2.45km, H=3.5m, width=3.5m, 5 adits 500m interval – Emergency vehicle for rescue and fire fighting can pass Evacuation Tunnel. – In case of another 2-lane tunnel required, Evacuation Tunnel can be utilized as a part of additional Main Tunnel.	– Escaping Shelter width of 1.5m provided.	– Minimum Escaping Shelter width of 1.2m provided.	– 4 Inclined Escape Adits are provided.
Recommendation				**Recommended**	

CHAPTER 10

PRELIMINARY DESIGN OF APPROACH ROAD

CHAPTER 10
PRELIMINARY DESIGN OF APPROACH ROAD

10.1 GEOLOGICAL INVESTIGATON UNDERTAKEN

10.1.1 Survey Area

The geological investigation was carried out for the selected alignment of part of Tribhuvan Highway as shown in **Figure 10.1-1**. The road length for the survey is approximately 4.6km.

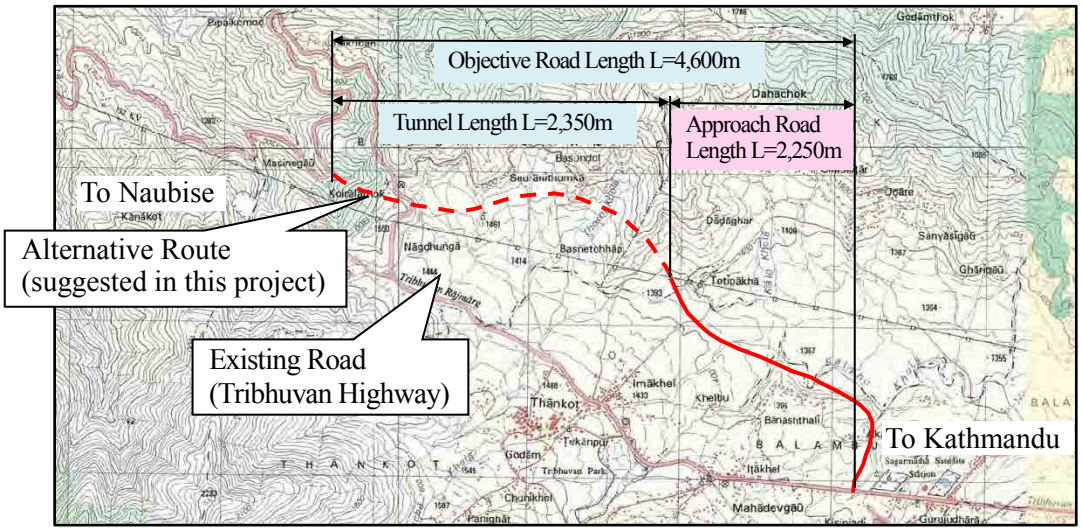


FIGURE 10.1-1 LOCATION MAP OF THE SURVEY AREA

(1) Geological Setting

As **Figure 10.1-1** shows, the investigation area is located in a wide valley of Balkhu Khola, which is one of tributaries of Bagmati River. This valley is underlain by basement rocks of Lower Paleozoic age. These basement rocks correspond stratigraphically to Phulchauki Group, and divided into three formations, namely Tistung Formation, Sopyang Formation and Chandragiri Limestone in ascending order.

The valley of Balkhu Khola composes the western part of Kathmandu Basin, and is filled with Quaternary fluvio-lacusrtine sediments. The basal part of the basin-fill sediments consists of lower Pleistocene lacustrine clays of Kalimati Formation. At the surface of the valley, Kalimati Formation is overlain by unconsolidated sediments of talus deposit and recent river deposit.

The geological map of the survey area is shown in **Figure 10.1-2**.

Lithological characteristics of the Lower Paleozoic basement rocks and the overlying Quaternary sediments are as follows;

[Phulchauki Group (Lower Paleozoic)]

1) **Tistung Formation:** The formation consists essentially of slates, phyllites, and meta-sandstone, being considered to be of early Cambrian age. The lower part of the formation consists of dark phyllites with fine biotite, which disappears or becomes inconspicuous at upper part. Sericite and chlorite are the dominant metamorphic minerals.

2) **The Sopyang Formation:** This formation is a transitional zone between the fine-grained clastic rocks of the Tistung Formation and the thick Chandragiri Limestone. It consists of softly weathered phyllitic slates, argillaceous limestone of black color. Worm tracks on the bedding planes of slate have been reported

3) **Chandragiri Limestone:** Limestone is the most prominent formation of the Phulchauki

Group. It consists of wellbedded to massive weathered limestone. In the lower part, the limestone is more thinly bedded to more argillaceous. The formation contains conodonts and echinoderms indicating Middle Cambrian and Middle-Late Ordovician age.

[Quaternary]

1) **Kalimati Formation:** The Kalimati Formation (or Kalimati Clay) is mainly composed of thick black lacustrine clay, which is rich in organic matter, diatoms, plant fossils and natural gases.

2) **Talus deposits:** In foothill slopes, unconsolidated clay, silt and sand to boulders of variable thickness compose the inhomogeneous deposits.

3) **River deposits:** The recent alluvial sediments, which are composed of sand, gravel to boulder, and distributed in flood plains and lower alluvial terraces.

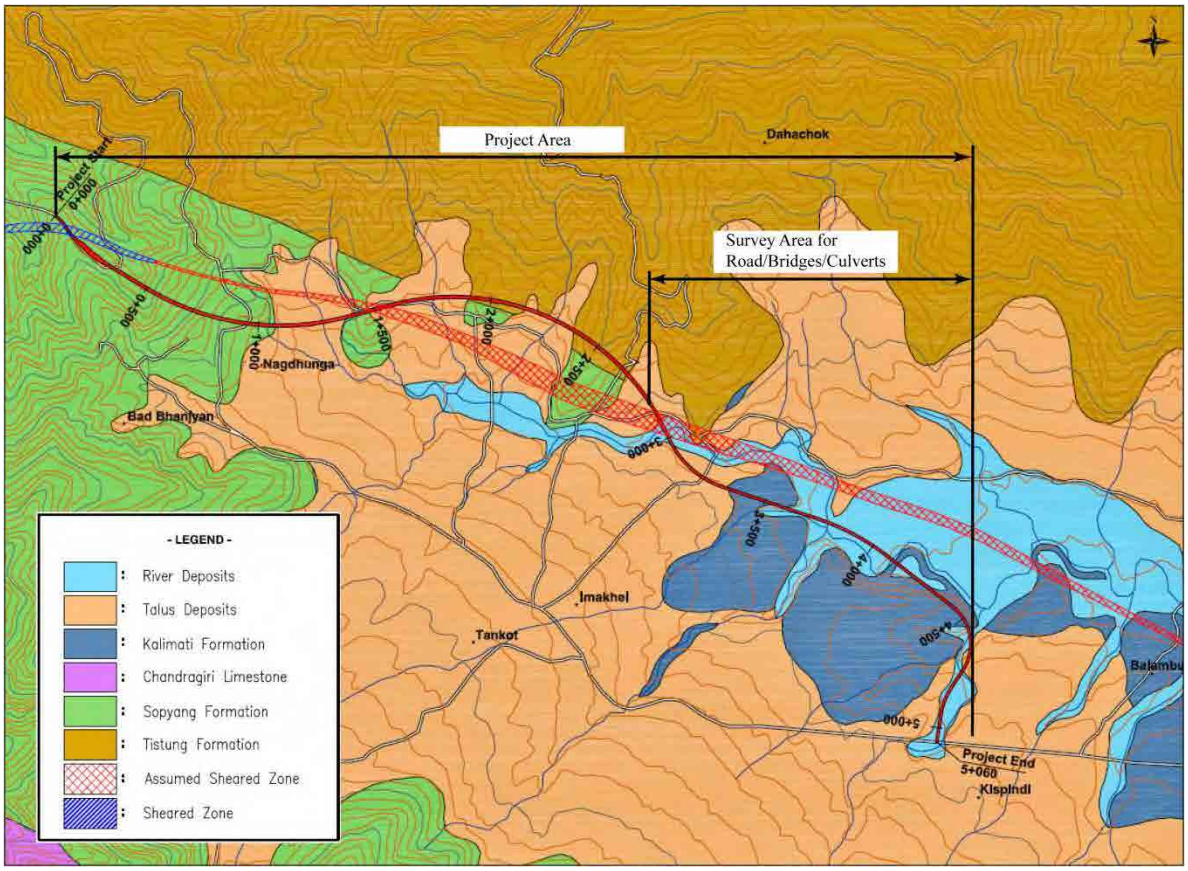
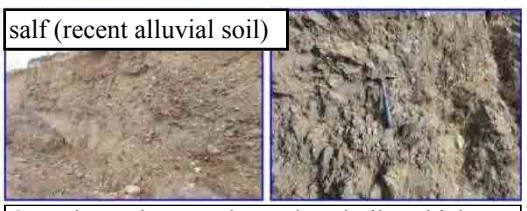


FIGURE 10.1-2 GEOLOGICAL MAP OF STUDY AREA

Focusing on the study area for an approach road and bridges/culverts, the area is relatively flat and Quaternary clay and silt is distributed. Also, the area is accumulated by alluvial fan deposits composed of gravel. The detail of Quaternary feature (salf, klm) is shown in **Figure 10.1-3**.



Gravel, sandy gravel, sand and silt: Thickness increases towards the center of the fan. Finer grained material increases towards the margin.

Gray to dark silty clay and clayey silt: Organic clay, fine sand bed sand peat layers are common. Total thickness is up 450mm or more.

FIGURE 10.1-3 LOCATION MAP OF STUDY/SURVEY AREA

(2) Objective of the Geotechnical Investigation

The objective of the investigation was to determine the geotechnical properties of the sediments which are distributed along the planned route of the approach road. Rotary drillings and the standard penetration tests (SPT) were carried out to identify the characteristics of the ground as the foundation of bridges and culverts. Soil samples for laboratory tests were obtained from drilling cores. Also test-pits and auger-borings had were carried out to obtain the samples of laboratory tests to analyze soil parameters as materials and foundations for the road construction.

(3) Scope of Work

Items and quantities of the geological investigation are shown in **Table 10.1-1**. Also, the locations of each investigation are indicated as follows;

1) Locations of borings for bridges/culverts: shown in **Figure 10.1-4**.

2) Locations of test-pits and auger-borings: shown in **Figure 10.1-5**.

Each geological investigation and laboratory tests were conducted in accordance with the relevant ASTM standard or equivalent standards shown in **Table 10.1-1**.

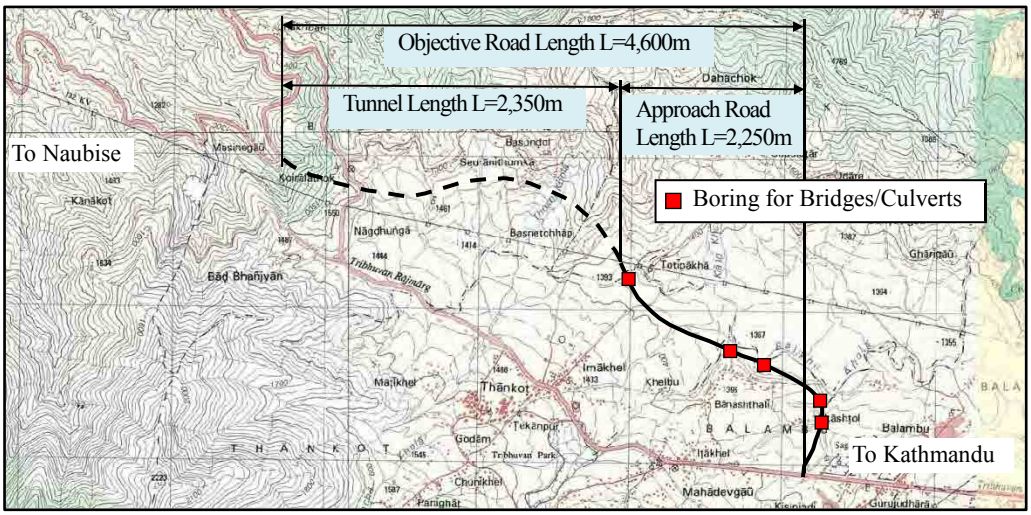


FIGURE 10.1-4 BORING LOCATIONS FOR BRIDGES/CULVERTS

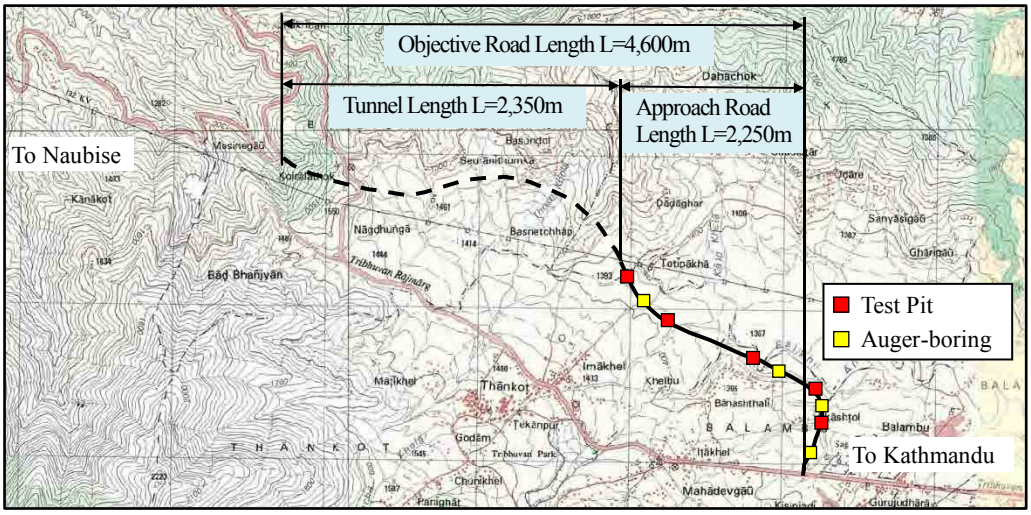


FIGURE 10.1-5 LOCATIONS OF TEST-PITS AND AUGER-BORINGS

TABLE 10.1-1 INVESTIGATION/TEST ITEMS AND QUANTITIES

Investigation/Test for the Bridge /Culvert Site					
Particulars			Qty	Unit	Applied Method
1.	Drilling (5BHs)		70	meter	ASTM D5434-03 / D2113-08
2.	Standard Penetration Test (SPT)		70	each	ASTM D1586-11
3.	Laboratory Test				
	1)	Specific gravity	5	sample	ASTM D854-14
	2)	Natural Moisture Content	5	sample	ASTM D2216-10
	3)	Grain size Distribution	5	sample	ASTM D422-63(2007)e1 / D2217-85(1998)
	4)	Soil Classification	5	sample	ASTM D2487-11
	5)	Atterberg limit	5	sample	ASTM D4318-10e1

Investigation /Test for the Approach Road Site					
Particulars			Qty	Unit	Applied Method
1.	Test Pit		5	pit	Excavation at 1.0 x 1.5 x 2.0m
2.	Auger Boring		14	point	ASTM D1452-09
3.	Laboratory Test				
	1)	Specific gravity	10	sample	ASTM D854-14
	2)	Natural moisture content	10	sample	ASTM D2216-10
	3)	Grain size distribution	10	sample	ASTM D2217-85(1998) / D421-85(2002)
	4)	Soil classification	10	sample	ASTM D2487-11
	5)	Atterberg limit	10	sample	ASTM D4318-10e1
	6)	Moisture-density relation	5	sample	ASTM D698-12e1
	7)	CBR	5	sample	D1883-99

Note; - Atterberg limit (Liquid limit and Plastic limit) of soil test was conducted only for cohesive soil.
- CBR test was conducted with samples obtained in the test pits.

10.1.2 Method of Investigation

(1) Rotary Drilling

Rotary drillings were carried out on the site of planned sites for bridges and culverts. As the investigated area is covered with unconsolidated sediments, mud drilling or rotary drilling without injecting water had been performed, and the standard penetration test (SPT) according to ASTM D-1586, at intervals of 1 meter (depth) in the borehole.

Drilled cores and SPT samples were placed in core boxes in a systematic manner for the logging. Photographs of core boxes of each borehole were taken and combined continuously in the sheets. Drilling logs and photographs of cores are included in the Final Report.

Geological survey include approach road, was performed in a range of 1 km or more left and right. Geological map is shown in **Figure 10.1-2**.

Before the implementation of rotary drilling, geological mapping and aerial photograph interpretation with scale of 1: 50,000 had been performed to analyze the geological structure of the basin-fill sediments.

(2) Standard Penetration Test (SPT)

The standard penetration test (SPT), according to ASTM D-1586, had been carried out at intervals of 1 meter depth in the borehole, until N-value of 300 or more (SPT blow count 50 or more/5 cm) is confirmed. The soil classification, tone of color, mixed matters, etc. of the soil samples which obtained by "Raymond-sampler" were recorded.

(3) Test-pit and Auger-boring

The subgrade investigation of the low embankment section by test-pit and auger-boring had been carried out. The test-pits and the auger-borings were performed alternately at about 500-meter interval.

Size of the test-pits were 1.5m in length, 1m in width and 2m in depth in principle, and the soil samples for the laboratory tests, such as CBR tests, were obtained.

The auger-boring had been drilled until 2 meter depth, and the soil samples for the laboratory tests were also obtained.

(4) Laboratory Test of Soil Samples

The laboratory test of soil samples according to the standards indicated in **Table 10.1-1**. And in addition to the above mentioned items, CBR (California Bearing Ratio) test had been carried out with samples obtained in the test pits.

1) **Specific Gravity (ASTM D854-14):** The test methods cover the determination of the specific gravity of soil solids that pass the 4.75-mm (No. 4) sieve, by means of a water pycnometer. When the soil contains particles larger than the 4.75-mm sieve, Test Method C127 shall be used for the soil solids retained on the 4.75-mm sieve and these test methods shall be used for the soil solids passing the 4.75-mm sieve.

2) **Natural Moisture Content (ASTM D2216-10):** The test methods cover the laboratory determination of the water (moisture) content by mass of soil, rock, and similar materials where the reduction in mass by drying is due to loss of water except.

3) **Grain Size Distribution (D421-85(2002)):** The test method covers the quantitative determination of the distribution of particle sizes in soils. The distribution of particle sizes larger than 75 μm (retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 μm is determined by a sedimentation process, using a hydrometer to secure the necessary data.

Grain Size Distribution (ASTM D2217-85(1998)): The practice covers the wet preparation of soil samples as received from the field for particle-size analysis and determination of soil constants. Procedure A provides for drying the field sample at a temperature not exceeding 140°F (60°C), making a wet separation on the No. 10 (2.00-mm) sieve, or No. 40 (425-[mu]m) sieve, or both, as needed, and finally drying at a temperature not exceeding 140°F. Procedure B provides that the sample shall be kept at moisture content equal to or greater than the natural water content. The procedure to be used should be indicated in the specification for the material being tested. If no procedure is specified, the provisions of Procedure B shall govern.

4) **Soil Classification (ASTM D2487-11):** This practice describes a system for classifying mineral and organo-mineral soils for engineering purposes based on laboratory determination of particle-size characteristics, liquid limit, and plasticity index and shall be used when precise classification is required.

5) **Atterberg Limit (ASTM D4318-10e1):** The liquid and plastic limits of a soil and its water content can be used to express its relative consistency or liquidity index. In addition, the plasticity index and the percentage finer than 2-μm particle size can be used to determine its activity number. The test methods cover the determination of the liquid limit, plastic limit, and the plasticity index of soils. Two methods for preparing test specimens are provided as follows:

- *Wet preparation method,*
- *Dry preparation method,*

In the case that no method was specified, the wet preparation method was used.

6) **Moisture-density Relation (ASTM D698-12e1):** The test methods cover laboratory compaction methods used to determine the relationship between molding water content and dry unit weight of soils (compaction curve) compacted in a 4 or 6-in. (101.6 or 152.4-mm) diameter mold with a 5.50-lbf (24.5-N) rammer dropped from a height of 12.0 in. (305 mm) producing a compactive effort of 12 400 ft-lbf/ft3 (600 kN-m/m^3).

7) **Moisture-Density Relation (ASTM D698-12e1):** The test methods cover laboratory compaction methods used to determine the relationship between molding water content and dry unit weight of soils (compaction curve) compacted in a 4 or 6-in. (101.6 or 152.4-mm) diameter mold with a 5.50-lbf (24.5-N) rammer dropped from a height of 12.0 in. (305 mm) producing a compactive effort of 12 400 ft-lbf/ft3 (600 kN-m/m^3).

8) **CBR (ASTM D1883-99):** This test method covers the determination of the CBR (California Bearing Ratio) of pavement subgrade, subbase, and base/course materials from laboratory compacted specimens. The test method is primarily intended for but not limited to, evaluating the strength of cohesive materials having maximum particle sizes less than 3/4 in. (19 mm).

10.1.3 Result of Investigation

(1) General

Achieved quantity of the rotary drillings, test-pits and auger-borings are summarized in **Table 10.1-2**. And based on observation of the drilling cores and soil samples which were obtained by SPT, test-pits and auger-borings, the geological structure of the basin-fill sediments along the approach road were analyzed.

As **Figure 10.1-6** shows, the geological profile is proposed as the results of analysis.

TABLE 10.1-2 LIST OF SURVEYED AMOUNT

No.	Item of work	ID No.	Planned	Achieved
1	Rotary Drilling (Bridge site)	Br-1	20m	21m
		Br-2	20m	18m
		Br-3	20m	10m
		Br-4	20m	10m
		Br-5	10m	11m
		Total	90m	70m
2	Test Pit	TP-1	2.0m	2.0m
		TP-2	2.0m	2.0m
		TP-3	2.0m	1.5m
		TP-4	2.0m	2.0m
		TP-5	2.0m	2.0m
		Total	10.0m	9.5m
3	Auger Boring	AG-1	2.0m	2.0m
		AG-2	2.0m	2.0m
		AG-3	2.0m	2.0m
		AG-4	2.0m	2.0m
		Total	8.0m	8.0m

(2) Result of Rotary Drilling and SPT on Bridge /Culvert Sites

5(five) rotary drillings were performed to confirm the geotechnical properties of foundations for bridges and culverts. Results of the geological logging, N-Value and photographs of the core boxes are summarized in logging sheets, and included in the Appendix.

(3) Result of Laboratory Test of the Soil Samples

Result of the laboratory tests on the samples obtained by rotary drillings, test-pits and auger-borings are summarized in **Table 10.1-3**, **Table 10.1-4** and **Table 10.1-5**.

The samples of rotary drilling are composed of black organic clay, correspond to Kalimati Formation, and are classified into ML. The samples of the auger-borings are mainly composed of grey clay, silt and sand of the river deposits, and classified into CL-ML. The samples of test-

pit TP-1, TP-2, TP-4 and TP-5 are composed of black clay of Kalimati Formation, and classified mainly into ML, while the sample of TP-3 is sandy silt with gravel of talus deposits, and classified into CL.

TABLE 10.1-3 SUMMERY SHEET OF LABORATORY TEST ON BRIDGE DRILLING SAMPLES

S.No.	Bore Hole	Depth (m)	Laboratory Test Results							Remarks
			NMC (%)	Moist Bulk Density (g/cc)	Sp.Gr.	LL (%)	PL (%)	PI	Soil Classification	
1	BR-1	4.5(SPT-5)	26.18	2.16	2.568	22	NP	NP	ML	
2	BR-2	11.5(SPT-12)	43.10	1.77	2.524	36	26	10	ML	
3	BR-3	5.5(SPT-6)	39.95	1.81	2.493	36	29	7	ML	
4	BR-4	7.5(SPT-8)	27.01	2.06	2.601	32	25	7	ML	
5	BR-5	6.5(SPT-7)	31.81	1.99	2.579	34	25	9	ML	

TABLE 10.1-4 SUMMERY SHEET OF LABORATORY TESTS ON AUGER BORING SAMPLES

S.No.	Bore Hole	Depth (m)	Laboratory Test Results						Remarks
			NMC (%)	Sp.Gr.	LL (%)	PL (%)	PI	Soil Classification	
1	AG-1	0.00 - 0.35	23.01	2.695	23	17	6	CL-ML	
2	AG-2	0.30 - 0.75	27.74	2.685	27	22	5	CL-ML	
3	AG-3	0.60 - 0.10	23.81	2.624	22	NP	NP	ML	
4	AG-4	1.70 - 2.00	25.83	2.557	24	NP	NP	ML	
5	AG-4 (A)	2.00	23.97	2.579	23	16	7	CL-ML	

TABLE 10.1-5 SUMMERY SHEET OF LABORATORY TESTS ON TEST PIT SAMPLES

S.No.	Bore Hole	Depth (m)	Laboratory Test Results									Remarks
			NMC (%)	Sp.Gr.	OMC (%)	MDD (g/cc)	CBR (%)	LL (%)	PL (%)	PI	Soil Classification	
1	TP-1	2m down	21.03	2.579	11.70	1.95	7.10	22	NP	NP	ML	
2	TP-2	2 m	44.51	2.535	16.70	1.71	4.70	34	27	7	ML	
3	TP-3	1.5 m	21.60	2.557	7.90	2.10	10.30	28	20	8	CL	
4	TP-4	2m down	31.45	2.514	12.00	1.75	7.00	22	NP	NP	ML	
5	TP-5	2m down	31.20	2.535	15.90	1.82	6.30	29	22	7	CL	

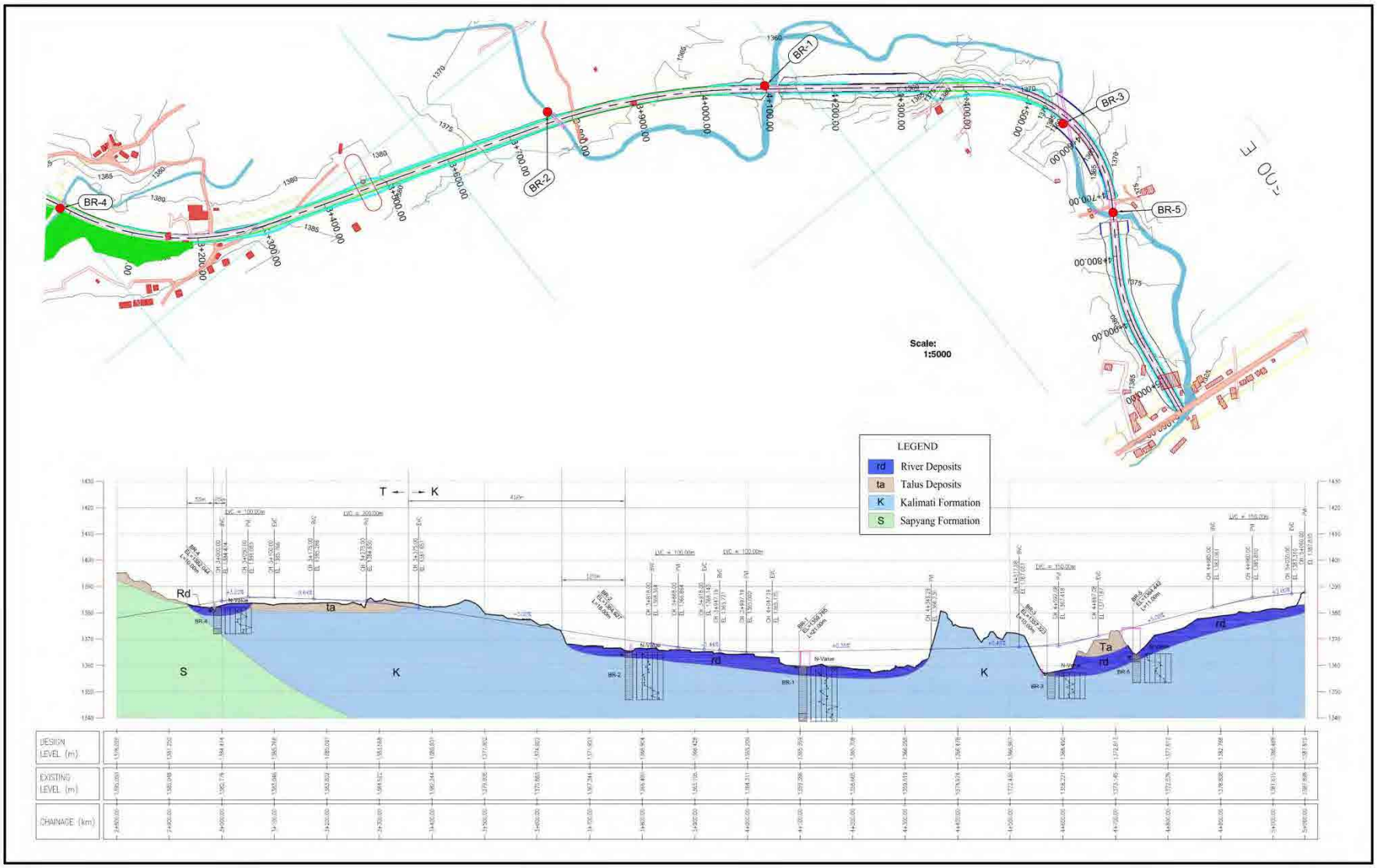


FIGURE 10.1-6 GEOLOGICAL PROFILE ALONG THE APPROACH ROAD

10.2 DESIGN STANDARDS (ROAD AND BRIDGE)

10.2.1 Design Standards (Road)

The standards applied for the design of approach roads are;

- Nepal Road Standards, 2070
- AASHTO Guide for Design of Pavement Structures 1993" (AASHTO Guide)
- Road Structure Guidelines, Japan Association of Roads, February 2004
- Other equivalent guidelines

The criteria to be applied for the design of the objective road are summarized in **Table 10.2-1**. These criteria have been determined after reviewing the criteria adopted during the Data Collection Survey. In addition to the Standards of Nepal, actual figures applied in other projects were also referred in establishing these criteria.

TABLE 10.2-1 PROPOSED DESIGN CRITERIA FOR HIGHWAY DESIGN

SN	Items		Parameters	Reference	Remarks
1	Highway Classification		National Highway Class II		
2	Design Speed (km/h)		60.0		5000-20000 PCU/day
	Cross section	No of lanes	2.0		
		Formation Width (m)	12.0		
		Lane Width (m)	7.0		
		Hard Shoulder (Paved) (m)	2.0		
		Soft Shoulder (Earthern) (m)	1.0		
		Camber/ Crossfall (%)	2.5		
		Slope of Earthwork			
		Fill	V:H = 1:1.8	JRA	
		Cut	V:H = 1:0.8 to 1.8	JRA	
3	Sight Distance	Stopping Sight Distance (m)	65	NRS	
4	Overtaking	Overtaking Distance (m)	300		
5	Horizontal Alignment	**Minimum Radius of Horizontal Curve (m)**			
		Desirable Minimum (m)	150		
		Absolute Minimum (m)	100		
		Unavoidable condition (m)	90		
		Maximum superelevation (%)	6		
		Minimum Length of Transitonal Curve (m)	50	JRA	
6	Vertical Alignment	Maximum Average vertical grade (%) section	4	NRS	
		Maximum Average vertical grade (%) in limited length	6	NRS	
		Critical Length of grade (m)			
		For less than equal maximum average	No limit	NRS	
		For greater than maximum average	210	NRS	
		Minimum Radius of Vertical Curve (m)			
		Crest / Summit Curve	1000		
		Sag / Valley Curve (m)	1200		

Source: JICA Survey Team

10.2.2 Design Standards (Bridge and Culvert)

(1) Review of Design Standard

Nepal Road Standards (NRS 2027) contained the standard design for various kinds of bridges

and culverts in Nepal published in 1988. However, this is too old to adopt to design bridge and culvert in Nepal now. Department of Road (DOR) has formulated these standards with a view to establish a common procedure for design and construction of road, bridge and culvert in Nepal. It is called "NBS (Nepal Bridge Standards) -2067 (2010)".

However, the above standard is not practical enough for design all kinds of bridges and culverts at the construction site, therefore, IRC (Indian Roads Congress), AASHTO (Standard Specifications for Highway Bridges) and Japanese Standard shall be applied for the items not covered by the above NBS 2067.

(2) Classification of Bridge and Culvert

Classification of bridge and culvert shall be as follows:

- Culvert : Length up to 6m
- Minor Bridge : When length ≤ 50m (with span ≤ 25m)
- Major Bridge : When span > 25m or length >50m (with smaller spans)
- Special Bridge : Bridge that require special design considerations, whose construction features (e.g. concrete girder bridges with >50m span, steel truss >100m span, arch bridges, suspension bridges, cable-stayed bridges and other non-standard bridges).

(3) Design Life and Design Discharge

All permanent bridges and culverts shall be designed for a design line of minimum 50 years. Traffic projections shall be made for a period 30 years.

All permanent bridges shall be designed for a discharge of 100 years return period and culverts shall be designed for a discharge of 50 years. For the calculation of design discharge empirical formulas especially developed for other catchments shall not be used.

(4) Loadings

All permanent road bridges and culverts in Nepal shall be designed per IRC loadings or AASHTO loadings. All design shall be carried out in accordance to IRC standards for bridge and culvert unless otherwise specified in the project documents. There are various kinds of loadings for bridge such as dead load, live load, impact friction, pre-stress, creep and shrinkage of concrete, dynamic water pressure, earth pressure, buoyancy, wind load, thermal effects and seismic force are considered in design of bridges and culverts.

Live load is applied HS 20-44 (AASHTO) for this important artery road.

(5) Carriageway and Foot path

All bridges in Highways and Urban Roads shall be designed with a minimum carriageway width of 7.5m.

Footpaths shall be provided on all bridges located at settlement areas or on areas of high movement of pedestrian traffic. They should be separated from the vehicular traffic by safety curbs (in rural areas) and by raised footpath or curbs (in urban areas).The width of the footpath should be decided according to projection of pedestrian traffic, however, a minimum clear width (excluding the width of railings) of 1.0 m footpaths to be provided, where necessary.

(6) Clearances

1) Vertical Clearance

The vertical clearance of structures shall be:

- For all roads not less than 4.75m for through structures.
- Overhead wires, poles etc. shall be at least 7.0m above the highest point of the road surface.
- For culvert, clearance shall be more than the highest water level.

2) Horizontal or Lateral Clearance

The horizontal clearance is the clear width available for the passage of vehicles. For culverts, the full roadway width as well as width of shoulders shall be carried through.

(7) Minimum Free Board

In case of bridges over water bodies, the free board from the design HFL (Highest Flood Level) with afflux to the lowest point of bridge superstructure shall not be less than 1.0m. The minimum freeboard shall be as shown on the following **Table 10.2-2**.

TABLE 10.2-2 MINIMUM FREE BOARD

Discharge (m^3/sec)	Minimum Free Board (mm)
Less than 200	1,000
201-500	1,200
501-2,000	1,500
2,001-5,000	2,000
5,000 and above	More than 2,000mm (depending on the reliability of the available data for the calculation of discharge)

Source: Nepal Bridge Standards- 2067, DOR

(8) Seismic Force

According to IRC (Indian Roads Congress), the horizontal seismic coefficient is calculated by the following formula:

$$kh = \alpha\beta\lambda$$

Where, kh = horizontal sesmic coefficient

α= 0.08 (Zone V) : coefficient depends upon the location

β= 1.0 to 1.5 : coefficient depands upon the soil condition (and standard penetration test)

λ= 1.5 : coefficient depends upon the importance of bridge

According to NRS-2067, the horizontal seismic coefficient is 0.15 for the important bridge.

(9) Other Facilities and Utilities to be Provided

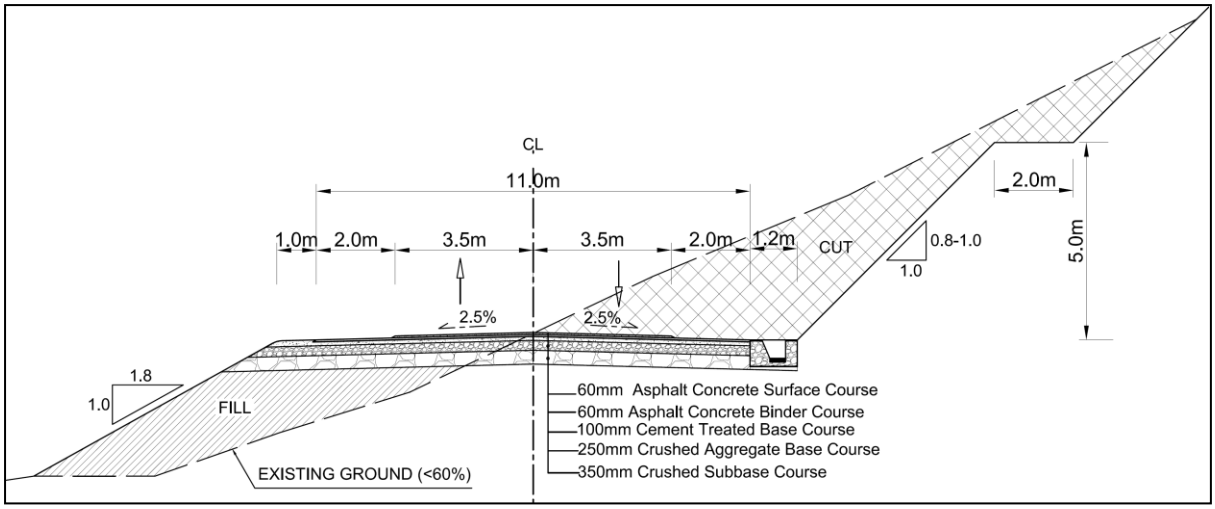
All bridges shall be designed taking into consideration the provision of the following facilities and carrying utilities:

- Curbs and safety curbs (bridge barriers)
- Carriageway drainages
- Railings
- Utilities (electricity, water, telephone and other cables)

10.3 TYPICAL CROSS-SECTIONS

10.3.1 Typical Cross Section (Road)

The proposed typical cross section for the approach road is shown in **Figure 10.3-1**.



Source: JICA Survey Team

FIGURE 10.3-1 TYPICAL CROSS SECTION OF APPROACH ROAD

1) Number of Lanes

The number of lanes on the approach road will be 2 lanes. The width of the lanes will be 3.5m as required by the NRS.

2) Shoulder

The cross section consists of two types of shoulders. A hard shoulder, which will have similar pavement as the lanes will be 2.0m wide. This width is the recommended width in the NRS. The wide shoulder has been applied in order to secure space for traffic in cases of emergency parking or vehicle break down.

On the other hand a 1.0m wide soft shoulder, which will not have a metallic pavement, will be provided on each side of the carriageway. The edge of the shoulder will be rounded in order to prevent from possible erosion.

3) Pavement Structure

Asphalt pavement is proposed for the approach. The pavement will have two layers of 60mm thick asphalt concrete for surface course and binder course. The base course will also have two layers. The upper layer will be cement treated with a thickness of 100mm, and the 250mm thick crushed stone will be provided for the bottom layer. The subbase will be 350mm thick where crushed stones will be applied. This pavement composition is derived from the calculation method discussed in Section 10.4.

4) Drainage Facilities

At cut sections, side ditch will be provided in the soft shoulder to facilitate drainage safely. At high fill section, drainage facility (side ditch) will be provided at the slope toe to facilitate drainage from both the surface and the fill slope runoff.

As the land use along the approach road in the Kathmandu Valley side is mostly cultivated land, it is necessary to ensure that the flow of water is not interrupted. For this purpose, provision of pipe culverts (diameter 900mm) every 200m interval is recommended.

5) Cross fall

Cross fall of camber of 2.5% is adopted based on the requirement for asphalt pavement as mentioned in the NRS.

6) Right-of-Way

The ROW for the proposed approach road is 50m (25m at each side from the centreline at) as according to the standards of Nepal.

(1) Fill and Cut slopes

A slope of 1:1.8 is applied for fill sections and 1:0.8-1.0 for cut sections. Where fill height exceeds 5m, gentler slope will be considered. A berm, 2m wide, is provided in such sections and the top of the slope will be rounded to prevent from erosion. Provision of guard rails will be considered for section where the fill height exceeds 3m. The slopes will be provided with adequate vegetation.

For cut slopes, although the standard slope is 1:1, the slope of 1:0.8 will be applied in case of rocks. As in fill, cut sections will also be provided with a 2m wide berm where the cut height exceeds 5m. The slope face will be provided with proper vegetation. In case of weathered rocks, the slope face will be protected by applying shotcrete.

10.3.2 Ancillary Facilities

1) Pavement Markings

In order to encourage safe operation of traffic and to reduce traffic accidents, road markings will be provided on approach roads. The types of pavement markings and its details are recommended as mentioned in **Table 10.3-1**.

TABLE 10.3-1 TYPES OF RECOMMENDED PAVEMENT MARKINGS

Item	Line Type/Colour	Dimension	Remarks
Centerline	Broken / White	15cm	
Sideline (Shoulder)	Solid / White	15cm	
Travelled lane	Broken/White	15cm	Transition section
Stop Line	Short Broken / White	40cm	
Yield line (Road)	Short Broken / White	15cm	Yield Intersections
Yield line	Short Broken / White	40cm	Roundabouts
Cross walks	Solid / White	3m x 0.4m	Intersections
Directional Arrows	Solid / White	Varies	Straight, Left/ Right Turn
Zebras	Solid / White	40cm	45 degrees

Source: JICA Survey Team

2) Sign Posts

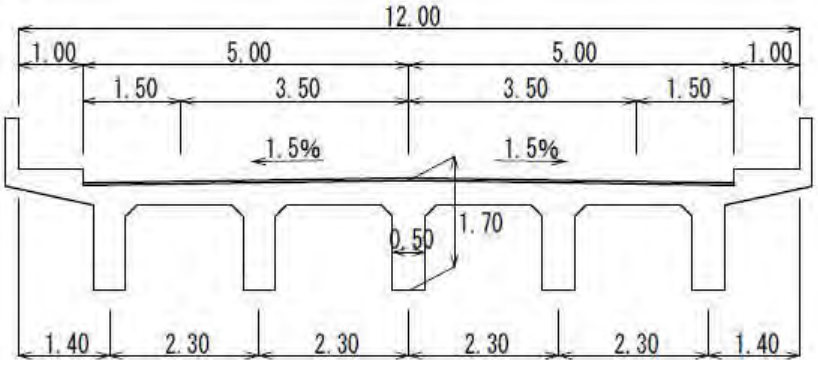
Regulatory signs and informatory signs (informatory signs are limited to bus stop sign) will be provided on the approach roads based on the requirements of Nepal. The provision of such road signs are expected to control, alert and inform the drivers and secure the safety and efficiency of roads.

3) Traffic Lights and Traffic Signals

Approach road section will be provided adequately with Traffic lights. Traffic signals will be provided at intersections at the start point and end point of the approach

10.3.3 Typical Cross Section（Bridge）

The typical cross section applied for bridges on the approach road is shown in **Figure 10.3-2**. As shown in figure, the carriageway of the bridge is designed for the same width as the approach road to secure smooth and safe traffic flow. A 1.5m shoulders 1.5m wide and sidewalks 1m wide are provided at both sides of the bridge. As for the structure, the bridge is planned to be reinforced concrete.

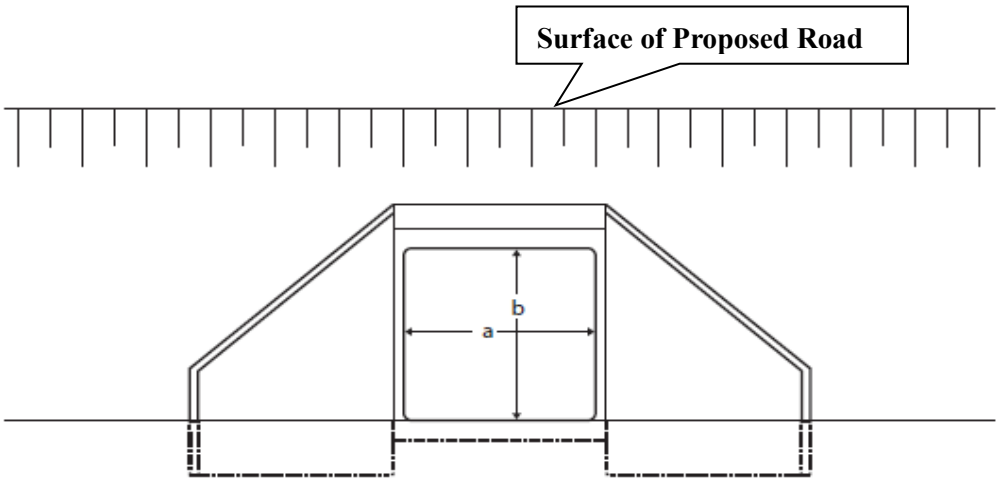


Source: JICA Study Team

FIGURE 10.3-2 TYPICAL BRIDGE CROSS SECTION

10.3.4 Typical Cross Section（Culvert）

The typical cross section of a culvert to be applied to the approach road is shown in **Figure 10.3-3**. The size of the barrel, 'a' and 'b' shown in the figure depends upon volume of the maximum water flow.



Source: JICA Study Team
Note: Detailed dimensions of each culvert is shown in 10.6.6 Dimension of Culverts

FIGURE 10.3-3 TYPICAL CULVERT CROSS SECTION

10.4 PAVEMENT DESIGN

10.4.1 General

This section describes pavement design for the project approach road section. The pavement design based on the following;

a) The results and findings of the sub-grade characteristics over which the road is to built;
b) The traffic load anticipated to traverse the proposed road alignments over the selected design life; and
c) The type of pavement to be adopted based on the technical advantages.

10.4.2 Pavement Design Standards

The pavement design is in accordance with the "Guide for Design of Pavement Structures, 1993" by the American Association of State Highway and Transportation Officials and in reference also to Pavement Design Guideline (Flexible Pavement) by Planning, Monitoring and Evaluation UNIT, DOR.

10.4.3 Technical Approach

The design parameters used in the pavement design includes time constrains, traffic, design serviceability loss, reliability, sub-grade strength and material properties for pavement structure design.

Following are major design condition;

(1) Design period

10 years

It is assumed that the design life of pavement consummates the 20-year design period before rehabilitation is performed.

(2) Traffic

The structural design of the pavement is based on fatigue loads. Fatigue loading is taken as the cumulative number of passes of an Equivalent Standard Axle load (ESAL) of 8,300kgs (18kips) per axle, to which the pavement structure will be subjected throughout its design life.

10.4.4 Recommended Pavement Structures

(1) Pavement Structure

The recommended pavement structure for the main carriageway is as below;

No	Thickness	Pavement Structure
1	60mm	Asphalt Concrete Surface Course
2	60mm	Asphalt Concrete Binder Course
3	100mm	Cement Treated Base Course
4	250mm	Crushed Aggregate Base Course
5	350mm	Crushed Sub-Base Course

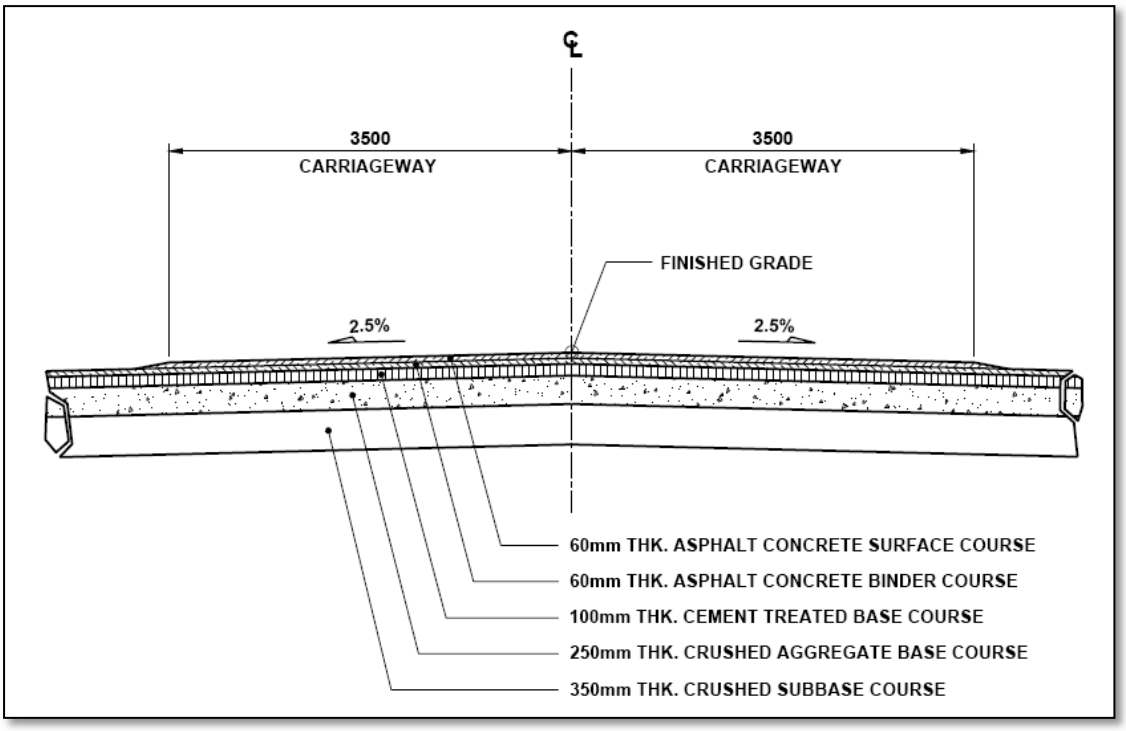


FIGURE 10.4-1 PAVEMENT STRUCTURE OF MAIN CARRIAGEWAY

TABLE 10.4-1 TRAFFIC VOLUME AND COMMUTATIVE EQUIVALENT STANDARD AXLE LOAD (ESAL) (W18KIPS)

【Design Period : 20 years】

Project Title: Nagdhunga Tunnel Project

Year				Total	Large V/Total	Large V	Class 1	Class 2	Class 3	Class 4	Class 5		Total
			Vehicle Type				Cars	Micro Bus	Large Bus	Light Truck	Heavy Truck		
			Traffic Volume in 2021 *	6,300	37%	2,300	1,300	600	1,700	400	2,300		
			Load Equivalence Factor (LEF)**			-	0.0002	0.0004	1.1005	1.5720	4.5370		
			Grouth Rate*	4.50%			0.03	0.030	0.06	0.045	0.045		
	2021	1	Open				0.26	0.24	1,870.85	628.80	10,435.10		12,935.25
1	2022	2					0.27	0.25	1,983.10	657.10	10,904.68		13,545.39
2	2023	3					0.28	0.25	2,102.09	686.67	11,395.39		14,184.67
3	2024	4					0.28	0.26	2,228.21	717.57	11,908.18		14,854.51
4	2025	5					0.29	0.27	2,361.91	749.86	12,444.05		15,556.37
5	2026	6					0.30	0.28	2,503.62	783.60	13,004.03		16,291.83
6	2027	7					0.31	0.29	2,653.84	818.86	13,589.21		17,062.51
7	2028	8					0.32	0.30	2,813.07	855.71	14,200.73		17,870.12
8	2029	9					0.33	0.30	2,981.85	894.22	14,839.76		18,716.46
9	2030	10					0.34	0.31	3,160.76	934.46	15,507.55		19,603.42
10	2031	11					0.35	0.32	3,350.41	976.51	16,205.39		20,532.98
11	2032	12					0.36	0.33	3,551.43	1,020.45	16,934.63		21,507.21
12	2033	13					0.37	0.34	3,764.52	1,066.37	17,696.69		22,528.29
13	2034	14					0.38	0.35	3,990.39	1,114.36	18,493.04		23,598.52
14	2035	15					0.39	0.36	4,229.81	1,164.50	19,325.23		24,720.30
15	2036	16					0.41	0.37	4,483.60	1,216.91	20,194.87		25,896.15
16	2037	17					0.42	0.39	4,752.62	1,271.67	21,103.63		27,128.72
17	2038	18					0.43	0.40	5,037.77	1,328.89	22,053.30		28,420.79
18	2039	19					0.44	0.41	5,340.04	1,388.69	23,045.70		29,775.28
19	2040	20	in 20 years				0.46	0.42	5,660.44	1,451.18	24,082.75		31,195.26
Cummulative ESAL													415,924.04

		one lane	lane adjustment coefficient		
415,924.04	× 365days ×	0.5	× 1.0 =	75,906,138	(Design ESAL)

* Based on Traffic Demand Forecast

** Source:Study Team

TABLE 10.4-2 FLEXIBLE PAVEMENT DESIGN

Design Standard: Guide for Design of Pavement Structures, 1993, American Association of State Highway and Transportation Officials
Design Case: 2021 to 2040 (20 years)
Project Title: Nagdhunga Tunnel

1. Calculation of Structural Number

(1) Basic Formula

The formula shown below is applied for flexible pavement design in accordance with AASHTO design guideline.
Design Condition is shown in Table 1.
Structural Number is computed to accommodate the basic formula.

$$\log_{10}(W_{18}) = Z_R \times S_0 + 9.36 \times \log_{10}(SN+1) - 0.20 + \frac{\log_{10}[\Delta PSI/(4.2-1.5)]}{0.40 + 1094/(SN+1)^{5.19}} + 2.32 \times \log_{10}(MR) - 8.07$$

(2) Design Condition

Design Condition		Index	Value	Grounds	Remarks
	Design Period		20	2017 ~2040(20 Years)	Design life of pavement of initial pavement structure
1. Traffic	Design ESAL	W18	75,906,138		
2. Level of Reliability	Reliability	R(%)	80	Principal Arterial (AASHTO)	The possibility to satisfy road user during design period. Stronger pavement structure is required in accordance with Value.
	Standard Normal Deviate	ZR	-0.841	Value corresponding to R=80%	Corresponding to R
	Overall Standard Deviation	S0	0.45	Average of Flexible Pavement	Variation of reliability according to regional traffic difference
3. Serviceability	Initial Serviceability Index	P0	4.2	Standard of AASHTO	5: Perfect 0: Inperfect
	Terminal Serviceability Index	PI	2.5	Standard of AASHTO	Serviceability expected at the end of design period
	Present Serviceability Index	ΔPSI	1.7	PSI = P0- Pt	
4. Pavement Support Layer	CBR(%)	CBR	7		
	Resilient Modulus	MR	10,500	MR=1,500×CBR	Soil Subgrade Strength

(3) Computation of SN

1. Left side of Basic Formula	log10(W18)	7.880
2. Value of Righ side of Basi Formula		7.880
3. SN Value required	SN	5.537

2. Pavement Structure

1(inch)=2.540(cm)

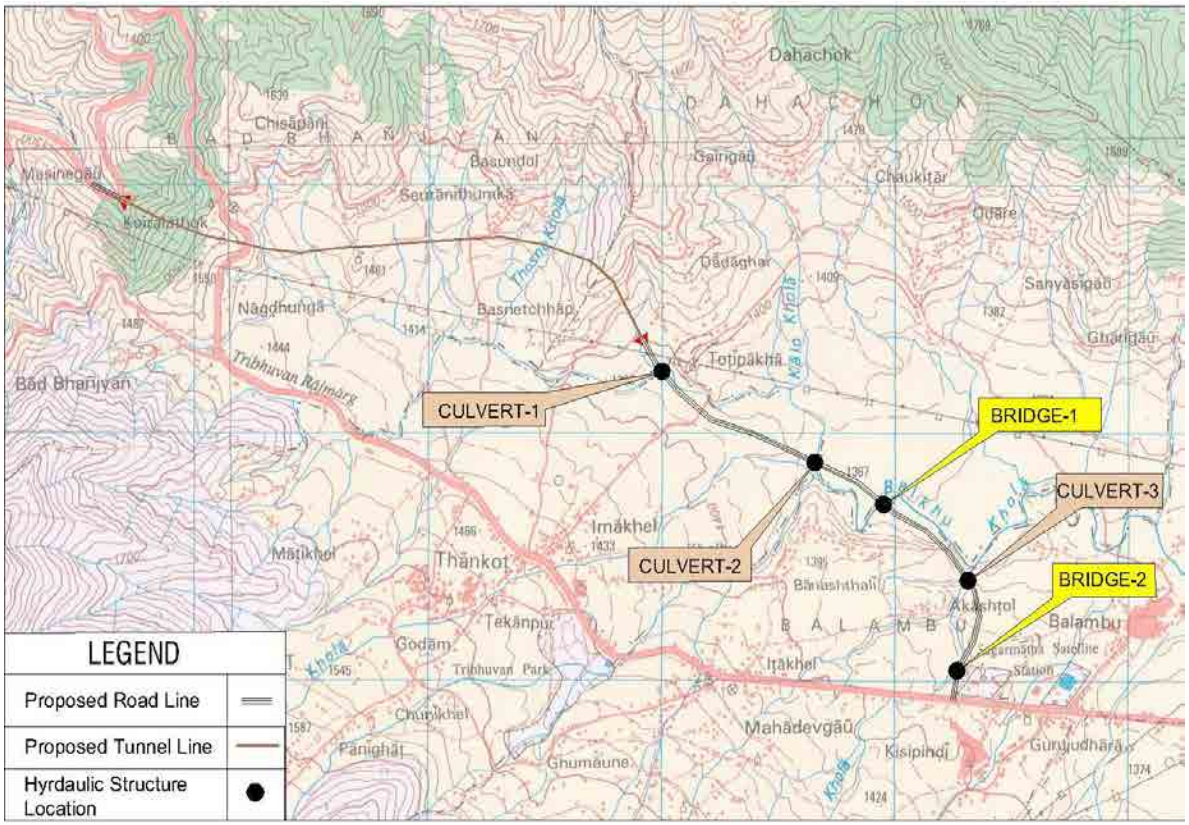
Pavement Structure		Layer Coefficient (a)	Thickness D (cm)	Thickness d (inch)	Drainage Coeffient (m)	Structural Number SN=a×m×D1	Remarks
Asphalt Concrete Surface	new	0.390	**6.00**	2.362	-	0.921	
Asphalt Concrete Binder	new	0.390	**6.00**	2.362	-	0.921	
Cement Treated Base	new	0.230	**10.00**	3.937	1.0	0.906	Cement treated base course
Crushed Aggregate Base	new	0.140	**25.00**	9.843	1.0	1.378	Crushed aggregate,CBR>20
Crushed sub-base	new	0.110	**35.00**	13.780	1.0	1.516	Crushed aggregate
Evaluation:	Required SN			5.537	<	5.642	OK

W18 : Predicted number of 18-kip equivalent single axle load applications
ZR : Standard normal deviate
S0 : Combined standard error of the traffic prediction and performance prediction)
MR : Resilient modulus (psi)
D : Layer thickness(inches)
m : Layer drainage coeficient
SN is equal to the structural number indicative of the total pavement thickness required.
SN = a1D1 + a2D2m2 + a3D3m3

10.5 BRIDGE DESIGN

10.5.1 Location of Bridge and Culverts

The location of the proposed cross drainage structures such as bridges and culverts along the proposed approach road is shown in **Figure 10.5-1**. The east side approach road will require two bridges and three culverts to span water channels or rivers.



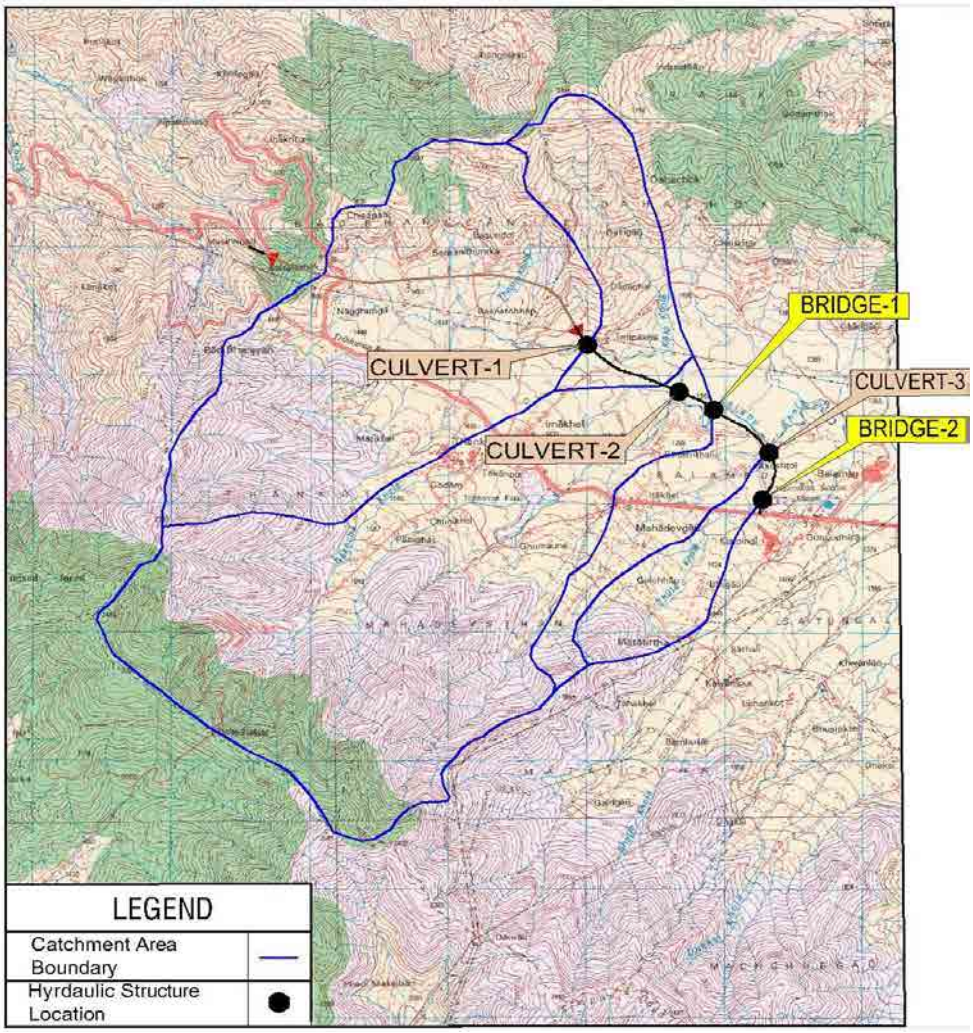
Source: JICA Study Team

FIGURE 10.5-1 LOCATION OF BRIDGES AND CULVERTS

10.5.2 Hydrological Study

The watershed map comprising the catchment basins and sub-basins corresponding to the proposed route and location for the proposed cross drainage structures are shown in **Figure 10.5-2**. All the basins and sub-basins lie below the Mahabharat range of mountains, therefore, none of the rivers have contribution of melting snow in their flow. They have a very low flow during the dry season and high flood during monsoon. In the upper areas of the catchment, the average gradient is quite high but decreases significantly where the small tributaries meet to form the Balkhu khola.

In the present sites, the road geometric requirement has become the dominant parameter in deciding the sizes of the cross drainage structure, both in span and height rather than that of hydrological requirements. Therefore, in this case the road geometric requirement is the main deciding factor rather than the hydrological consideration for the height and width of bridges and culverts.



Source: JICA Study Team

FIGURE 10.5-2 AREAS OF CATCHMENT BASINS AND SUB-BASINS

10.5.3 Discharge Estimation

For the present phase of the study, discharge in the streams where cross drainage structures are required, has been calculated using two methods, namely, WECS/DHM method and Rational Method. The former is a local empirical formula widely used in Nepal. Brief description of each method is given below.

(1) Water and Energy Commission Secretariat (WECS/DHM) Method

The WECS/DHM method, based on flood frequency analysis, is recommended for the context of Nepal after performing few case studies. In this method, the most significant independent variable is the area of the basin below 3,000m elevation. This area represents the portion of the basin that is influenced by monsoon precipitation. The results of this method are not applicable to basins located entirely above 3,000m elevation. Also, even if the proportion of a basin lying below 3,000m is very small, the results of this method will not be particularly reliable.

As per the recommendation of the Water and Energy Commission Secretariat / Department of Hydrology and Meteorology (WECS/DHM) of Nepal, the flood flows of any river of catchment area A (km²) lying below 3,000m elevation are given by:

Instantaneous Peak flood for a return period of 2 years, $\mathbf{Q_2 = 1.8767\ (A + 1)^{0.8783}}$
Instantaneous Peak flood for a return period of 100 years, $\mathbf{Q_{100} = 14.63\ (A + 1)^{0.7342}}$

The flood flow for any other return period, T years, can be found as:

$$Q_T = \exp (\ln Q_2 + s\sigma)$$

Where, A = area below 3,000m elevation
σ = standard deviation of natural logarithms of annual floods = $\ln (Q_{100} / Q_2) / 2.326$
s = Standardised normal variate from a particular return period
= 0, 0.842, 1.282, 1.645, 2.054, 2.326, and 2.576 for T = 2, 5, 10, 20, 50, 100, and 200 years, respectively.

(2) Rational Method

The design intensity of rainfall corresponding to the time of concentration is determined from IDF curve. The time of concentration is determined using Kirpich equation. Most of the catchment area lies in hilly terrain and covered by vegetation. So the average coefficient of runoff is taken as 0.4 for the application of Rational method.

$$Q_t = \frac{C * I_{Ct} * A}{3.6}$$

Where, Q_t = discharge at return period t years in m^3/s
C = Average Runoff coefficient
I_{ct}= Intensity of rainfall corresponds to t years return period in mm/hr
A = Catchment area in sq. Km

(3) Results of the Estimated Discharge

In Nepal, for the design of major bridge, 100 year return period flood value is taken as the design discharge and for the culverts 50 year return period flood is taken as the design discharge. Therefore, for all the basins, 50 year and 100 year return period flood has been computed and presented in the following **Table 10.5-1**.

TABLE 10.5-1 RESULTS OF ESTIMATED DISCHARGE

Hydrologic element	Basin area (km^2)	100 years return period flood (m^3/s)		50 years return period flood (m^3/s)		Recommended Design Discharge (m^3/s)
		WECS method	Rational	WECS method	Rational	
Bridge-1	15.03	112.24	146.88	92.50	131.08	146.88
Bridge-2	0.65	21.50	9.72	16.99	8.59	9.72

Source: JICA Study Team

The discharge calculated using Rational Formula has been recommended because this method takes into account the rainfall data in the vicinity/or of the watershed. Also it considers the runoff coefficient accounting for all differences between the rainfall intensity and the flood peak which gives a more reliable result.

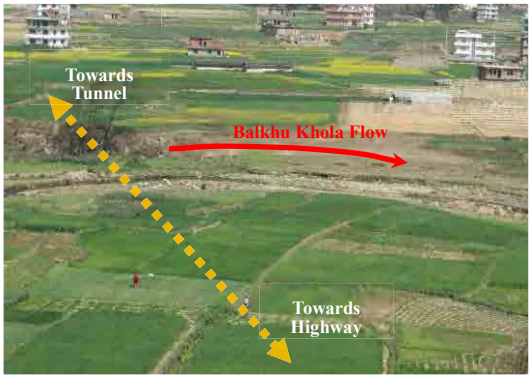
10.5.4 Proposed Bridge-1

The proposed bridge site for Bridge-1 is over the main Balkhu Khola. The proposed bridge axis lies in the meander of the stream. The river is shallow during the dry period with very little flow but at the time of flood, the river spreads laterally and linear waterway reaches almost 20m, inundating the nearby flood plain, which in dry season is used for cultivation. The lateral spread of the flood is more prominent on the right bank than on the left as the elevation of right bank is lower than that of the left bank.

In addition, river bank cutting is also prevalent in this river near the bridge site. The bridge axis, being in the meander of the river, needs special protection as the concave banks are prone to erosion. Bridge of about 20m has been proposed at this site and associated river training works are also needed for the safe passage of flood. According to the local people, the rise in water level is about 2.5m from the bed level, during flood. Hence the proposed deck level should be well above this elevation including adequate room for freeboard.

The stream section of the Bridge-1 site is shown in **Photo 10.5-1**.

(a) Proposed Bridge Site



(b) Bird's Eye View

PHOTO 10.5-1 PROPOSED BRIDGE SITE FOR BRIDGE-1

(1) Span of Bridge-1

Length of bridge span is estimated by using the following formula:

$$L = 20 + 0.005Q$$

Where, L= minimum span length (m)
Q= maximum discharge (m^3/s)

In the case of less than 500 m^3/s discharge, the above 'L' shall be reduced to 15.0m.

According to the above formula, the result of the span length for the Bridge-1 is estimated as follows:

$L = 15 + 0.005 \times 147$ = approximately 16m

Therefore, the length of span for the Bridge -1 is designed for minimum 16.0m and it should take allowance to be 20.0m as safe length.

(2) Height of Bridge-1

The hydrological study is concentrated in estimating the approximate High Flood Levels (HFL) at the stream crossings for the judgment of bridge deck levels. However, there are no gauging stations in any of the streams within the Project Area. In the absence of flood data of the rivers the flood determination has been estimated by empirical methods and Rational Method only.

High Flood Level (HFL) was estimated by inquiring the knowledgeable local people at the site. In Bridge-1, where the rise in water level is about 2.5m from the bed level during serious flood according to the local people.

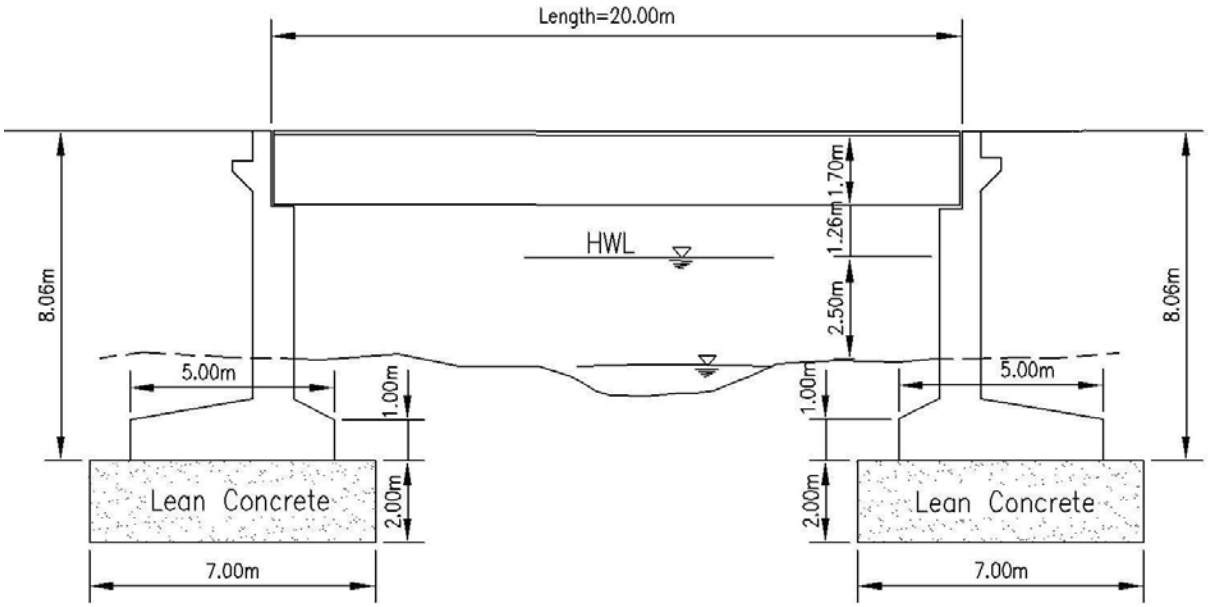
(3) Foundation of Bridge-1

According to the boring examination at the location of the Bridge-1, clayey and sandy gravel as a top soil covers this area with a thickness of 3.5m. Silt clay is found from 3.5m up to 15.0m below the ground level. N value of 20 and over 20 is seen at the 3.5m below the existing ground level.

Therefore, as a support layer of the bridge, the bottom of structure shall be 3.5m deep from the existing level. In this case, however, short piles are not suitable for the bridge. Instead of adoption of pile foundation, lean concrete with a thickness of 2.0m can be most applicable as a foundation for Bridge-1.

(4) Dimension of Bridge-1

Schematic side view of the bridge-1 is shown in **Figure 10.5-3**.



Source: JICA Study Team

FIGURE 10.5-3 SCHEMATIC SIDE VIEW OF THE BRIDGE-1

10.5.5 Proposed Bridge-2

The proposed bridge-2 is over a small tributary of Balkhu Khola. The stream is in a deep gorge of about 5m. At this site, in the dry season, the waterway of the stream is narrow, about 2 m only and the depth of water is shallow. Moreover, a lot of vegetation covers the drainage line of the stream and also on the adjacent terraces many trees are present as seen in **Photo 10.5-2**. On the right bank of the stream has been used for farming and on the left bank there is a stone paved road.

As per the local residents of the area, during monsoon season the water level in the stream rises to about 2m from the stream bed level. However, discharge water of Bridge-2 is very little due to small area of catchment according to **Table 10.5-1**. In this case the road geometric requirement is the main deciding factor rather than the hydrological consideration for the height and width of this bridge.

Besides the above, in order to accommodate the existing local road and small stream with the provision of extension, the span of bridge is divided into 2 spans, one in 15m and another is 20 m. Therefore, span of Bridge-2 is 35m.

PHOTO 10.5-2 PROPOSED BRIDGE-2

(1) Span of Bridge-2

As described above, discharge water of Bridge-2 is too small to apply the empirical formula which is applied for Bridge-1. Span of Bridge-2 is decided by geometrical profile, but it has to be considered for the existing local road and the alignment of proposed approach road intersect near by the small stream.

In order to accommodate both the local road and small stream under the bridges, 2 spans of the bridge should be proposed. One span is for the existing road and the other span is for the small stream. Thus the total length of Bridge2 becomes 35 m in 2 spans.

(2) Height of Bridge-2

Due to the small stream under the Bridge-2, the height of the bridge is not decided by the Highest Flood Level. But there was another factor to be considered is road finish level and gradient of the proposed road. Road gradient is 5.0% increasing order and the difference between two ends is almost 1.75 m.

Therefore, it has to be considered to maintain the height of bridge is 7.7m in lower abutment, 8.7m in center pier and 9.7m in higher abutment respectively as shown in **Figure 10.5-4**.

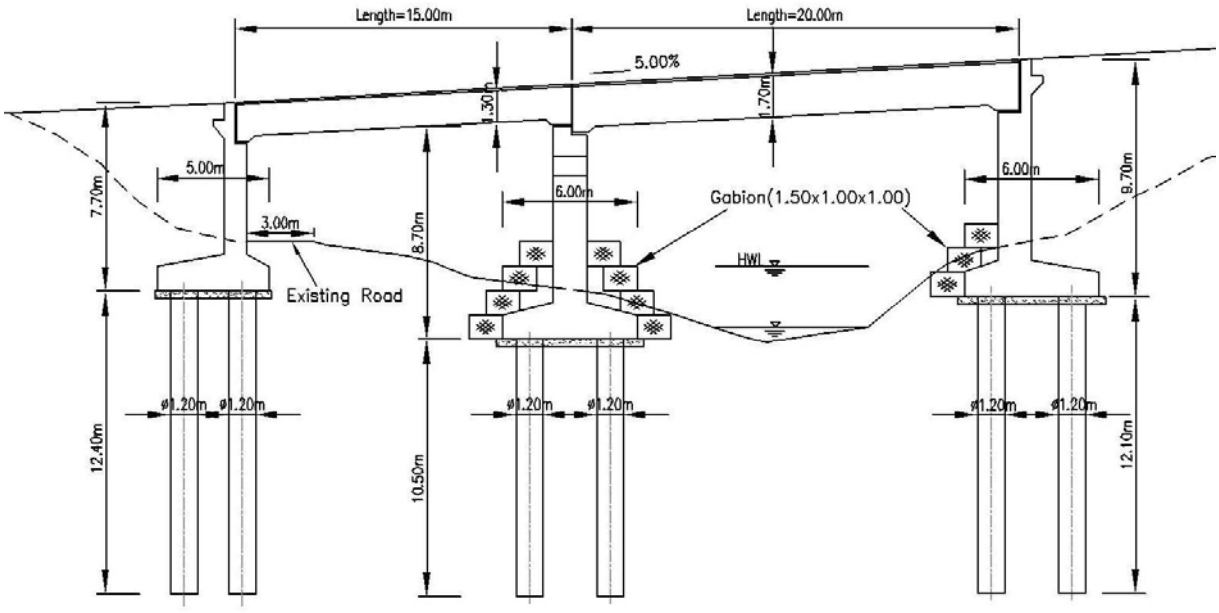
(3) Foundation of Bridge-2

According to the boring examination at the location of the Bridge-2, clayey gravel and grey fine sand as a top soil covers this area with a thickness of 9.0m. Black clay is found from 9.0m upto 11.0m. Soft layer with N value of less than 20 is seen at the 6.0m below the existing ground level. However, N value of 38 is seen at the 11m below the ground level.

Therefore, as a support layer of the bridge, the bottom of the structure shall be 11.0m from the existing level. In this case pile foundation should be applied. The piles with a length of 10.5m to 12.4m can be applied for Bridge-2.

(4) Dimension of Bridge-2

The length of Bridge-2 is 35 m and divided in to two span; 15 m and 20 m respectively. The height of bridge is different in two ends because of road alignment and its gradient. Overall height at centre pier is 8.7 m. The depth of pile is different from 10.5 m to 12.4 m as shown below. Schematic side view of the bridge-2 is shown in **Figure 10.5-4**.



Source: JICA Study Team

FIGURE 10.5-4 SCHEMATIC SIDE VIEW OF THE BRIDGE-2

10.6 CULVERT DESIGN

10.6.1 Discharge Estimation

According to **10.5.2 Hydrological Examination and Figure 10.5-4**, discharge in the streams where cross drainage structures are required, has been calculated using two methods, namely, WECS/DHM method and Rational Method. The former is a local empirical formula widely used in Nepal. Brief description of both methods are given **10.5.3 Discharge Estimation**.

In Nepal, for the design of major bridge, 100 year return period flood value is taken as the design discharge and for the culverts 50 year return period flood is taken as the design discharge. Therefore, for all the basins, 50 year return period flood has been computed and presented in the following **Table 10.6-1**.

TABLE 10.6-1 RESULTS OF ESTIMATED DISCHARGE

Hydrologic element	Basin area (km^2)	100 years return period flood (m^3/s)		50 years return period flood (m^3/s)		Recommended Design Discharge (m^3/s)
		WECS method	Rational	WECS method	Rational	
Culvert-1	5.65	58.83	71.08	47.77	63.44	63.44
Culvert-2	7.20	68.61	84.19	55.91	75.14	75.14
Culvert-3	0.72	21.81	10.52	17.31	9.39	9.39

Source: JICA Study Team

The discharge calculated using Rational Formula has been recommended because this method takes into account the rainfall data in the vicinity/or of the watershed. Also it considers the runoff coefficient accounting for all differences between the rainfall intensity and the flood peak which gives a more reliable result.

10.6.2 Proposed Culvert-1

This stream is also one of the tributaries of Balkhu Khola. The proposed section is about 3m wide and the stream has a low flow during dry season. The stream is extremely polluted with stagnant heaps of garbage in the waterway. Either banks are used for cultivation. It is suggested to keep the HFL at least 1.5m above the current bed level at the proposed site.

PHOTO 10.6-1 PROPOSED CULVERT-1

10.6.3 Proposed Culvert-2

The stream is one of the tributaries of Balkhu Khola draining from the north of the watershed of Balkhu Khola. A little upstream of the proposed culvert site, there exists a slab culvert of about 5m length and having an opening of approximately 2m depth. Just upstream of the bridge site the stream takes a sharp curved path and also the stream has been heavily channelized to approximately 50-60m upstream.

At this section of the stream, the flood has not exceeded the banks, according to the local

residents. However, the increasing trend of channelizing the stream into a narrower width and encroachment of the nearby lands filled with increased surface flow due to rapid urbanization could significantly raise the water levels in the stream during flood time. Therefore the design level should be adequately high such that passage of flood is safe. Consequently, high flood level, at least 2m higher from the current stream bed level is suggested for this stream. Also, standard freeboard height should be provided for the culvert.

PHOTO 10.6-2 PROPOSED CULVERT-2

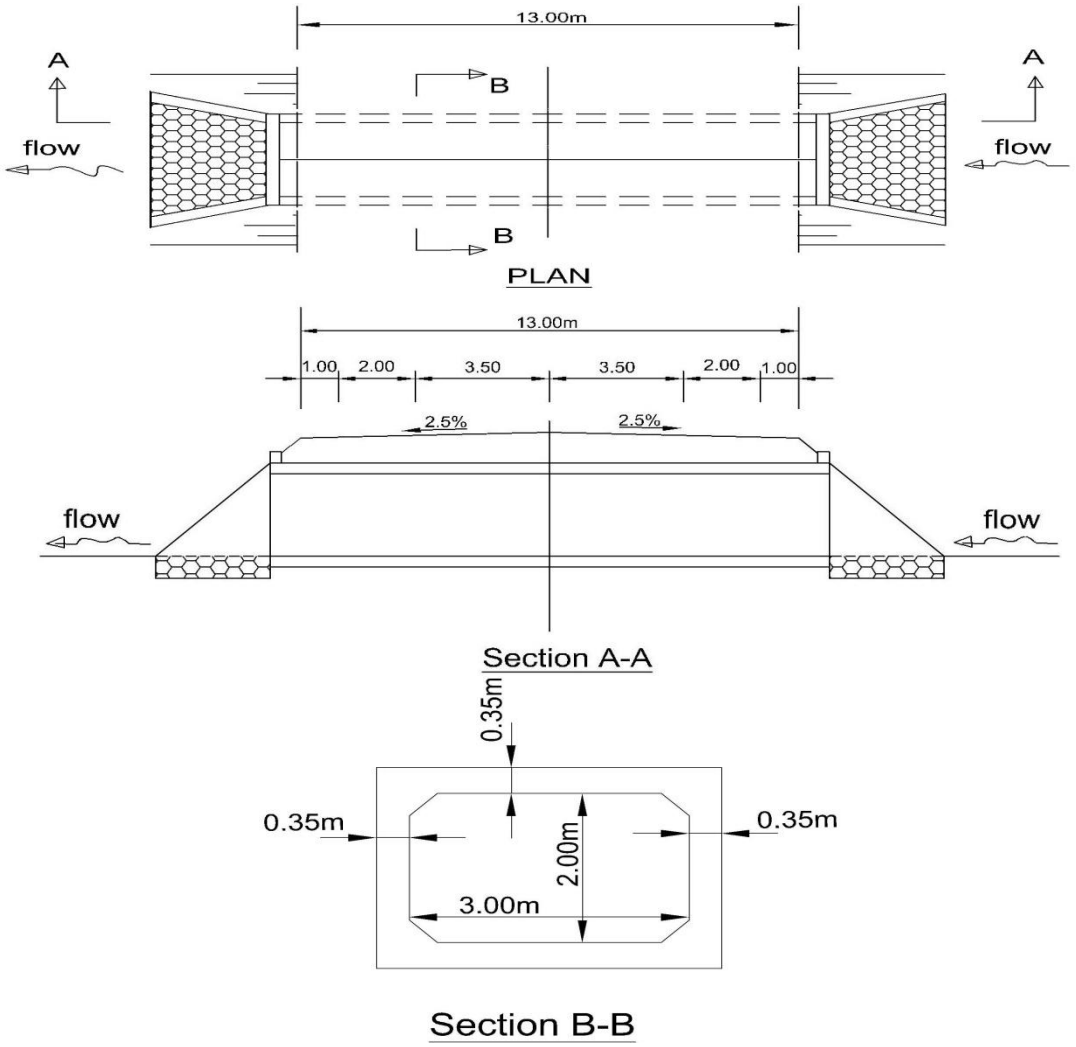
10.6.4 Proposed Culvert-3

The proposed Culvert-3 is located nearby Bridge-2 only 200m away downstream. Therefore, the stream flows continuously from the Bridge-2 to Culvert-3. The depression is about 2m deep and 3m wide. A lot of bushes cover the drainage line of the stream and also on the adjacent terraces many bushes are present as seen in **Photo 10.6-3**.

PHOTO 10.6-3 PROPOSED CULVERT-3

10.6.5 Dimension of Culverts

According to the **Table 10.6-1** and geometric requirement, size of each culvert are finalized as shown in **Figure 10.6-1**.



Source: JICA Study Team

FIGURE 10.6-1 SCHEMATIC SIDEVIEW OF EACH CULVERT

10.7 INTERSECTION DESIGN

To secure traffic safety and efficient vehicle operation, it is important to identify where intersection need to be properly controlled. This Study shall thus identify the critical intersections along the study road, determine the intersection type and propose a plan to be adopted.

10.7.1 Identification of Intersections

The approach road crosses or meets with existing roads at several locations. However, following locations as shown in **Figure 10.7-1** and listed below are identified as intersections to be selected for the design.

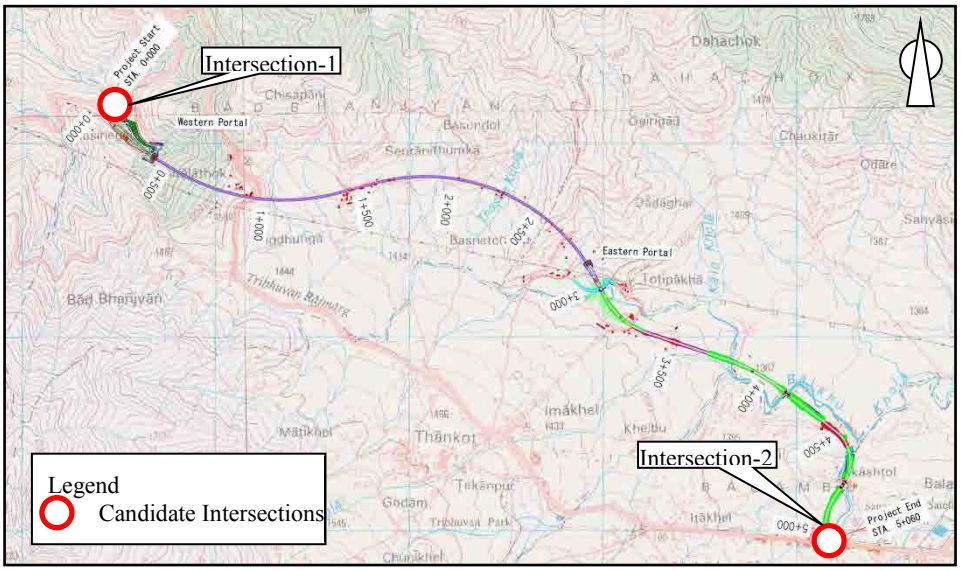
- The beginning point of the approach road
- The end point of the approach road

Although there are other locations where existing roads do cross with the approach road, these existing roads are district roads or community roads, where traffic volume is extremely low compared to the approach road. Therefore, design of intersection at these locations is not required and traffic flow here are planned to be controlled by providing stop lines and appropriate road signs and other facilities.

10.7.2 Design Conditions

Following conditions apply to the design of intersections.

- At-grade cross intersections will be applied considering the traffic volume and land use,
- The target year for intersection design will be 2020.
- Target vehicles for intersection at location 1 is SU-12 as classified by AASHTO, which are equivalent to trucks and buses in Nepal,
- Target vehicles for intersection at location 2 is WB-19 as classified by AASHTO, which is equivalent to semi-trailers,



Source: JICA Study Team

FIGURE 10.7-1 LOCATION OF INTERSECTION

10.7.3 Type of Control System

Types of control system that may be applied for any intersection are as follows;

i) Non-signalized (Stop sign),

ii) Signalized,

iii) Roundabout, and

iv) Signalized roundabout

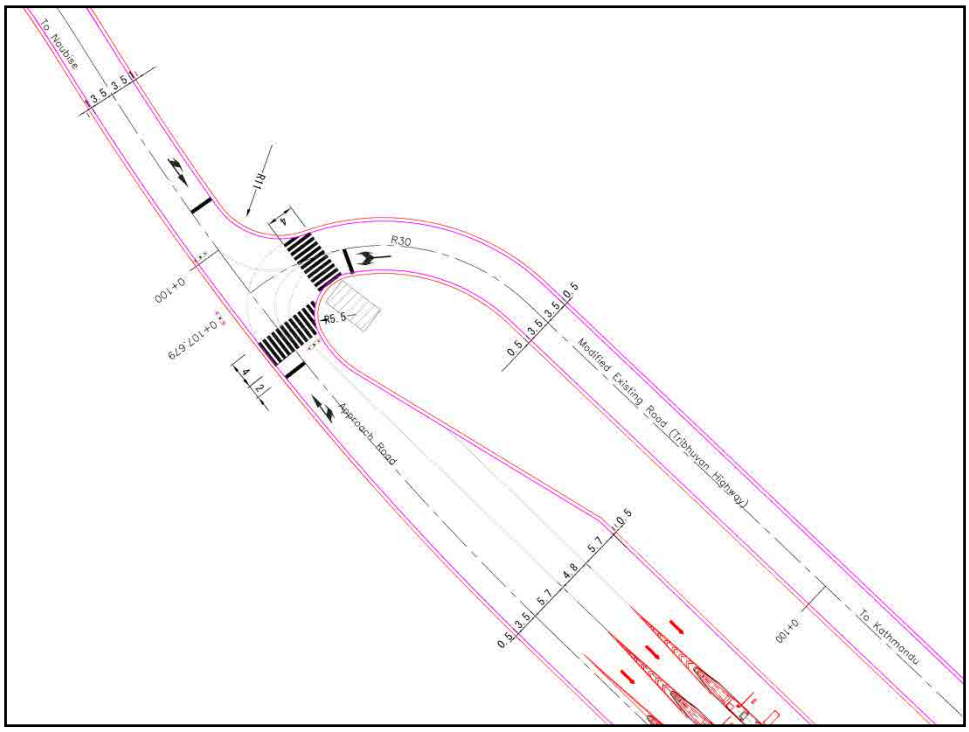
However, the types of control system to be applied for the selected intersections will be signalized intersection due to following reasons;

- In general, non-signalized intersections are applied where traffic volume is less than 1000 vehicles. As given in Chapter 5, the estimated traffic volume in year 2020 along the approach road and the existing road are approx. 7,300 and 2,500 respectively.
- Roundabout is efficient when traffic volumes are low and are equal on all the legs (roads). Also, it is considered not effective on high standard highways. In addition, the topographic condition and the land use at the above locations are not favorable for provision of a roundabout.
- Same thing can be said for signalized roundabout as mentioned for roundabout.

10.7.4 Design of Intersections

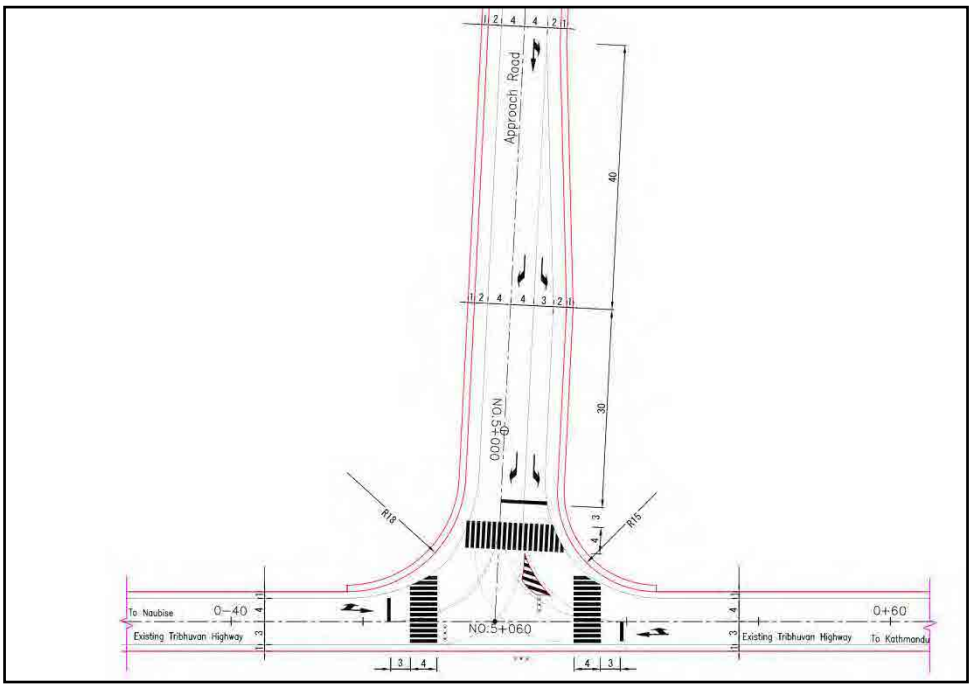
The plan of Intersection-1 and Intersection-2 are shown in **Figure 10.7-2** and **Figure 10.7-3**

respectively. Both the intersections are planned to be signal controlled. Turn-exclusive lanes have been provided at Intersection-2 for securing safe and smooth traffic flow from approach road to the existing road. It has not been designed at Intersection-1 as the major stream of traffic here is expected on the approach road, which will go straight and take no turns.



Source: JICA Study Team

FIGURE 10.7-2 PLAN OF INTERSECTION-1



Source: JICA Study Team

FIGURE 10.7-3 PLAN OF INTERSECTION-2

10.8 SLOPE PROTECTION DESIGN

There are sections where the approach road sees embankment and cut height that reaches up to 10 meters. For this height, it is judged that provision of vegetation is sufficient to protect the slopes and no special slope protection measures are required. Particularly, the cut section is limited to a highland near the end of the approach road. The topography here is not as rugged as in the mountains nearby. The geological condition is also fair as the earth here is not made of withered and fractured rocks but is made of alternating layer of clay or silt and sand. However, in order to protect the slopes, following measures have been undertaken in association with provision of vegetation on the slopes.

Fill Slopes

i) Soil from tunnel excavation has been planned to be used for fill material of the approach road. The material consists of rock and sandy soil and is considered to be suitable for filling material. (Soil from the nearby mountains should not be used for fill material. Particularly, the top layer of the area is composed of Kalimati, literally meaning black soil formed by sediments of lake. Kathmandu Valley used to be a lake in the past).

ii) The fill slopes 1:1.8 or gentler are applied.

iii) Berms are provided for fill height exceeding 5 meters.

Cut Slopes

i) The cut slope of 1:0.8 to 1.0 is applied.

ii) Berms are provided when the height exceeds 5 meters.

10.9 DRAINAGE DESIGN

As described in section 10.3, open ditch will be constructed for both cut section and embankment section. Road surface water move to both side of the open ditch then discharge to river or stream shown in **Figure 10.9-1**. Surface water volume at road section will calculate the open ditch size / pipe culvert size which will be determined in the detailed design stage.

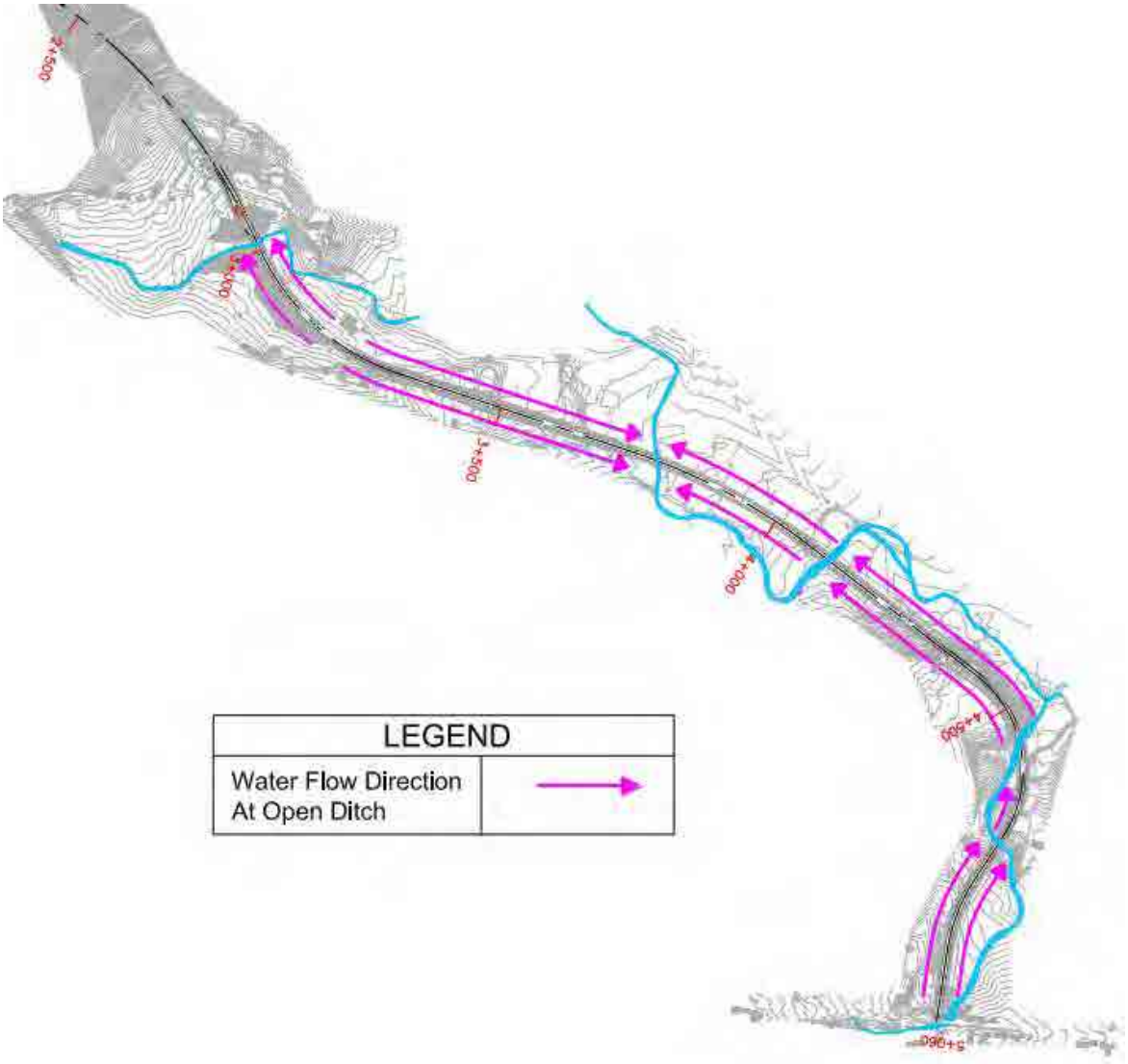


FIGURE 10.9-1 DRAINAGE DESIGN CONCEPT AT APPROACH ROAD SECTION

CHAPTER 11

PROJECT COST ESTIMATE

CHAPTER 11
PROJECT COST ESTIMATE

Confidential

CHAPTER 12

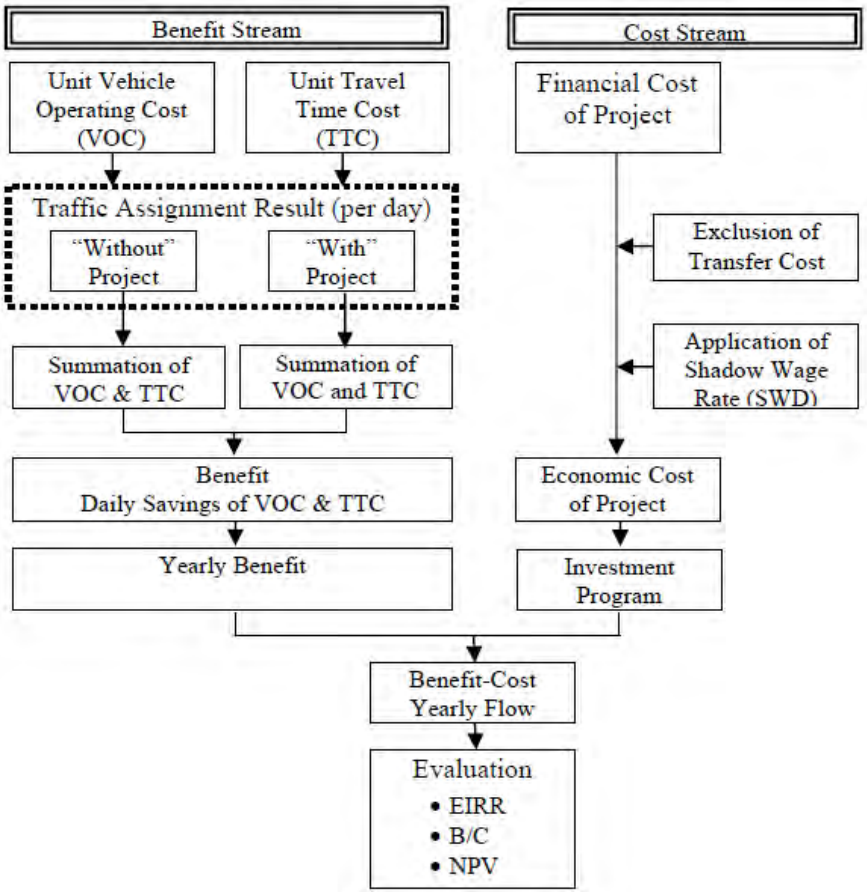
ECONOMIC AND FINANCIAL EVALUATION

CHAPTER 12
ECONOMIC AND FINANCIAL EVALUATION

12.1 ECONOMIC EVALUATION

12.1.1 Methodology

The economic analysis shall be determined whether the construction and operation of the proposed project will be feasible based on the benefits and costs to be derived from the project. The road projects such as Nagdhunga tunnel construction project can play a very important role in strength of the accessibility and economic growth. It is required however, that the project must be economically viable, satisfying the government-prescribed hurdle rates. Annual economic cost and benefits shall be estimated under "With project" and "Without project" case. The difference in economic costs and benefits in both cases shall be attributed to the project and subjected to economic feasibility measurement. The economic feasibility of the project shall be indicated by the Economic Internal Rate of Return (EIRR), Cost Benefit Ratio (CBR), and Net Present Value (NPV) at an assumed discount rate of 12%, which is acceptable social discount rate for economic appraisal of public investment projects in the development bank such as world bank. The hurdle rates for economic feasibility are the following: EIRR > 12%, B/C > 1.0, and NPV > 0. Sensitivity of the project arising from adverse changes in costs and benefits shall be examined to establish the capacity of the project to exhibit economic feasibility under these cases.



Source: JICA Survey Team

FIGURE 12.1-1 WORK FLOW OF ECONOMIC EVALUATION

Economic costs and benefits throughout the project life periods are compared by a discount cash flow analysis. The discount rate (hereinafter referred to as "DR") is at 12%, which is widely used in World Bank project as a social discount rate. For economic evaluation, three

indicators are calculated: Economic Internal Rate of Return (hereinafter referred to as "EIRR"), Cost Benefit Ratio (CBR, hereinafter referred to as "B/C") and Net Present Value (hereinafter referred to as "NPV").

In addition, the economic life is assumed to be 30 years from 2022 to 2051, taking into account future rapid growth and changes of socioeconomic conditions. Therefore, the Pro-forma cash flow of a project evaluation will be prepared for 2015-2051. They are defined as **Table 12.1-1**.

TABLE 12.1-1 INDICATORS OF ECONOMIC EVALUATION

No.	Indicators	Calculation Formula or Value
1	Net Present Value (NPV)	$\sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^{t-1}}$ *i=12.0%*
2	Benefit/Cost Ratio (CBR; B/C)	$\frac{\sum_{t=1}^{n} B_t/(1+i)^{t-1}}{\sum_{t=1}^{n} C_t/(1+i)^{t-1}}$ *i=12.0%*
3	Economic Internal Rate of Return (EIRR)	i_0: social discount rate that satisfies the following equation $\sum_{t=1}^{n} \frac{B_t - C_t}{(1+i_0)^{t-1}} = 0$

Source: JICA Survey Team

12.1.2 Economic Cost of the Project

(1) Initial Cost

The project cost must be estimated by shadow price in the cost benefit analysis. This is because market price is distorted by governmental system and policies such as custom duty, and market intervention. The shadow price expresses the real value of the resources. The Project cost of Nagdhunga Tunnel project is estimated in market prices in Chapter 11. It is converted into economic cost and the residual cost after the project life is calculated for economic evaluation, taking the following process.

a) Out of material and equipment cost, import duty and value added tax (VAT) at 13% are deducted.
b) The life year will be considered at 30 years

TABLE 12.1-2 IMPLEMENTATION SCHEDULE AND ECONOMIC COST

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(2) Operation and Maintenance Cost

The Operation and Maintenance Cost was estimated. The operation and maintenance cost per year is for tunnel infrastructure and facilities including electricity, tunnel management office

running with staff cost, and maintenance work / replacement of parts. As road user fee will be considered for the vehicle passing this tunnel, operation and maintenance cost for toll gate is charged in this study.

TABLE 12.1-3 OPERATION AND MAINTENANCE COSTS

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12.1.3 Economic Benefit of the Project

Economic benefits are calculated according to multiplied the estimated traffic volumes and Vehicle Operating Cost (VOC) /Travel Time Cost (TTC) respectively for each case, and the amount of 'without' case minus 'with' case is considered as the benefit provided by the project.

(1) Unit Vehicle Operating Cost (VOC)

The VOC per unit distance is estimated by type of vehicle being composed of the following components; they are a) fuel cost, b) oil cost, c) tire cost, d) spare parts cost, e) depreciation cost, f) capital opportunity cost and g) crew and overhead cost. The type of vehicles is 6 type of vehicles, passenger car, micro-bus, mini-bus, heavy bus, light truck, and heavy truck.

The department of roads use the VOC estimated by HDM-4 in PIP report in 2007. However, unite VOC is not opened in this report. In this study, the VOC is calculated based on road user costs knowledge system by world bank refer to the basic idea of PIP report and interview to certain car owner or truck company for collecting the basic information of operation and maintenance cost for vehicle. And also, due to intended road section is very hard uphill road; the VOC should be considered gradient condition. In term of these aspects, the VOCs depending on the gradient type is estimated. Finally, the VOC estimated was confirmed adequacy by the comparison to the realistic situation from owner of vehicle.

TABLE 12.1-4 UNIT VOC BY SIX VEHICLE TYPES IN 2014

Gradient= 0 NPR/veh-km

Speed (km/hr)	Car	S_Bus	M_Bus	H_Bus	L_Truck	H_Truck
10	26.9	35.8	77.4	135.2	30.7	127.8
20	23.5	29.8	54.8	89.0	26.9	95.1
30	20.2	23.8	32.3	42.7	23.1	62.4
40	19.4	22.6	28.8	36.6	22.2	55.0
50	18.3	21.0	24.3	29.1	20.7	45.0
60	17.5	19.8	21.3	24.3	19.6	38.4

Gradient= 3.2% NPR/veh-km

Speed (km/hr)	Car	S_Bus	M_Bus	H_Bus	L_Truck	H_Truck
10	27.0	36.3	83.9	155.0	32.4	136.7
20	23.7	30.2	59.4	102.0	28.4	101.7
30	20.3	24.1	35.0	48.9	24.4	66.7
40	19.6	23.0	31.2	41.9	23.4	58.9
50	18.5	21.3	26.3	33.3	21.9	48.1
60	17.6	20.0	23.1	27.9	20.7	41.1

Gradient= 7.0% NPR/veh-km

Speed (km/hr)	Car	S_Bus	M_Bus	H_Bus	L_Truck	H_Truck
10	28.0	41.3	105.4	211.5	40.9	182.3
20	24.5	34.4	74.6	139.2	35.9	135.6
30	21.0	27.4	43.9	66.8	30.8	89.0
40	20.3	26.1	39.2	57.3	29.6	78.5
50	19.1	24.2	33.0	45.5	27.6	64.1
60	18.3	22.8	29.0	38.0	26.2	54.8

Source: JICA Survey Team

(2) Unit Travel Time Cost (TTC)

The Travel time cost is the lost cost for travel by vehicle. TTC should be considered for economic analysis of this tunnel construction project. Because the income and price are increasing every year in Nepal, therefore, it is not affordable to ignore this item if considering the economic increasing in Nepal. The Travel Time Cost is normally calculated based on the average labor productivity and income in the country. As DoR don't configure official TTC for road project in Nepal, the Survey Team estimated TTC per vehicle-km based on income level, working time and occupancy from OD survey on roadside by type of vehicle.

Basically, reduction in travel time is the main component in the derivation of the TTC saving. The annual savings was calculated as the difference in travel time between the base road network and with Nagdhunga tunnel project. Due not to collect the latest official income data, the information based on the interview to authorities in Nepal government was used as the average income per income level. The unit TTC of vehicles will also be corresponded to the six (6) vehicle types of estimated such as 1) Passenger Car, 2) Micro-bus, 3) Mini-Bus, 4) Heavy Bus and 5) Light Truck, 6) Heavy truck, which is shown in **Table 12.1-5**.

TABLE 12.1-5 UNIT TRAVEL TIME COST IN 2014

Classification	NPR/veh.-min
Passenger Car	12.2
Micro-bus	22.1
Mini-bus	18.4
Large Bus	58.8
Light truck	3.3
Heavy truck	7.6

Source: JICA Survey Team

(3) Estimation of Economic Benefit (VOC and TTC Saving)

Based on the unit VOC by vehicle type by vehicle speed and the total vehicle-km, VOC saving by year will be estimated. The daily TTC saving by year also will be estimated based on the unit TTC by vehicle type and the total vehicle-hour. **Table 12.1-6**.

TABLE 12.1-6 ECONOMIC BENEFIT

	Economic Benefit (billion NPR / year)		
year	Saving of TTC	Saving of VOC	Total
2020	1.2	1.0	2.2
2025	1.5	1.3	2.8
2030	2.0	1.6	3.6
2035	1.7	1.3	3.0

**2015: Sindhuli road will be in service*
***2031: Fast track road will be in service*
Source: JICA Survey Team

12.1.4 Results of Economic Analysis

The result of economic analysis is shown at **Table 12.1-7**. The economic costs and benefits of the project generated a positive NPV and on EIRR that is higher than the government prescribed hurdle rate (12%). These values indicate that the project is economically viable.

TABLE 12.1-7 RESULT OF ECONOMIC ANALYSIS

No.	Indicators	Result
1	Net Present Value (NPV)	494 Million NPR
2	Benefit/Cost Ratio (CBR; B/C)	1.05
3	Economic Internal Rate of Return (EIRR)	12.5%

**Social discount rate is 12.0%*
Source: JICA Survey Team

12.1.5 Project Sensitivity

The Project Sensitivity to the identified risks is shown in **Table 12.1-8**. Results show that the project is able to hurdle the minimum acceptance criteria of EIRR =12.0%. In order to hurdle the minimum criteria EIRR=12.0%, it is necessary to keep within the 10% down of the benefits or cost increase of 10%.

TABLE 12.1-8 PROJECT SENSITIVITY

	Base	Cost plus 10%	Cost plus 20%
Base	12.5%	11.8%	10.9%
Benefit less 10%	11.7%	10.7%	9.9%
Benefit less 20%	10.5%	9.6%	8.9%

Source: JICA Survey Team

TABLE 12.1-9 ECONOMIC ANALYSIS

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CHAPTER 13

ENVIRONMENTAL AND SOCIAL CONSIDERATION STUDY

CHAPTER 13
ENVIRONMENTAL AND SOCIAL CONSIDERATION STUDY

13.1 EIA AND RAP SYSTEM IN NEPAL

13.1.1 EIA in Nepal

(1) Laws, Rules and Standards

1) National Laws and Others Related to Environmental and Social Impacts Control

Following table is the list of laws, guidelines and reviewing institutions the Project need to consult with. For EIA review procedure, both the EPA/EPA of MOSTE and the ESMF of DOR/GESU shall be the legal base. For detailed technical guidance of EIA survey and review procedure, the ESMF shall be the main resource.

In Nepal, soil disposal activity related to a road project is considered as a part of the Road Construction Project, and impacts from the proposed road and the soil disposal are reviewed in the same process. Therefore, the soil disposal activity does not require separate permission.

TABLE 13.1-1 NATIONAL LAWS AND OTHERS RELATED TO ENVIRONMENTAL AND SOCIAL IMPACTS CONTROL

Topic		Name of Laws and Regulations	Reviewing Institution
Development review and permission	EIA/IEE	Environmental Protection Act (1997) Environmental Protection Rules (1997)	MOSTE
		Environmental and Social Management Framework (2007)	DOR/GESU
Power generation licensing		Electricity Act (1993)	Ministry of Energy Nepal Electricity Authority
Pollution prevention	Environmental Standards	Nepal Gazette B.S. 2060/4/19 (4 August, 2003) (Air) Nepal Gazette, BS 2054-9-8 (Gas emission from vehicles)	MOSTE Ministry of Works and Transport
	Soil disposal	Environmental and Social Management Framework (2007)	DOR/GESU MOSTE District Village
	Waste control	Environmental and Social Management Framework (2007)	DOR/GESU MOSTE District Village
Natural environment	Forest clearance Biodiversity conservation	Nepal Forest Guidelines (2006)	MOFSC
	Underground water	None	
	Rivers	None	
	Nature conservation	National Parks and Wildlife Conservation Act (1973)	MOFSC
Cultural heritage		Ancient Monument Preservation Act, Ancient Monuments Preservation Rules 2046 (1989)	Ministry of Culture, Tourism and Civil Aviation
Social considerations	Community forest	Forest Act (1993)	MOFSC District Forest users' group
	Drinking water	Water Resources Act (1992)	District Irrigation Office
	Indigenous groups	National Foundation for Upliftment of Aadibasi/Janjati Act 2058 (2002)	DOR/GESU

Topic		Name of Laws and Regulations	Reviewing Institution
	Dalit groups	Caste-based Discrimination and Untouchability (Offence and Punishment) Act (2011)	DOR/GESU
	Land acquisition and compensation	Land Acquisition Act 2034 (1977)	DOR District
	Additional assistances	Environmental and Social Management Framework (2007)	DOR/GESU
	Underground property right	None	
	Land use change (agriculture to urban)	No governmental procedure is required.	N/A (Land owner's consent)

Source: JICA Survey Team

2) IEE/EIA According to EPA and EPR

According to the Section 3 of the Environmental Protection Act (EPA), and the Schedule 1 (IEE) and Schedule 2 (EIA) of the Environmental Protection Rule (EPR), the IEE/EIA report is required to include positive and negative impacts on physical, natural/biological, social, economic and cultural environment. The resettlement action plan and the vulnerable community development plan, which are required by the ESMF, will also be reviewed together with the EIA report. Those plan may be a part of the EIA report, or may be prepared as separate volumes. The final approval of the EIA report shall be awarded by the Environmental Auditing Committee, which is a consultative body of the MOSTE.

The EPA and the EPR went into practice in 1997. The EPR was amended in 1999. The electric files of English version of the 1997 EPA and the 1999 EPR are the only version available from the web site of the Nepal Law Commission. The EPA and the EPR are, however, have been amended 9 times in total, as shown in the next Table.

The amended Section 14 of the EPA is in **Annex13.1-1**.

The amended Schedule 2 of the EPA is in **Annex13.1-2**.

TABLE 13.1-2 HISTORY OF AMENDMENTS OF EPA AND EPR

Amendments			1	2	3	4	5	6	7	8	9
Date			2007. Aug.20	2009. Feb.2	2009. Feb.16	2009. Mar.9	2009. May.4	2010. Jan.27	2010. Aug. 12	2010. Oct.14	2012. Oct.29
EPA	Sec.14	Power to constitute Environment Protection Council			X						
EPR	Sec.15	Prevention and control of pollution					X		X		X
	Schedule 1 (Re: Sec. 3)	IEE target project Under Rule Section 3	X	X		X		X			
	Schedule 2 (Re: Sec. 3)	EIA target project Under Rule Section 3	X	X		X				X	

Source: JICA Survey Team, Nepal Gazettes

3) ESMF

The Environmental and Social Management Framework (ESMF) (2007, DOR) was developed to implement the World Bank supported 'Road Sector Development Project (RSDP)'. Then in 2012, the ESMF was made as Ministry-approved policy and since then the ESMF is the guideline applied for all the DOR projects. The reviewing institution for the ESMF is the Geo-Environmental and Social Unit (GESU) of DOR.

If a project is subject to IEE, GESU shall be the final reviewing and approving institution. For a project subject to EIA, GESU shall forward the EIA report to MOSTE through MOPIT for further review and approval.

The English and Nepali versions of the ESMF are available at the web site of DOR.

(http://www.dor.gov.np/documents/8.%20Environmental%20and%20Social%20Management%20Framework.pdf)

4) Eligibility of the Project for EIA Review

The list of the projects which are required impact review are summarized in the Schedule 1 (IEE) and Schedule 2 (EIA) of the Environmental Protection Rule.

This Project is subjected to EIA study 1) because it is a construction of new alignment of national highway, and 2) because the investment shall surpass NRs. 250 million (250,000,000).

Also, the Project is required to apply for MOFSC Project Approval, in the view point of biodiversity conservation, since the Western Portal of the proposed tunnel is located in national forest.

MOFSC and MOE (Ministry of Energy) may join the review of the EIA report as members of the Environmental Auditing Committee, when the scale of the national forest clearance and the electricity transmission line is decided by the Project.

TABLE 13.1-3 ELIGIBILITY OF THE PROJECT FOR EIA REVIEW

	Target Project	Eligibility of this Project
EPR Schedule 2	**EIA Eligibility**	
A. Forest Sector	12. Proposal implementing through other organization instead of forest related government agencies clearing more than 5 hectares of forest.	Yes (national forest) No (area of clearance)
D. Road Sector	1. Construction of the following roads: (a) National highways.	Yes
L.1.	Operation of any plan, project or programme relating to any developmental work physical activity or change in land use except the proposals mentioned in Clause (a) to Clause (K), and those below the standards of such proposals, as well as the proposals below the standards of those mentioned in schedule -1, with a cost of more than Two Hundred Fifty millions Nepali Rupees (Rs. 250,000,000.).	Yes
EPR Schedule 1	**IEE Eligibility (Overruled by Schedule 2)**	
A. Forest Sector	4. Clear felling or rehabilitation of national forests with an area of not more than 5 hectares.	Yes (national forest) Yes (area of clearance)
D. Road Sector	5. Construction of tunnels	Yes
E. Water Resources and Energy Sector	1. Supply of electricity through the constructions of transmission lines of 33 to 66 KV capacity.	No (11 KV)

Source: Schedule 1 and 2, Environmental Protection Rule (2012)

TABLE 13.1-4 EIA STATUS SUMMARY

Issue	Condition	Additional Information
EIA Status Based on the Nepal Laws and Regulations	Required (Under official procedure)	Full EIA and approval of MOSTE for new construction of National Highway
Status of other necessary environmental permit(s) Name(s) of required permit(s) :	Required. The review process is ongoing as of August 2014. Forest clearance permission from Ministry of Forest and Soil Conservation	Application was submitted June 26, 2014 to DOR. The application is to be forwarded to MOFSC and relevant (Kathmandu) District Forest Office.

Source: JICA Survey Team

(2) STEPS AND SCHEDULE OF EIA APPROVAL PROCEDURE

1) Nepali Standard Procedure

Based on the EPR, the ESMF, and interviews with DOR/GESU, MOSTE, MOFSC, and local consultants, the steps necessary in the Nepali EIA approval procedure are summarized in

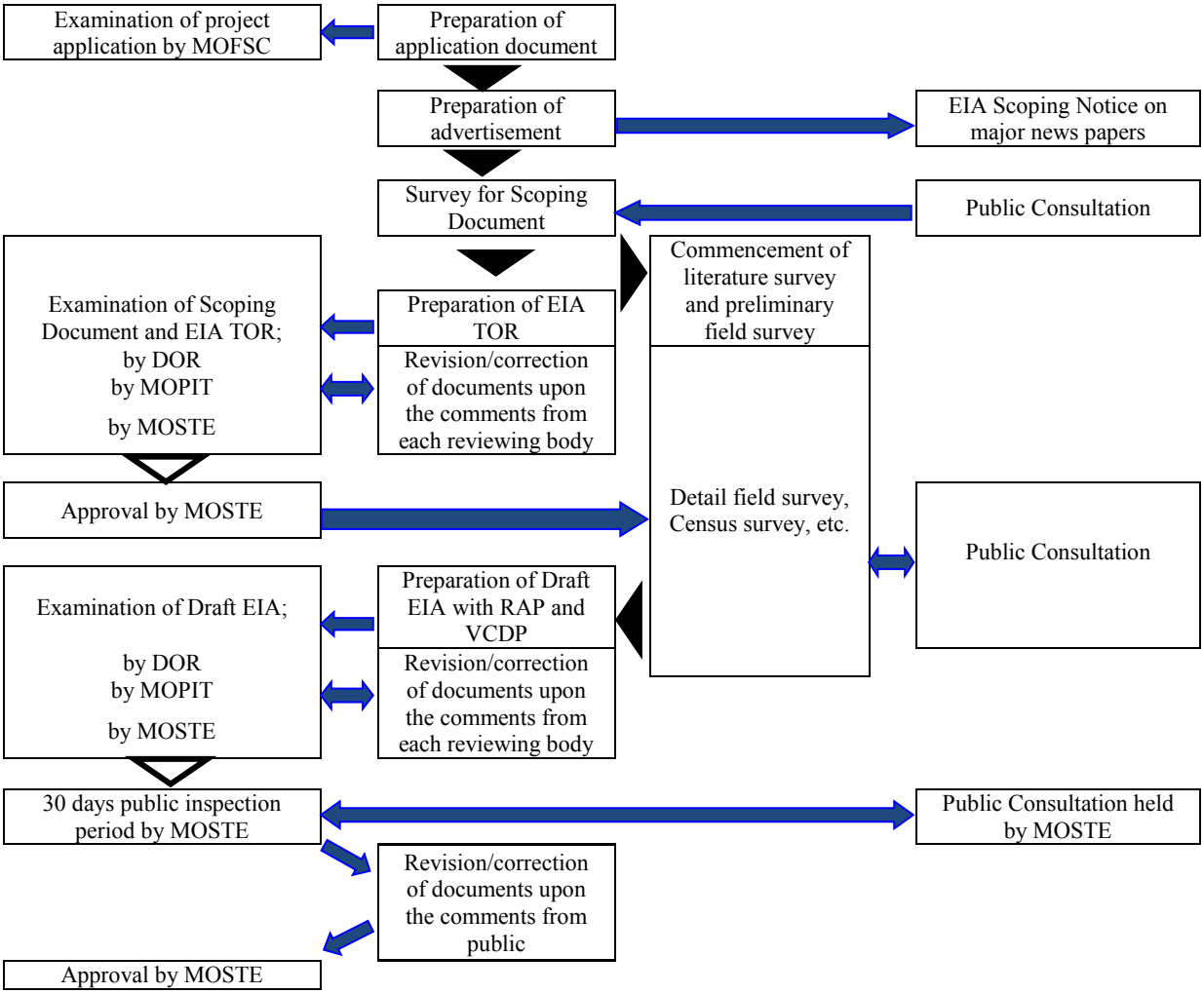
Figure 13.1-1 and **Table 13.1-5**.

First, the Project Proponent shall submit the Scoping Document and the EIA TOR for approval of all related institutions, i.e. DOR, MOPIT and MOSTE.

After obtaining the above approval, detailed field survey, such as interviews and census survey of the residents located on the ROW, may be started, with further local meetings to explain the purpose of such surveys.

The results of the surveys, together with evaluation of the impacts and their mitigation plans, shall be documented as the draft EIA report. The draft EIA report shall go through the same review and approval procedure as the Scoping Document.

The final approval of the EIA report by MOSTE is required before the commencement of the construction works.



Source: JICA Survey Team

FIGURE 13.1-1 EIA APPROVAL PROCEDURE

TABLE 13.1-5 EIA APPROVAL PROCEDURE

CONSULTANCY WORK **ADMINISTRATIVE DURATION**

No.	Activities	Duration Month
●	**MOFSC Permission**	
●	Document preparation for MOFSC approval	
●	Permission to start the EIA study is required from the Ministry of Forest and Soil Conservation (MOFSC) before executing Environmental Assessment	2 months
●	**Scoping and TOR**	
●	Publication of 15 days Scoping Notice (EPR, 2054- Rule 4.3)	0.5 month
●	Preliminary field survey and investigation. Scoping Notice affix and collection of deeds of notice affix at local institutions	0.5 month
●	Preparation and Submission of Scoping Report and TOR (In the format of EPR, 2054- Schedule 4) to DOR	1-1.5 month
●	Review of the Reports by DOR	0.5 month
●	Incorporation of suggestions and recommendations provided by the DOR and submission to MOPIT through DOR	0.5 month
●	Review of Scoping and TOR by MOPIT	1 month
●	Presentation of Scoping and TOR at MOPIT	1 day
●	Incorporation of suggestions and recommendations provided during presentation in Scoping and TOR and submit to MOPIT through DOR	0.5 month
●	Forward of Scoping and TOR to MOSTE from MOPIT	0.5 month
●	Review of Scoping and TOR by MOSTE	0.5 month
●	Presentation of Scoping and TOR at MOSTE	1 day
●	Incorporation of suggestions and recommendations in Scoping and TOR provided by MOSTE and its resubmission	0.5 month
●	Approval of Scoping and TOR from MOSTE	1 month
●	**EIA Study**	
●	Survey Team Mobilization, Interaction with stakeholders and meetings at local level	0.5 month
●	RAP Study, Cadastral Survey, Census Survey, Data Enumeration	1 month
●	Literature Review, Review of Acts, Policies, Legislations and Guidelines and Analysis and prediction of impacts	0.5 months
●	Propose Mitigation and Augmentation Measures and Preparation of Environmental Management Plan; Vulnerable Community Development Plan; Acquisition, Compensation and Resettlement Action Plan	1 month
●	Preparation of Draft EIA Report as per Schedule 6 of EPR, 2054	2 months
●	Publication of Notice for Public Hearing and Public Hearing as per EPR, Rule 7.2 at field sites	0.5 month
●	Submission of Draft EIA Report to DOR with the incorporation of opinions and suggestions collected from Public Hearing and Recommendation Letters from affected VDCs.	0.5 month
●	Review of the Draft EIA Report by DOR	0.5 month
●	Incorporation of Suggestions and Recommendations provided by DOR in Draft EIA Report and Submission 10 copies to MOPIT through DOR	0.5 month
●	Review of the Draft EIA Report by MOPIT	0.5 month
●	Incorporation of Suggestions provided by MOPIT in Draft EIA Report and Submission of 10 copies to MOSTE through DOR and MOPIT	0.5 month
●	Review of the Draft Final EIA Report by MOSTE	0.5 month
●	PP Presentation of Draft Final EIA Report at MOSTE	1 day
●	Incorporation of Suggestions provided by MOSTE during presentation in Draft Final EIA Report and Re-Submission to MOSTE through DOR and MOPIT	0.5 month
●	Issuance of 30 day public notice in daily newspaper for public opinions and suggestions by MOSTE and Approval of EIA report by MOSTE as per EPR, Rule 11.2, 11.4, 11.5 and 11.6)	3 to 4 months

Source: JICA Survey Team

13.1.2 RAP System in Nepal and Resettlement Policy for this Project

This Project Activity that may lead to land being expropriated or to people being resettled by the construction of the approach (access) road, construction of the proposed tunnel, soil disposal site development by excavation of the tunnel, and land use alteration for ancillary facilities. Therefore, it is necessary to consider and to prepare a Resettlement Action Plan (RAP), which could be based on the JICA Environmental and Social Guidelines, 2004, as well as the World Bank Safeguard Policy.

On the other hand, there are some RAPs, which are based on the Environmental and Social Management Framework (ESMF), April 2007 as the main guideline for environmental and social issues associated with new road construction and upgrading in Nepal. Based on the ESMF, present main RAP system for road development project of Nepal are as follows:

(1) Institutional Responsibilities and Implementation Arrangements for RAP

1) Key Agencies at Different Level

At central level, the Ministry of Physical Planning and Works (MoPPW) will be the Executing Agency (EA) and Department of Roads (DoR) will be the Implementing Agency (IA) for this Sector Wide Road Program.

For all sub-projects forth coming under this Program, a Project Implementation Unit (PIU) will be established at DoR, headed by the Project Manager (PM). This PIU will be responsible for the overall planning, implementation and coordination of the sub-projects. All aspects relating to resettlement and land acquisition activities will be addressed in close consultation and collaboration of the GESU of DoR.

At District and village level, offices of various line ministries such as Home Physical Planning and Works, Agriculture and Co-operatives, Forest, Health, Education and Sports and others will be consulted during RAP implementation. Similarly, CBOs, NGOs and Civil Society of the concerned project area will equally be considered during the preparation and the implementation of the RAP.

2) Geo-Environment and Social Unit (GESU)/or Social Unit (SU) of DoR

The Geo-Environment and Social Unit (GESU) plays a key role while incorporating proper social safeguard measures in all projects designs related to road development in Nepal. The GESU will have a Senior Resettlement Expert (SRE) to assist PIU.

The SRE will monitor of land acquisition and resettlement operations and vulnerable/indigenous people's issues. S/he will report to the Project Manager at PIU. S/he will work in close coordination with the concerning Division Road Offices under DoR, field-based consultants' offices and Project NGO/s on the day-to-day activities of the resettlement plan implementation.

A Social Development/Resettlement Specialist from the Project Supervision Consultants will support the SRE updating the sub project RAPs based on detailed design. S/he will also be responsible in supervision and coordination of all activities related to resettlement implementation for all the sub-projects.

3) Implementing NGOs

NGOs experienced in resettlement, rehabilitation and livelihood restoration will be engaged as partner organization with Project Supervision Consultant (PSC) to provide facilitation services for implementation of resettlement plan and activities.

4) Implementation Schedule for the RAP

The Project Proponent will ensure that funds are delivered on time to the Compensation Fixation Committees (CFC) and the implementing Consultants and partner NGOs for timely preparation and implementation of the RAP, as applicable. Civil works contracts will not be awarded unless required compensation payment has been completed.

However, a social preparation initiative including income rehabilitation measures may continue and be completed even after civil works has begun.

(2) Resettlement Policy for this Project

The development projects undertaken by the Department of Road (DoR) must serve the public well and in the design and implementation of such projects, all efforts will be executed to help ensure that Project-affected Persons (PAPs) are not worse off. In addition, the Project should provide an opportunity for the local population to derive benefits from the Project.

This portion shall provide a tool, which will also help ensure that all PAPs along the road project, regardless of their number, receive the appropriate assistance in a fast and timely manner. For achieving the goal, the Project will follow the principles in accordance with those in the ESMF in Nepal, which has been mainly based on the World Bank Policy OP/BP 4.12.

Main basic resettlement policies/principles for this Project are as follows:

- The Government of Nepal is bound to follow the Project Resettlement Policy (the Project Policy) for the Nagdhunga Tunnel Construction Project specifically which is intended to comply with the JICA Guidelines.
- Where there are gaps between the Government of Nepal legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.
- Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.
- Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.
- Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their:
  - Standard of living adversely affected;
  - Right, title or interest in any house, interest in, or right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently;
  - Income earning opportunities, business, occupation, work or place of residence or habitat adversely affected temporarily or permanently; or
  - Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning.

- All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above.
- Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives.
- All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and inventory of lost assets(IOL), are entitled to compensation for their lost assets (land and/or non-land assets), at replacement cost, if available and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.

13.2 GAP ANALYSIS BETWEEN NEPAL EIA/RAP SYSTEM AND JICA GUIDELINE

The compensation and assistance requirements of the ESMF are prepared for the WB-assisted project, the Road Sector Development Project, in 2007, and are used for all the projects of DOR since 2011.

The DOR projects, therefore, are implemented according to the framework which is equivalent to the requirements of the JICA guidelines, including in the area such as calculation of compensation amount, additional assistances for resettlement of residents without legal ownership of lands, and assistances for business losses as shown in **Table 13.2-1**.

Remaining issue is to verify how to define 'market price' in Nepali society, and whether the decisions in Kathmandu and Dhading District Compensation Committees justly reflect the market price.

Such conditions are confirmed by interviews with DOR/GESU, and by the existing reports listed in the following **Table 13.2-2**.

TABLE 13.2-1 GAPS BETWEEN JICA AND GON RESETTLEMENT POLICY

Gaps listed in the M/M dated April 17, 2014 and others			Typical operation of DOR based on ESMF	Remaining GAP and/or survey
Key Policy Gaps	JICA Guideline (World Bank O.P.4.12)	Government Laws		
Compensation Principle	All the compensation is based on the principle of replacement cost	Compensation rate will be determined by CDC, consisting of CDO , (ii) representative from DDC (iii) Chief of Land Revenue Office (iv) Project Manager, (Land Acquisition Act Clause 13) The Land Acquisition Act 1977, also mention the need of considering periodic circulations issued by the GoN while fixing compensation for the affected assets (Land Acquisition Act Clause 16)	DPs are allowed to take salvaged materials. CDC will make final decision on the compensation rates after viewing and verification of affected.	1) Whether the provisions be made for the replacement cost for the loss of land, houses/ structures by CDC is under survey. 2) There is no official license for real estate appraiser/valuer for land, houses/ structures. Most transactions are conducted face to face of selling and buying side. Real estate broker industry is not licensed without any common professional rules. How to determine rational replacement cost is under survey.
Compensation for Non-titleholders	Squatters/ vulnerable encroachers/non- title holders are entitled to the payment for affected structures/ houses/ business/ crops, trees, and other assistance	Do not consider squatters/ encroachers/ non-titled land users for compensation	ESMF (p. 7-9, 10) provides encroacher/ squatter and non-registered tenant/renter/lease holder does not qualify for compensation for land losses; however they will be entitled to compensation for crops, and compensation for full or partial loss of house and other structures at full replacement cost of materials and labor according to house/structure type, with no deduction for depreciation. Every displaced household will receive transportation allowance on actual cost basis.	None.
Relocation Assistance	A all the eligible DPs including tenants, employees are entitled to receive financial assistance to cover physical and economical displacement	LA Act Clause 16-2 provisions to consider extent of losses caused due to relocation/ shifting of Displaced people, while fixing the compensation rate (LA Act Clause 16-2.	ESMF (p. 7-11) provides Displacement Allowances; 1) each displaced household will receive equivalent to 2 months poverty line income, 2) Renters will receive 35 days notice or rental stipend equivalent to 0.5 month poverty line income plus transportation assistance; 3) every household of displaced businesses will be entitled to a	None.

Gaps listed in the M/M dated April 17, 2014 and others			Typical operation of DOR based on ESMF	Remaining GAP and/or survey
Key Policy Gaps	JICA Guideline (World Bank O.P.4.12)	Government Laws		
			business displacement allowance for loss of commercial establishment.	
Income Restoration	Income restoration program such as training and other measures to restore and improve the standard of living of the displaced households of those having more than 10 % of the total landholdings and income	Apparently, the Land Acquisition Act 1977, do not consider for income restoration.	ESMF (p. 7-11, 12) requires assistance with training in life skills, preferential access to road construction employment for 1) households/APs having significant impacts, 2) households of the vulnerable categories, 3) APs family members over 16 years of age.	None.
Grievance Procedures	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	There are provisions for the Compensation Determination Committee (CDC).	ESMF (p 7-15) provides. For each sub-project a grievance redress mechanism will be established to allow APs to appeal any disagreeable decisions, practices, and activities arising from compensation for land, assets settlements, and technical and general project-related disputes.	None
Compensation payment timing	Compensation and other kinds of assistance must be provided prior to displacement.	There are provision that compensation for land is paid after determination of rates and verification of the list of entitled applicants by the Compensation Determination Fixation (CFC).	ESMF (p 7-24) provides. The project will ensure that civil works are not started on any subproject sites before compensation and assistance to the affected population have been provided in accordance with the Resettlement Policy Framework.	No major gap.

Source: JICA Survey Team

TABLE 13.2-2 RECENT CASE OF THE ESMF-APPLIED PROJECTS

Project	Report Title	Dated
Nepal India Trade and Transport Facilitation Project(NITTFP)	Vulnerable Community Development Plan, Narayanghat- Mugling Road	January, 2013
	Resettlement Action Plan, Narayanghat-Mugling Road	January, 2013
Road Sector Development Project (New Project Preparation and Supervision Services) (IDA grant NO: H339 – NEP)	(Draft) Review and update of initial environmental examination study report for upgrading of Gokuleswor to Thaktholi (chainage: km 54+000 – km 92+400)	August 2010
	(Draft) Initial Environmental Examination Study Report for Upgrading of Thaktholi to Darchula (Chainage: km 92+400 – km 126+000)	August 2010
Road Sector Development Project (AF) (IDA GRANT NO: H629 – NEP) (IDA CREDIT NO: 4832 – NEP) (New Project Preparation and Supervision Services)	Resettlement Action Plan, Gokuleswor-Thaktholi- Darchula Road	January 2011

All the above reports were prepared by;
MMM Group ltd. (Canada), in JV with Sai Consulting Engineers (p) Ltd. (India), in association with Iteco Nepal (p) Ltd. (Nepal) & Total Management Services (Nepal)
Source: http://www.dor.gov.np/publication/index_category.php?cat=RSDP-RESETTLEMENT ACTION PLAN
http://www.dor.gov.np/publication/index_category.php?cat=Nepal India Regional Trade and Transport Project NIRTTP
http://www.dor.gov.np/publication/index_category.php?cat=Supplementary Resettlement Action Plan SRAP
http://www.dor.gov.np/publication/index_category.php?cat=ADB reports
http://www.dor.gov.np/publication/index_category.php?cat=Updated ESMF

One condition that may need attention is that the compensations and assistances in urban area are paid in cash. Land-for-land type compensation and provision of resettlement housing is

quite difficult in the urban area where every piece of land, including steep slopes, is intensely used by private owners.

The other limitation of Nepali condition is that, in terms of environmental impacts during the construction phase, governmental agencies may not have proper monitoring capacity, and most part of responsibility shall be on the contractor. Further study is necessary for the standard operation as well as the capacity of quantitative monitoring by private consultants.

13.3 ACHIEVEMENT SO FAR REGARDING THE EIA APPROVAL PROCEDURE

13.3.1 Consultation with MOF and Awarding the Priority Project Status

In the meeting with MOPIT and JICA in July 2014, the Project was nominated as the Priority Project (P1 Project).

In the meeting between DOR and the Team on August 12, DOR confirmed that the Project will surely be regarded as the National Priority Project from its importance and necessity.

The Team shall continue its effort to obtain any official document to prove the P1 status of the Project either from DOR, MOPIT or MOF. At the same time, the Team shall pay its full effort for faster handling of EIA approval at MOPIT and MOSTE, with support of DOR and JICA Nepal.

13.3.2 Project Application to MOFSC

On June 26, 2014, the Team submitted the project application document for MOFSC to DOR/GESU to request approval to commence the EIA study of the Project that affect national forest. The document was forwarded to MOFSC through MOPIT for approval. As of September 11, 2014, the application document had been reached to the Kathmandu District Forest Office for review. DOR/GESU notified the Team that neither Department of Forest nor the District Office had found any substantial cause to stop the Project. DOR/GESU is expected to receive an official approval document from MOFSC.

The application document is included in **Annex 13.3-1**.

13.3.3 JICA Screening Result

The Team drafted the following Screening Sheet and submitted to DOR/GESU on June 30, 2014.

Screening Format

Name of Proposed Project: The Preparatory Survey for Nagdhunga Tunnel Construction Project
Project Executing Organization, Project Proponent or Investment Company:
Ministry of Physical Infrastructure and Transport, Department of Roads
Name, Address, Organization, and Contact Point of a Responsible Officer:

Name: Engineer Devendra KARKI, Director General
Address: Babarmahal, Kathmandu
Organization: Department of Roads, Ministry of Physical Infrastructure and Transport
Tel: +977-1-4262675
Fax: +977-1-4262993
E-Mail: devendra@dor.gov.np
Date:
Signature:

Check Items

Please write "to be advised (TBA)" when the details of a project are yet to be determined.

Question 1: Address of project site:

From Naubise VDC at Dhading District to Balambu VDC at Kathmandu District

Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)

2-1. Project profile (scale and contents)

New construction of 3-lane tunnel and 2-lane approach road (national highway) as follows:

- Tunnel Length: 2.45 km
- Approach Road Length: 2.60 km
- Approach Road ROW: 50 m

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

■YES: Please describe the higher program/policy）

"An Approach Paper to the 13th Plan (FY2013/14 – FY2015/16)"

□NO

2-3. Did the proponent consider alternatives before this request?

■YES: Please describe outline of the alternatives

（A detailed comparison of 3 alternatives were conducted after a screening process from the 5 initially proposed alternatives during the Data Collection Survey on Thankot Area Road Improvement in Nepal" ）

□NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

□Implemented ■Not implemented

If implemented, please mark the following stakeholders.

□Administrative body

□Local residents

□NGO

□Others （ ）

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

■New □Ongoing (with complaints) □Ongoing (without complaints)

□ Other （ ）

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE) Is, required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why EIA is required.

■Necessity (□Implemented ■Ongoing/planning)

(Reason why EIA is required: This proposed development activities include construction of a new section of National Highway in Nepal. In this case an EIA needed based on Environmental Protection Act in Nepal.)

☐Not necessary

☐Other (please explain)

Question 5:

In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.

□Approved without a supplementary condition	□Approved with a supplementary condition	■Under appraisal

(Date of approval: Competent authority:)

□Under implementation

□Appraisal process not yet started

□Other ( )

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

□Already certified

Title of the certificate: ( )

■Requires a certificate but not yet approved

Title of the certificate:(Approval to proceed EIA study by Ministry of Forest and Soil Conservation)

□Not required

□Other 〔 〕

Question 7:

Are any of the following areas present either inside or surrounding the project site?

□Yes ■No

If yes, please mark the corresponding items.

□National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

□Primeval forests, tropical natural forests

□Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)

□Habitats of endangered species for which protection is required under local laws and/or international treaties

□Areas that run the risk of a large scale increase in soil salinity or soil erosion

□Remarkable desertification areas

□Areas with special values from an archaeological, historical, and/or cultural points of view

□Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

□Yes ■No

If yes, please mark the appropriate items.

□ Large-scale Involuntary resettlement (scale: households persons)

□ Large-scale Groundwater pumping (scale: m3/year)

□Large-scale Land reclamation, land development, and/or land-clearing (scale: hectors)

□ Large-scale Logging (scale: hectors)

Question 9:

Please mark related adverse environmental and social impacts, and describe their outlines.

■Air pollution

☐Water pollution

☐Soil pollution

■Involuntary resettlement

☐Local economies, such as employment, livelihood, etc.

☐Waste
■Noise and vibrations
☐Ground subsidence
☐Offensive odors
☐Geographical features
☐Bottom sediment
☐Biota and ecosystems
■Water usage
☐Accidents
☐Global warming

☐Land use and utilization of local resources
☐Social institutions such as social infrastructure and local decision-making institutions
☐Existing social infrastructures and services
☐Poor, indigenous, or ethnic people
☐Misdistribution of benefits and damages
☐Local conflicts of interest
☐Gender
☐Children's rights
☐Cultural heritage
☐Infectious diseases such as HIV/AIDS
☐Other ( )

Outline of related impact:

- Small-scale involuntary resettlement may occur.
- Some adverse impacts such as air, noise/vibration during construction and operation phase may occur.
- Excavation of the tunnel may affect ground water level and local aquifer.
- Depending on the alignment, any poor (lower cast) may affect adverse impacts on the present living conditions. The impacts will be avoided and/or minimized by implementation of the Vulnerable Community Development Plan.

Question 10:

In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?

☐Yes ■No

Question 11:

Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

■Yes ☐No

End.

13.3.4 JICA Scoping Result

As of July 2014, The Project activities that may cause environmental and/or social impacts were recognized as listed in **Table 13.3-1**.

TABLE 13.3-1 RECOGNIZED CAUSE OF IMPACTS

Phase	No.	Cause of Impacts: Activities, Existence of Facilities and Structures
Planning Phase	1	Land acquisition of the Work Area
	2	Lease of land parcels along the existing District Road
	3	Clearing of ROW of existing highway
Construction Phase	4	Transportation generation of construction materials and workers
	5	Clearance of forest trees
	6	Activities of construction equipments and tools
	7	Construction and use of the staging area, concrete mixing plant, storage, etc.
	8	Construction and use of the Workers' Camp, including septic tanks
	9	Employment of workers and caretakers
	10	Construction and operation of the water treatment plant for the turbid water from construction sites.

Phase	No.	Cause of Impacts: Activities, Existence of Facilities and Structures
	11	Water intake for the concrete plant, other construction facilities and the Workers' Camp
	12	Construction of the soil disposal site, and disposal
	13	Construction of the Tunnel (Excavation, facilities, pavement, etc.)
	14	Construction of road facilities (Toll post, tunnel management office, electricity system, backup generator, weigh bridge, etc.)
	15	Construction of the Approach Road (Filling, cutting, bridges and culverts)
	16	Construction of the temporal stand-by area/ holding parking space for construction vehicles along the District Road (on lease)
Operation Phase	17	Existence of new road and traffic
	18	Existence of road facilities (Used site for staging area and other facilities)
	19	Used site for disposal area
	20	Traffic on the existing highway

Source: JICA Survey Team, 2014

Environmental and social items that may be affected by the above listed activities, facilities and structures are selected as shown in **Table 13.3-2**.

Then the Team drafted the Scoping Table, shown as **Table 13.3-3**, and submitted to JICA on June 30, 2014,

TABLE 13.3-2 ENVIRONMENTAL IMPACT SCOPING MATRIX

Pollution

			Planning Phase			Construction Phase													Operation Phase			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Land acquisition of the Work Area	Lease of land parcels along the existing District Road	Clearing of ROW of existing highway	Transportation generation of construction materials and workers	Clearance of forest trees	Activities of construction equipments and tools	Construction and use of the staging area, concrete mixing plant, storage, etc.	Construction and use of the Workers' Camp, including septic tanks	Employment of workers and caretakers	Construction and operation of the water treatment plant for the turbid water from construction sites.	Water intake for the concrete plant, other construction facilities and the Workers' Camp	Construction of the soil disposal site, and disposal	Construction of the Tunnel (Excavation, facilities, pavement, etc.)	Construction of road facilities (Toll post, tunnel management office, electricity system, back up generator, weigh bridge, etc.)	Construction of the Approach Road (Filling, cutting, bridges and culverts)	Construction of the temporal stand-by area/ holding parking space for construction vehicles along the District Road (on lease)	Existence of new road and traffic	Existence of road facilities (Used site for staging area and other facilities)	Used site for disposal area	Traffic on the existing highway
1	Air	NO2 or NOx				X		X											X			+
		SO2 or SOx																				
		Dust, SPM (PM10, PM2.5)				X		X	X	X				X	X	X		X				+
2	Water (surface, public)	BOD or COD								X										X		
		SS												X	X		X					
		N and P																				
		Temperature																				
		pH																				
		DO																				
3	Waste	Solid Waste							X	X		X								X		
		Soil													X		X					
		Liquid Waste								X		X			X							
4	Soil	Soil contamination						X	X													
5	Noise and vibration	Noise						X											X			
		Vibration																				
6	Ground subsidence	Ground subsidence																				
7	Odor	Odor																				
8	Bottom sediment	Bottom sediment																				

Natural Environment

			Planning Phase			Construction Phase													Operation Phase			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Land acquisition of the Work Area	Lease of land parcels along the existing District Road	Clearing of ROW of existing highway	Transportation generation of construction materials and workers	Clearance of forest trees	Activities of construction equipments and tools	Construction and use of the staging area, concrete mixing plant, storage, etc.	Construction and use of the Workers' Camp, including septic tanks	Employment of workers and caretakers	Construction and operation of the water treatment plant for the turbid water from construction sites.	Water intake for the concrete plant, other construction facilities and the Workers' Camp	Construction of the soil disposal site, and disposal	Construction of the Tunnel (Excavation, facilities, pavement, etc.)	Construction of road facilities (Toll post, tunnel management office, electricity system, backup generator, weigh bridge, etc.)	Construction of the Approach Road (Filling, cutting, bridges and culverts)	Construction of the temporal stand-by area/ holding parking space for construction vehicles along the District Road (on lease)	Existence of new road and traffic	Existence of road facilities (Used site for staging area and other facilities)	Used site for disposal area	Traffic on the existing highway
9	Protected Area	Protected Area																				
10	Ecology	Protected flora species					*															
		Protected vegetation					*															
		Protected fauna species					*															
11	Water regime	Surface water (Volume, speed, depth)											X	X	X		X		X			
		Ground water (depth, location of aquifer)													X				X			
		Springs													X				X			
12	Geology	Slope stability												X	X		X		X		X	

Social and Economical Environment

		Planning Phase			Construction Phase													Operation Phase			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		Land acquisition of the Work Area	Lease of land parcels along the existing District Road	Clearing of ROW of existing highway	Transportation generation of construction materials and workers	Clearance of forest trees	Activities of construction equipments and tools	Construction and use of the staging area, concrete mixing plant, storage, etc.	Construction and use of the Workers' Camp, including septic tanks	Employment of workers and caretakers	Construction and operation of the water treatment plant for the turbid water from construction sites.	Water intake for the concrete plant, other construction facilities and the Workers' Camp	Construction of the soil disposal site, and disposal	Construction of the Tunnel (Excavation, facilities, pavement, etc.)	Construction of road facilities (Toll post, tunnel management office, electricity system, back up generator, weigh bridge, etc.)	Construction of the Approach Road (Filling, cutting, bridges and culverts)	Construction of the temporal stand-by area/ holding parking space for construction vehicles along the District Road (on lease)	Existence of new road and traffic	Existence of road facilities (Used site for staging area and other facilities)	Used site for disposal area	Traffic on the existing highway
13	Involuntary Resettlement and/or Loss of Properties	X		X																	
14	Poor,	X		X																	
15	indigenous, and marginalized groups, refugees																				
16	Local economy such as employment and livelihood				+					+			X			X		+			X
17	Land use, Local resource use, Communal/ Common resource use rights					X						X	X			X					
18	Water Rights /Water use	X										X	X			X		X	X		
19	Traffic/Public Facilities, infrastructures, Social services				X								X			X		+	+		
20	Social institutions/ infrastructures such as local decision-making systems, corporative																				
21	Uneven distribution of benefits and damages					X												X			X
22	Local conflict of interests					X												X			X
23	Physical splits of Communities															X					
24	Historical and cultural resources												X		X	X					
25	Landscape																				
26	Gender															X		+			
27	Children's rights																				
28	Sanitation, Public Health Condition, Infectious diseases such as HIV/AIDS								X			X							X		
29	Industrial safety and health, Working environment				X	X	X	X	X		X		X	X	X	X	X				
30	Accidents, crime Traffic accidents				X													X			
	Fire after traffic accidents																	X			
	Crime								X	X											
	Smuggling																	X			
31	Greenhouse gas																				
	Ozone depleting substances																				

TABLE 13.3-3 JICA ENVIRONMENTAL IMPACT SCOPING FORMAT

No.	Items		Planning Phase, Construction Phase	Operation Phase	Selected Reason (Reason of Priority, Location of Impacts)
1	Air	NO2 or NOx	B-	B-	CONSTRUCTION PHASE : Transportation vehicle on road and construction equipment at the work areas of the Project shall emit exhaust gas. OPERATION PHASE : Traffic exhaust gas on the Approach Road shall alter the existing air quality condition.
		Dust, SPM (PM10, PM2.5)	B-	C	CONSTRUCTION PHASE : Activities of the construction equipment at the work areas listed in the left cell, and the transportation vehicle of the Project shall cause dust, that will be diffused in the surrounding area..
2	Water (surface, public)	BOD	B-	C	CONSTRUCTION PHASE : Waste water from kitchen, bath and toilet shall be generated at the Camp at West Portal. OPERATION PHASE : Road facilities at West and East Portal, shall be equipped with toilet, and may also have kitchen and shower facilities.
		SS	B-	D	CONSTRUCTION PHASE : Culverts and bridges shall be constructed at the bottom of the Soil Disposal Site and at the Approach Road. During the construction of those structures, the river water will be muddier than its original state. The ground water discharged from the work area of the Tunnel shall be mixed with sands and clay on site.
3	Waste	Solid Waste	B-	C	CONSTRUCTION PHASE : Bags, containers and other wastes shall be generated at the staging area and work areas. Kitchen wastes and other types of wastes shall be generated at the Workers' Camp. Sludge from septic tank and water treatment plant shall be discarded at designated locations. OPERATION PHASE Workers at road facilities constructed at the used stock yard shall generate general wastes and septic tank sludge.
		Soil Waste	B-	D	CONSTRUCTION PHASE : The construction work shall generate excavation material.
		Liquid Waste	B-	C	Groundwater discharge is expected during the construction of the tunnel Kitchen, bath, and toilet at the Workers' Camp shall be treated in septic tank then overflow shall seep into the surrounding soil or discharged to waste water pipe. OPERATION PHASE Workers at road facilities constructed at the used stock yard shall generate liquid waste.
4	Soil	Soil contamination	B-	C	CONSTRUCTION PHASE : Oils and chemicals used in the construction phase may spill over at the Work Areas and the Stock Yards.
5	Noise	Noise	B-	C	CONSTRUCTION PHASE : Construction equipments and tools shall generate noise at the Work Areas. OPERATION PHASE : The noise from the traffic on the Approach Road shall be felt by local residents along the road.
6	Ground subsidence		D	D	No activities that may cause ground subsidence are planned related to the Project.

No.	Items		Planning Phase, Construction Phase	Operation Phase	Selected Reason (Reason of Priority, Location of Impacts)
7	Offensive Odor		D	D	No activities that may cause offensive odor are planned related to the Project.
8	Bottom Sediment		D	D	No activities that may cause contamination of bottom sediment in water bodies are planned related to the Project.
9	Ecology	Protected Areas	D	D	No protected areas are located in and near the Project Area.
10		Protected flora species	C	D	CONSTRUCTION PHASE : About 0.5 ha of national forest shall be cleared for the West Portal. Although there is low possibility of finding protected flora species in the Work Area, detailed field survey has never been done in the area, and it is worth studying at least for the academic record of the flora condition of the area.
		Protected vegetation	C	D	CONSTRUCTION PHASE : About 0.5 ha of national forest shall be cleared for the West Portal. Although there is low possibility of finding protected vegetation types in the Work Area, detailed field survey has never been done in the area, and it is worth studying at least for the academic record of the vegetation condition of the area.
		Protected fauna species	C	D	CONSTRUCTION PHASE : About 0.5 ha of national forest shall be cleared for the West Portal. Although there is low possibility of finding protected fauna species in the Work Area, detailed field survey has never been done in the area, and it is worth studying at least for the academic record of the fauna condition of the area.
11	Water regime	Surface water (Volume, speed, depth)	B-	D	CONSTRUCTION PHASE : 1. Water intake at Khatripauwa river for the concrete plant, other construction facilities and the Workers' Camp at the Stock Yard, throughout the Construction Phase, may affect water use of downstream. 2. During the first phase of the construction of soil disposal site, water drainage pipes or culverts shall be set at the bottom. While the construction is underway, water flow in Sisnekhola may be manipulated temporally. 3. By constructing the Tunnel, the ground water level in the area may become lower, and the volume of surface water flow may decrease. 4. During the construction of the bridges and culverts at the Approach Road, water flow in Bhanjyang Khola may be manipulated temporally. 5. During the construction of the Approach Road, the condition of the rain water discharge may be altered at the places where the road is located on the fill, until proper drainage is installed. OPERATION PHASE : Although the culverts and bridges shall be designed to accommodate sufficient volume of water, those structures may cause obstruction when the area suffers unusual scale of flood, and overflow in the surrounding area.
		Ground water (depth, location of aquifer)	B-	B-	CONSTRUCTION PHASE : OPERATION PHASE : By constructing the Tunnel, the ground water level in the area may become lower.
		Springs	B-	B-	CONSTRUCTION PHASE : OPERATION PHASE : By constructing the Tunnel, the ground water level in the area may become lower, and the volume of spring water may decrease.

No.	Items		Planning Phase, Construction Phase	Operation Phase	Selected Reason (Reason of Priority, Location of Impacts)
12	Geology	Slope stability	D	D	CONSTRUCTION PHASE : The Project road shall not cut natural steep slopes except at the West Portal. Artificial slopes, however, shall be constructed at the soil disposal site (fill slope), and at the Approach Road (cut slope and fill slope). OPERATION PHASE : Artificial slopes at the West Portal and the Approach Road need to be monitored and maintained to avoid slope collapse.
13	Involuntary Resettlement and/or Loss of Properties		B-	D	PLANNING PHASE: CONSTRUCTION PHASE : In total, about 14 ha of private land shall be acquired for ROW of the Approach Road and tunnel Portals. In the area, 3 residence houses and 2 business operation are recognized. Number who will be resettled are estimated as 8 households, 16 persons. Other area of the ROW is used mainly for private farming. Clearing of ROW of existing highway at Sisnekhola for the West Portal and the Stock Yard will require resettlement of 2 households, 12 persons. In addition to above, about 0.5 ha of national forest shall be cleared for the West Portal.
14	Poor		C	D	PLANNING PHASE: CONSTRUCTION PHASE : In total, about 14 ha of private land shall be acquired for ROW of the Approach Road and the West Portal. In total, the area, 5 residence houses 10 households, 28 persons shall be required to resettle. Other area of the ROW of the Approach Road is used mainly for private farming. Those who are affected may include people who belong to disadvantaged or marginalized social groups or other vulnerable population.
15	Indigenous or minority groups		D	D	According to the information from MOSTE, DOR, and related VDC Secretaries, there are no specific area in and near the Project Area where people who belong to indigenous or minority groups are residing in special circumstances. In general, the ratio of indigenous, minority, or marginalized groups among the total population in Kathmandu District is about 30 %. Similar situation is expected in the Project Area.
16	Local economy such as employment and livelihood		C	C	CONSTRUCTION PHASE : Local residents will lose their farming land for the construction of the soil disposal site and the Approach Road. The farming may be either subsistence farming or commercial farming. Such loss may have negative impacts on their livelihood. OPERATION PHASE : Road-side businesses may be activated along the Approach Road, while the bypassed part of the existing highway may receive less traffic and similar businesses may decline in the area.
17	Land use, Local resource use, Communal/ Common resource use rights		C	D	CONSTRUCTION PHASE : Most of the land to be included in the ROW is owned privately. In the Project Area, however, forest at Sisnekhola, and river water are used by local people as communal resource. Clearance of forest trees of about 0.5 ha at the West Portal will limit the yields of NTFP (NTFP : Non timber forest products) available. Water intake for the construction from Khatripauwa river

No.	Items	Planning Phase, Construction Phase	Operation Phase	Selected Reason (Reason of Priority, Location of Impacts)
				throughout the Construction Phase, may affect water use of downstream. While the drainage pipes or culverts are installed at the bottom of the soil disposal site at Sisnekhola, water flow of the river and irrigation canals may be disrupted temporally. Access to water for washing or any other purpose may be required to change during the Construction Phase of the Approach Road.
18	Water Rights /Water use	B-	C	PLANNING PHASE : Construction plan in the Work Area may affect water rights or facilities provided by the local water provider. CONSTRUCTION PHASE : Water intake for the concrete plant, other construction facilities and the Workers' Camp may affect existing water use during the Construction Phase (about 4 years). While the drainage pipes or culverts are installed at the bottom of the soil disposal site at Sisnekhola, water flow of the river and irrigation canals may be disrupted temporally. Access to water for washing or any other purpose may be required to change during the Construction Phase of the Approach Road. OPERATION PHASE : Access to water for washing or any other purpose may be required to change by construction of the Approach Road and heavy traffic. Road facilities located at each Portals shall need water for the staff. New demand for water may affect existing water use.
19	Traffic/Public Facilities, infrastructures, Social services	B-	B+	CONSTRUCTION PHASE : Daily traffic generation of the workers' movement, and material transportation to the Stock Yard and to the Work Areas will be added on to the traffic volume of the existing highway. Construction of the east and west intersections at the existing highway may require closure of 0.5 lane for one day. Construction of the drainage and retaining wall of the soil disposal site may require temporal closure of 0.5 lane. Construction of the Approach Road may affect access to public facilities or social services located nearby.
20	Social institutions such as social infrastructure and local decision - making institutions	D	D	The Project aims to construct a bypass road of already existing highway in the area near the existing road. Therefore, no significant impact is expected on the Social institutions such as social infrastructure and local decision - making institutions in the Project Area.
21, 22	Uneven distribution of benefits and damages Local conflict of interests	C	C	CONSTRUCTION PHASE : By reducing the area of registered community forest in the upper slope of Sisnekhola, the users may have to compete for the NTFP, or they may try to join in other Forest User's Groups located nearby. OPERATION PHASE : Road-side businesses may be activated along the Approach Road, while the bypassed part of the existing highway may receive less traffic and similar businesses may decline in the area.
23	Physical splits of Communities	C	C	CONSTRUCTION PHASE : During the Construction Phase, temporal closure of existing road may cause difficulties of movement among the population nearby. OPERATION PHASE : The linear Approach Road might split existing community for permanently.

No.	Items	Planning Phase, Construction Phase	Operation Phase	Selected Reason (Reason of Priority, Location of Impacts)
24	Historical and cultural resources	C	D	CONSTRUCTION PHASE : Locally worshipped cultural or religious resources may be affected by the Project.
25	Gender	C	D	CONSTRUCTION PHASE : During the construction of the Approach Road, access to the market, water source, or river (washing place) may be temporally obstructed and walking distance of homemaker may increase.
26	Children's rights	C	C	No specific negative impacts are expected by the activities of the Project. During the field survey, however, data collection on field and interviews to DOR/GESU and other related institutions shall be conducted for better decision and evaluation.
27	Sanitation, Public Health Condition, Infectious diseases such as HIV/AIDS	B-	C	CONSTRUCTION PHASE : If the living environment and water source are not kept in clean condition, infectious diseases may occur among the workers and may spread to the local residents.
28	Industrial safety and health, Working environment	B-	D	CONSTRUCTION PHASE : At every activity and location of construction works, there is possibility of accident, involving the workers or the general public passing by.
29	Accidents, crime Traffic accidents	B-	B-	CONSTRUCTION PHASE : Increased traffic on the existing highway may cause increase of traffic jam and accidents. OPERATION PHASE : Existence of Approach Road, Portals and Tunnel may cause increase of self-inflicted accidents and accidental encounters between people and cars.
	Fire after traffic accidents	D	B-	OPERATION PHASE : If a fire erupts following traffic accidents in tunnel, the impact shall be severe, and the tunnel may need to be closed for several months to re-install all the facilities.
	Crime	B-	D	CONSTRUCTION PHASE : Influx of workers with low morale may cause increase of troubles in the vicinity of Workers' Camp.
	Smuggling	D	B-	OPERATION PHASE : Since the traffic on the Project road shall not go through the Nagdhunga Police Check Point, illegal smuggling into Kathmandu Valley may increase.
30	Climate change, transboundary impacts	D	D	The Project plans to construct rather short, about 5 km, bypass road near the existing national highway. Therefore, there is no possibility of causing significant impact on climate change or transboundary impacts, i.e. impacts that cross over major watershed, jurisdiction of local government, or national borders. On the other hand, the Project need to consider impacts from climate change, such as increased possibility of slope failures and unexpectedly large storm and flooding. The Project is expected to contribute on reducing consumption of fossil fuel per vehicle on the section between the planned Portals, because the Project road offer shorter distance with gentler grade compared to the existing road.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.

Source: JICA Survey Team, 2014

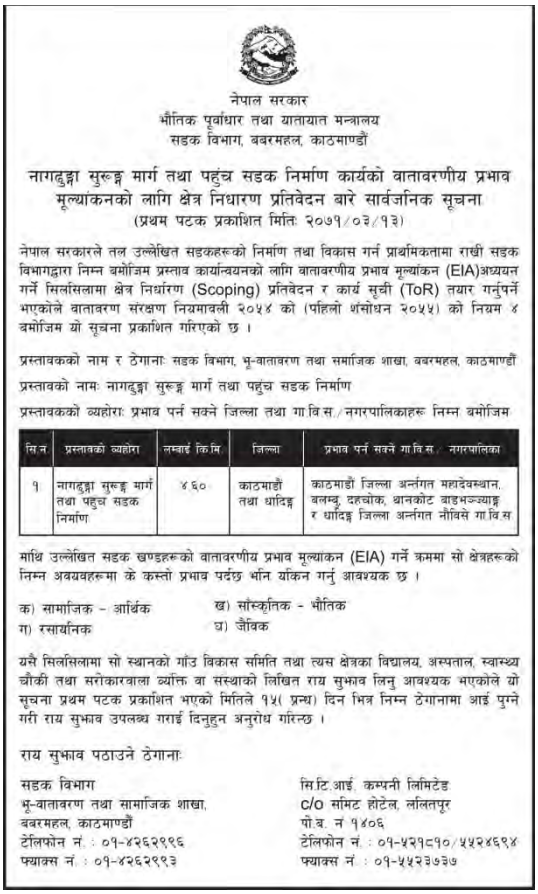
13.3.5 Fifteen Days Notice According to EPA

The public notice for scoping was published in Nepali on the Gholkapatra, a national daily newspaper, on June 28, 2014, on behalf of DOR. The copies of the public notice were also posted at the offices of the concerned VDCs of the project area, with approvals from the VDC Secretaries.

The purpose of public notice is to inform the stakeholders particularly of the project influence area about the project. The notice calls upon the concerned parties, project affected people, and in broader sense stakeholders to offer suggestions and concerns about natural systems, cultural practices, social systems, economic and human activities and interrelationships of environmental components.

Following are the issues and concerns raised by Local Government agencies, through their letters, in response to the Public Notice.

Those comments were also collected during the preparation of the Public Consultation, when the Team circulated general notice requesting local level stakeholders for participation in the meeting as shown in **Table 13.3-4**.



नेपाल सरकार
भौतिक पूर्वाधार तथा यातायात मन्त्रालय
सडक विभाग, बबरमहल, काठमाण्डौं

नागढुङ्गा सुरूङ्ग मार्ग तथा पहुंच सडक निर्माण कार्यको वातावरणीय प्रभाव मूल्यांकनको लागि क्षेत्र निधारण प्रतिवेदन बारे सार्वजनिक सूचना
(प्रथम पटक प्रकाशित मितिः २०७१/०३/१३)

नेपाल सरकारले तल उल्लेखित सडकहरूको निर्माण तथा विकास गर्न प्राथमिकतामा राखी सडक विभागद्वारा निम्न बमोजिम प्रस्ताव कार्यान्वयनको लागि वातावरणीय प्रभाव मूल्यांकन (EIA)अध्ययन गर्ने सिलसिलामा क्षेत्र निर्धारण (Scoping) प्रतिवेदन र कार्य सूची (ToR) तयार गर्नुपर्ने भएकोले वातावरण संरक्षण नियमावली २०५४ को (पहिलो शंसोधन २०५५) को नियम ४ बमोजिम यो सूचना प्रकाशित गरिएको छ ।

प्रस्तावकको नाम र ठेगानाः सडक विभाग, भू-वातावरण तथा समाजिक शाखा, बबरमहल, काठमाण्डौं

प्रस्तावको नामः नागढुङ्गा सुरूङ्ग मार्ग तथा पहुंच सडक निर्माण

प्रस्तावकको व्यहोराः प्रभाव पर्न सक्ने जिल्ला तथा गा.वि.स./नगरपालिकाहरू निम्न बमोजिम

सि.न.	प्रस्तावको व्यहोरा	लम्बाई कि.मि.	जिल्ला	प्रभाव पर्न सक्ने गा.वि.स./ नगरपालिका
१	नागढुङ्गा सुरूङ्ग मार्ग तथा पहुंच सडक निर्माण	४.६०	काठमाडौं तथा धादिङ्ग	काठमाडौं जिल्ला अर्न्तगत मगदेवस्थान, बलम्बु, दहचोक, थानकोट वाइभञ्ज्याङ्ग र धादिङ्ग जिल्ला अर्न्तगत नौविसे गा.वि.स

माथि उल्लेखित सडक खण्डहरूको वातावरणीय प्रभाव मूल्याकन (EIA) गर्ने क्रममा सो क्षेत्रहरूको निम्न अवयवहरूमा के कस्तो प्रभाव पर्दछ भनि यकिन गर्नु आवश्यक छ ।

क) सामाजिक - आर्थिक　　ख) सांस्कृतिक - भौतिक
ग) रसायनिक　　घ) जैविक

यसै सिलसिलामा सो स्थानको गाँउ विकास समिति तथा त्यस क्षेत्रका विद्यालय, अस्पताल, स्वास्थ्य चौकी तथा सरोकारवाला व्यक्ति वा संस्थाको लिखित राय सुझाव लिनु आवश्यक भएकोले यो सूचना प्रथम पटक प्रकाशित भएको मितिले १५(पन्ध्र) दिन भित्र निम्न ठेगानामा आई पुग्ने गरी राय सुझाव उपलब्ध गराई दिनुहुन अनुरोध गरिन्छ ।

राय सुझाव पठाउने ठेगानाः

सडक विभाग
भू-वातावरण तथा सामाजिक शाखा,
बबरमहल, काठमाण्डौं
टेलिफोन नं. : ०१-४२६२९९६
फ्याक्स नं. : ०१-४२६२९९३

सि.टि.आई. कम्पनी लिमिटेड
c/o समिट होटेल, ललितपुर
पो.ब. नं १४०६
टेलिफोन नं. : ०१-५२१८१०/५५२४६९४
फ्याक्स नं. : ०१-५५२३७३७

Source: JICA Survey Team, 2014

FIGURE 13.3-1　　FIFTEEN DAYS NOTICE

TABLE 13.3-4 RECOMMENDATIONS / SUGGESTION / CONCERNS AND ISSUES FROM STAKEHOLDERS

Topics		Recommendations / Suggestion / Concerns and Issues from VDC offices	Balambu	Mahadevsthan	Dahachok	Thankot	Baad Bhanjyang	Naubise
		PROJECT COMPONENTS						
Improving Road alignment	1	The improvement and upgrading of existing roads, up to some limited extent, seems to be touched by proposed road.	X		X	X	X	
Road facilities	2	In the proposed road, there must be proper facility of footpath and road lights.	X		X	X	X	
Road alignment	3	For the Oil Corporation Depot in Thankot, the proposed road must link that area. If not, then new approach road must be constructed.				X		
	4	The Tunnel road starting point is in Sisne khola at present. If it started by Naubise it will be much better.					X	
	5	The Tunnel road must start by Naubise and end at Badbhanjyan VDC, ward-2.					X	
Employment opportunities to local people	6	Priority must be given to locals in employment opportunities in the Project	X		X	X	X	
Local resource use	7	There must be maximum utilization of local sources and resources.	X		X	X	X	
Public consultation meetings	8	Only after the intensive public consultation meetings with the locals of affected VDCs, the project work is to be started.	X		X		X	
		LAND ACQUISITION AND COMPENSATION						
Compensation price for land	9	Keeping in view the sentiments and concerns of local people, there must be adequate compensation pattern and assurance	X		X	X	X	
	10	Throughout the Baad Bhanjyang VDC, there is tunnel road. Adequate compensation must be provided to the land owners who are having their land on the tunnel road. Then only work is to be started.					X	
Grievance redress mechanism	11	The proposed road seems to be economically and socially advantageous for the new the community. But the people who are living and earning in the previous route will be affected. So, the concerned agency must focus on the people who may negatively affected on the existing road.	X		X	X	X	
		NATURAL AND SOCIAL ENVIRONMENT						
Resource protection	12	The work construction work must be done without hampering the geography and environment of that area.	X		X	X	X	
Flora and fauna protection	13	Construction work will affect flora and fauna of the area. They should be protected.					X	
Water resource protection	14	The project work is to be done without hampering the local drinking water sources. If it happens the concerned agency must look upon the alternative drinking water source.	X		X	X	X	
	15	The drinking water source may be wipe out after construction of Tunnel road. Alternative of drinking source must be arranged.					X	

Topics		Recommendations / Suggestion / Concerns and Issues from VDC offices	Balambu	Mahadevsthan	Dahachok	Thankot	Baad Bhanjyang	Naubise
	16	Near the proposed tunnel road there are many natural drinking water sources. The people of ward-3 and 4 of Naubise VDC depend upon that source. So, during the construction of proposed tunnel road, the drinking water source must not be affected.						X
Soil disposal without affecting irrigation, agriculture and settlement	17	During construction of tunnel, the soil generated is planned to be disposed in Sisne khola. There are paddy fields and Irrigation at lower parts. During soil disposal there, it might affect settlements and fields by soil debris during rain. So, soil must be disposed in other place, or without affecting present irrigation system and settlement.						X

13.3.6 Public Consultation for Information Dissemination and Collection

After having the interval of 15 days from the publication of the Notice, the first public consultation meeting for scoping was held at two locations as shown in **Table 13.4-13**.

The detail of the meeting is described in **Section 13.4.5**.

13.3.7 Preparation and Submission of the Scoping Document and EIA TOR

As shown in **Table 13.3-5**, including the information obtained in the public consultation, the Team drafted the Scoping Document and the EIA TOR and submitted to DOR on August 1, 2014. After receiving the comments from DOR, the revised version of the documents were submitted to DOR, on August 12, 2014, for the second time, to be forwarded to MOPIT for review.

The documents are submitted to MOSTE by MOPIT, and MOSTE planned the Environmental Audit Committee on September 23. The meeting, however, was cancelled the day before due to an urgent family responsibility of the chair person.

The Committee was held on October 17. With the reflection of the expert comments submitted by October 19 from 5 experts, the revised version of the SD and TOR were submitted to MOSTE on October 22. The MOSTE approval is expected to be issued within one week after the revised documents are submitted to MOSTE.

TABLE 13.3-5 PREPARATION AND SUBMISSION OF THE SCOPING DOCUMENT AND EAI TOR

DATES	ACTIVITIES
June, 2014	Start preparation of the Scoping Document and EIA TOR
August 1, 2014	1st submission to DOR
August 7, 2014	Comments from DOR received
August 12, 2014	2nd submission of revised documents to DOR
August 15, 2014	The Scoping Document and EIA TOR reached to MOPIT for review
August 21, 2014	The Scoping Document and EIA TOR reached to MOSTE for review
September 23, 2014	The presentation at MOSTE to the Environmental Audit Committee was planned but cancelled the day before
October 17, 2014	The presentation at MOSTE to the Environmental Audit Committee
October 22, 2014	2nd submission of revised documents to MOSTE
November 16, 2014	*MOSTE approval of Scoping Document and EIA TOR*

13.3.8 Draft Preparation of JICA Environmental Checklist

The Team prepared the draft of JICA Environmental Checklist in August, 2014, and updated in October. The Checklist is included in **Annex 13.3-2**.

13.3.9 Remaining Works and Procedure

(1) Field Survey for EIA Report

Starting from August 2014, works for the data collection, impact prediction, and mitigation planning for the items listed in the following Table shall be conducted to prepare the draft EIA report.

Detailed census survey and property survey for RAP shall be conducted after the Scoping Document and the EIA TOR are approved by MOSTE.

TABLE 13.3-6 FIELD SURVEY ITEMS FOR EIA

No.	Field Survey Items for EIA	
1	Air	NO2 or NOx
		Dust, SPM (PM10, PM2.5)
2	Water (surface, public)	BOD
		SS
3	Waste	Solid Waste
		Soil Waste
		Liquid Waste
4	Soil	Soil contamination
5	Noise	Noise
10	Ecology	Protected flora species
		Protected vegetation
		Protected fauna species
11	Water regime	Surface water (Volume, speed, depth)
		Ground water (depth, location of aquifer)
		Springs
12	Geology	Slope stability
13	Involuntary Resettlement and/or Loss of Properties	
14	Poor	
16	Local economy such as employment and livelihood	
17	Land use, Local resource use, Communal/ Common resource use rights	
18	Water Rights /Water use	
19	Traffic/Public Facilities, infrastructures, Social services	
21, 22	Uneven distribution of benefits and damages Local conflict of interests	
23	Physical splits of Communities	
24	Historical and cultural resources	
26	Gender	
28	Sanitation, Public Health Condition, Infectious diseases such as HIV/AIDS	
29	Industrial safety and health, Working environment	
30	Accidents, crime Traffic accidents	
	Fire after traffic accidents	
	Crime	
	Smuggling	

Source: JICA Survey Team, 2014

(2) Preparation of the EIA Report

In the preparation of the EIA report, the Team shall stand on the following basic policies.

1) Proposal of environmental monitoring plan based on the enforcement capacity of the local institutions

It is the present condition that even MOSTE does not have sufficient ability to conduct periodical monitoring of environmental items such as traffic noise, vibration, air pollution, and ground water level.

Existing condition prior to the commencement of the construction works, together with the condition throughout the construction works, of such items must be monitored to define and evaluate the impacts of the Project scientifically.

Based on such reality, the environmental monitoring plan shall contain monitoring items and measures that are implementable by DOR or other responsible institutions. And the field survey during the EIA study shall also be conducted using the same items and measures so that the pre- and post-construction condition can be compared in simple manner.

2) Selection of technology related to tunnel construction to avoid and minimize negative impacts

While selecting the technology of tunnel construction and waste water management, the Team shall aim to avoid and minimize the negative impacts such as changes in ground water level, decrease of volume of drinking water source, and negative changes in the vegetation in community forest.

The Team shall also assume alternative water sources, such as wells and water distribution systems within the scope of the Project as preparation for unexpected impact arises.

3) Social communications in recognition of the uneven distribution of the Project merit

Among the local governments of the Project concerned, the section in Baad Bhanjyang VDC will be the Tunnel section and will not receive direct merit from the Approach Road or improved road network. In addition, the existing highway in the VDC may receive less traffic and the shops and eateries may see less customers and sales.

In Naubise VDC, where the soil disposal site is proposed, the merit of the Project may not be significant.

Based on such recognition, public consultations and other intercommunications with local offices and residents shall be carefully planned with the advises of consultants, local officers, and staff of DOR, to avoid unnecessary oppositions as well as to increase positive attitudes among the local stakeholders.

4) Information collection and communication with the District Compensation Committees, Legal Departments of DOR and MOPIT

The procedure of determination of compensation and assistance is still under survey. The Team shall continue information collection and communication regarding the 'market price,' and the amount of compensation and assistances in sample project.

Legal and governmental system to protect the tunnel structure is still under development in Nepal. Whether it is possible to monitor and restrict construction activities above the Tunnel, and whether there will be any compensation for such restriction, is not decided by GON.

In the mean time, the Land Acquisition Law and the Compensation Determination Committee shall be the legal and governmental system to handle the issue, since both are well used and recognized by ordinary society.

In the long term, however, considering that many road tunnel project will be implemented throughout Nepal, specific and technical legal base is necessary, as well as the permission system for construction activities and daily monitoring of tunnel structures.

The Team shall collect information in Nepal and in other countries and provide them to DOR or other respective institutions for assistance.

13.3.10 Updated Approval Schedule

So far, the EIA approval schedule is almost on time with the originally expected Fast Track procedure. In the most optimistic schedule, processing up to step No.26 as shown in **Table 13.3-7**, MOSTE is expected to award approval of the Project 5.5 to 6.5 month after February 2015

TABLE 13.3-7 EIA APPROVAL SCHEDULE OF THE PROJECT

No.	Activities	Month	Achievement
1	**MOFSC Permission**		
2	Document preparation and submission for MOFSC approval		Submitted June 26 to DOR/GESU.
3	Permission to start the EIA study is required from the Ministry of Forest and Soil Conservation (MOFSC) before executing Environmental Assessment	2	Permission granted Feb. 2, 2015
4	**Scoping and TOR**		
5	Publication of 15 days Scoping Notice (EPR, 2054- Rule 4.3)	0.5	Published on June 28.
6	Preliminary field survey and investigation. Scoping Notice affix and collection of deeds of notice affix at local institutions	0.5	
7	Preparation and Submission of Scoping Report and TOR (In the format of EPR, 2054-Schedule 4) to DOR	1-1.5	Submitted on August 1.
8	Review of the Reports by DOR	0.5	Comments received on August 7.
9	Incorporation of suggestions and recommendations provided by the DOR, and	0.5	Revised documents submitted on August 12 to DOR/GESU.
	Submission to MOPIT through DOR		August 15.
10	***Review of Scoping and TOR by MOPIT***	***1***	
11	PP Presentation of Scoping and TOR at MOPIT	1 day	Not required.
12	***Incorporation of suggestions and recommendations provided during presentation in Scoping and TOR and submit to MOPIT through DOR***	***0.5***	Not required.
13	***Forward of Scoping and TOR to MOSTE from MOPIT***	***0.5***	August 21.
14	***Review of Scoping and TOR by MOSTE***	***0.5***	
15	PP Presentation of Scoping and TOR at MOSTE	1 day	Oct. 17.
16	***Incorporation of suggestions and recommendations in Scoping and TOR provided by MOSTE and its resubmission***	***0.5***	Oct. 22
17	***Approval of Scoping and TOR from MOSTE***	***1***	Nov. 16
18	**EIA Study**		
20	RAP Study, Cadastral Survey, Census Survey, Data Enumeration	1	Cut off date (Refer to Section 13.4)
22	Propose Mitigation and Augmentation Measures and Preparation of Environmental Management Plan; Acquisition, Compensation and Resettlement Action Plan	1	
24	Publication of Notice for Public Hearing and Public Hearing as per EPR, Rule 7.2 at field sites	0.5	Public Hearing conducted on Jan. 2, 2015
25	Submission of Draft EIA Report to DOR with the incorporation of opinions and suggestions collected from Public Hearing and Recommendation Letters from affected VDCs.	0.5	Submission on Jan. 22, 2015
26	***Review of the Draft EIA Report by DOR***	***0.5***	DOR issued written comments on Feb. 18, 2015 (Delay occured since GESU Chief position became vacant by promotion of ex-chief.)
27	***Incorporation of Suggestions and Recommendations provided by DOR in Draft EIA Report and Submission 10 copies to MOPIT through DOR***	***0.5***	
28	***Review of the Draft EIA Report by MOPIT***	***0.5***	
29	***Incorporation of Suggestions provided by MOPIT in Draft EIA Report and Submission of 10 copies to MOSTE through DOR and MOPIT***	***0.5***	
30	***Review of the Draft Final EIA Report by MOSTE***	***0.5***	
31	PP Presentation of Draft Final EIA Report at MOSTE	1 day	
32	***Incorporation of Suggestions provided by MOSTE during presentation in Draft Final EIA Report and Re-Submission to MOSTE through DOR and MOPIT***	***0.5***	
33	***Issuance of 30 day public notice in daily newspaper for public opinions and suggestions by MOSTE and Approval of EIA report by MOSTE as per EPR, Rule 11.2, 11.4, 11.5 and 11.6)***	***3 to 4***	

Items in Italic are the critical passes of the schedule. The critical timing in future is shown by thick line in the chart.
Nepali holidays or unexpected governmental holidays are not considered in the above chart.

Source: JICA Survey Team

13.3.11 Summary of Baseline Survey and Forecast

The result of baseline survey and forecast of impacts are shown in **Table 13.3-8**.

Serious impacts on natural, pollution and socio-economic items are not expected.

Detailed information will be included in the Draft EIA Report to be prepared in the first half of

November.

TABLE 13.3-8 SUMMARY OF BASELINE SURVEY AND FORECAST

No.	Items		Final Rating		Summary of Result	
			Planning & Construction Phase	Operation Phase	Baseline	Forecast
1	Air	NO2	B-	B+/-	Measurement results are between 10.28 and 26.26 microgram/m3, below 80, the ambient air standard.	**CONSTRUCTION PHASE :** Construction vehicles and machines will add the emission, but condition will not surpass the standard. **OPERATION PHASE :** Concentration will increase at East Portal, will decrease at West Portal, stay same at the end of Approach Road, but all below the standard.
		PM10	B-	B+/-	Measurement results are between 217 and 337 microgram/m3, far over 120, the ambient air standard.	**CONSTRUCTION PHASE :** Construction vehicles and machines will add the emission, but contribution to the existing condition will be small. **OPERATION PHASE :** Concentration will increase at East Portal, will decrease at West Portal, stay same at the end of Approach Road, but condition will remain over the standard.
2	Water (surface, public)	BOD	B-	B-	Measurement results are between 1.8 and 6.2 mg/L, far below 100, the emission standard.	**CONSTRUCTION PHASE :** Emission of toilet and kitchen waste water to septic tank may affect the water quality but the contribution will be insignificant. **OPERATION PHASE :** Emission of toilet and kitchen waste water at road facilities may affect the water quality but the contribution will be insignificant.
		TSS	B-	B-	Measurement results are between 28.3 and 63.3 mg/L, far below 200, the emission standard.	**CONSTRUCTION PHASE :** While constructing the Bridges, Culverts, and drainage pipes under the Soil Disposal Site, TSS in Balkhu Khola and Sisnekhola will increase. Waste water from the Tunnel construction site will be treated under the standard. **OPERATION PHASE :** Slopes of fill and cut section of the Approach Road and the Soil Disposal Site may erode with heavy rain and contribute higher TSS in water downstream.
3	Waste	Solid Waste	B-	B-	Local municipalities provide a disposal site, and private services are available for waste transportation in the Project Area.	**CONSTRUCTION PHASE :** Sludge and toxic materials will be disposed to officially designated disposal area. House wastes shall be segregated and reused as much as possible. **OPERATION PHASE** Office wastes and septic tank sludge shall be in small volume and be treated in the same manner with wastes in the area.

No.	Items		Final Rating		Summary of Result	
			Planning & Construction Phase	Operation Phase	Baseline	Forecast
		Soil Waste	B-	D	Soil disposal is recognized as part of a road project in Nepal. No specific approval is required.	**CONSTRUCTION PHASE :** All the excavated material from the Approach Road shall be reused. All the excavated material from the Tunnel shall be used to construct relocated Highway and Roadside Rest Area at Sisnekhola. With appropriate handling of drainage and irrigation canal existing in Sisnekhola, negative impacts of soil waste will be insignificant.
		Liquid Waste	B-	B-	Measurement results of BOD are between 1.8 and 6.2 mg/L, far below 100, the emission standard.	**CONSTRUCTION PHASE :** Emission of toilet and kitchen waste water to septic tank may affect the water quality but the contribution will be insignificant. **OPERATION PHASE :** Emission of toilet and kitchen waste water at road facilities may affect the water quality but the contribution will be insignificant.
4	Soil	Soil contamination	B-	D	Sandstone, Phyllite, talus, and the fourth alluvial bed in the Project Area do not contain natural hazardous minerals and chemicals such as heavy metals.	**CONSTRUCTION PHASE :** Oils and chemicals used at the Construction Yards and the Work Areas may spill over, but can be contained in small area and soil contamination outside of the area will be avoided.
5	Noise	Noise	B-	B+/-	Measurement results are between 59.33 and 78.25 dB(A). All measurements are over the daytime and night time guideline standard.	**CONSTRUCTION PHASE :** Construction vehicles and machines will add the noise level, but contribution to the existing condition will be small. **OPERATION PHASE :** Compared to the existing conditions, noise level will be higher at East Portal, lower at West Portal, stay the same at the end of Approach Road, but conditions will remain over the standard.
6	Ground subsidence		D	D	No geological layers that may cause subsidence were found.	Direct and indirect activities in the Project will not cause ground subsidence.
7	Offensive Odor		D	D		No activities that may cause offensive odor are planned related to the Project.
8	Bottom Sediment		D	D		No activities that may cause contamination of bottom sediment in water bodies are planned related to the Project.
9		Protected Areas	D	D	No protected areas are located in and near the Project Area.	
10	Ecology	Protected flora species	*D*	*D*	Interview survey and field survey was conducted	**CONSTRUCTION PHASE :** No protected flora species are expected to be affected.

No.	Items		Final Rating		Summary of Result	
			Planning & Construction Phase	Operation Phase	Baseline	Forecast
		Protected vegetation	*D*	*D*	in the Work Area and in the 0.25 ha of national forest used by Community Forest User's Group.	**CONSTRUCTION PHASE :** No protected vegetation is expected to be affected.
		Protected fauna species	*B-*	*D*		**CONSTRUCTION PHASE :** 7 listed fauna species are reported to be spotted in the area near the Community Forest and their habitat may be negatively affected during the Construction Phase.
11	Water regime	Surface water (Volume, speed, depth)	B-	B-	The flow volume of Sisnekhola was average 19 Litter/ minute, that of Balkhu Khola was average 2,151 Litter/ minute in July and August, and 492 Litter/ minute in August and September.	**CONSTRUCTION PHASE :** Construction of drainage system in Sisnekhola, and bridges and culverts at Balkhu Khola will temporally affect the water flow. Location of water intake and discharge will be determined in the **Detailed Design Phase**, and the impacts of the intake shall be evaluated based on the design. **OPERATION PHASE :** The culverts and bridges on Balkhu Khola may cause obstruction when the area suffers unusual scale of flood, and overflow in the surrounding area.
		Ground water (Depth, location of aquifer)	B-	B-	Monitoring of water level and water quality was started in July 2014.	**CONSTRUCTION PHASE & OPERATION PHASE :** By constructing the Tunnel, the ground water level in the area will become lower, at least temporally. It is difficult to forecast the timing and level of recovery.
		Springs	B-	B-	Monitoring of water flow and water quality was started in July 2014.	**CONSTRUCTION PHASE & OPERATION PHASE :** By constructing the Tunnel, the volume of spring water in the area will become smaller, at least temporally. It is difficult to forecast the timing and level of recovery.
12	Geology	Slope stability	D	D	No vulnerable slopes are located along the Alignment.	**CONSTRUCTION PHASE & OPERATION PHASE :** Cut slopes and fill slopes are designed according to the slope standards. Surrounding area of the cut slopes and alignment shall be treated appropriately to prevent slope failure or debris flow. With measures above, no negative impacts are expected.
13	Involuntary Resettlement and/or Loss of Properties		B-	D	Cadastral Survey and Census Survey was conducted on the land owners and the house owners to be affected.	**PLANNING PHASE & CONSTRUCTION PHASE :** The estimated total land acquisition areas, which may need for compensation, will be 11.6 ha. The total number of the resettlement households will be 5 and the resettled peoples will be 27.

No.	Items	Final Rating		Summary of Result	
		Planning & Construction Phase	Operation Phase	Baseline	Forecast
14	Poor	*D*	D	Census Survey was conducted on the land owners and the house owners to be affected.	**PLANNING PHASE & CONSTRUCTION PHASE :** The PAPs to be resettled or whose farm land to be affected do not belong to the poor or vulnerable group.
15	Indigenous or minority groups	*D*	D	ditto.	*ditto.*
16	Local economy such as employment and livelihood	*D*	*D*	Field observation and sample interviews were conducted.	**CONSTRUCTION PHASE & OPERATION PHASE :** The negative impact of loss of farming land and decrease of traffic volume on existing HWY will be insignificant on local employment and livelihood.
17	Land use, Local resource use, Communal/ Common resource use rights	D	D	Farming in Nepal is mainly subsistence farming, and loss of farming land to public works may mean loss of livelihood for some households. 0.25 ha of a Community Forest will be cleared.	**CONSTRUCTION PHASE & OPERATION PHASE :** Loss of farming land or a part of a community forest will not cause negative impact on the local resource use.
18	Water Rights /Water use	B-	B-	Local residents use water wells and piped water for household needs. The source of the piped water is located on the ridge area about 2 km north east of the Eastern Portal. River water is used for washing, bathing, herding and irrigation, but at limited locations.	**CONSTRUCTION PHASE :** Construction of drainage system in Sisnekhola, and bridges and culverts at Balkhu Khola will temporally increase the turbidity of the water. Location of water intake and discharge will be determined in the **Detailed Design Phase**, and the impacts of the intake shall be evaluated based on the design. **CONSTRUCTION PHASE & OPERATION PHASE :** By constructing the Tunnel, the ground water level and spring water volume in the area will become lower, at least temporally. It is difficult to forecast whether the change affects water use by the residents.
19	Traffic/Public Facilities, infrastructures, Social services	B-	B+	East Portal is located close to a District Road. Existing Hwy need to be relocated at West Portal. Emergency vehicles are stopped by traffic jams on existing Hwy.	**CONSTRUCTION PHASE :** Relocation of existing road will cause traffic jam during the **Construction Phase**. **OPERATION PHASE :** Ambulances will have better access to the hospitals in Kathmandu.
20	Social institutions such as social infrastructure and local decision - making institutions	D	D	Alignment of the Project Road avoided physical impacts on social infrastructures.	**CONSTRUCTION PHASE & OPERATION PHASE :** No negative impacts are forecasted.

No.	Items	Final Rating		Summary of Result	
		Planning & Construction Phase	Operation Phase	Baseline	Forecast
21, 22	Uneven distribution of benefits and damages Local conflict of interests	B-	B-	Entire stretch of the Alignment in Baad Bhanjyang VDC is tunneled. Existing Hwy in the VDC will receive less traffic.	**CONSTRUCTION PHASE & OPERATION PHASE :** Since the existing road network in Baad Bhanjyang VDC does not provide good access to the Approach Road, it is understandable that the VDC may feel 'left out' from the Project benefit, unless additional improvement of road access to the Project Road is provided.
23	Physical splits of Communities	D	D	Alignment of the Project Road avoided physical splits of continuous communities.	**CONSTRUCTION PHASE & OPERATION PHASE :** No impacts are forecasted.
24	Historical and cultural resources	D	D	In the Basic Design Phase, no significant resources are to be affected by the Project.	**CONSTRUCTION PHASE :** In **Detailed Design Phase**, new information may become available.
25	Gender	D	D	The Approach Road crosses with major/moderate roads and foot passes at 4 places.	**CONSTRUCTION PHASE :** Alternate route for the closed section of the existing road and foot passes can be provided and the negative impacts on access to market or wash places will be insignificant.
26	Children's rights	D	D	In Nepali Child Labour Act 2001 (2056), it is prohibited to engage children below 16 years in works in construction works. However, children between 14 and 16 years may work light and low-risk jobs such as roadside planting and drainage clearing. (ESMF 3.4.9)	**CONSTRUCTION PHASE :** Contractor shall be responsible to fulfill the requirement of JICA and Nepali Law during the **Construction Phase**. **OPERATION PHASE :** DOR shall be responsible to fulfill the requirement of Nepali Law and other international guidelines during the **Operation Phase**.
27	Sanitation, Public Health Condition, Infectious diseases such as HIV/AIDS	B-	B-	Measurement results of BOD are between 1.8 and 6.2 mg/L, far below 100, the emission standard. Higher rate of HIV holders is reported from Nepali workers returned after working in India.	**CONSTRUCTION PHASE :** Emission of toilet and kitchen waste water to septic tank may affect the water quality but the contribution will be insignificant. Since the limited number of unskilled workers, occurrence possibility of infectious diseases is small when the workers are hired from local community. **OPERATION PHASE :** Emission of toilet and kitchen waste water at Roadside Rest Area may affect the water quality but the contribution will be insignificant.

No.	Items	Final Rating		Summary of Result	
		Planning & Construction Phase	Operation Phase	Baseline	Forecast
28	Industrial safety and health, Working environment	B-	B-	Many accidents and deaths are reported with the tunnel construction works for hydropower projects in Nepal. DOR road maintenance workers are provided with equipments, work manuals, and accidents insurances.	**CONSTRUCTION PHASE :** Negative impacts on health of workers and possibility of accidents shall be minimized by project design. However, it will be necessary to prepare for worst case scenario during the **Construction Phase**. **OPERATION PHASE :** DOR will need to provide special trainings and manuals to the maintenance workers of the Tunnel to reduce the accidents and health impacts.
29	Accidents, crime *Traffic accidents on surface road*	D	B-	Results of traffic count were 7,890 at Nagdhunga, and 15,450 near the end of the Approach Road.	**CONSTRUCTION PHASE :** Trip number of construction-related vehicle on public road are expected about 10 both way, and insignificant on existing Highway and District Road. **OPERATION PHASE :** With new opening of Highway section in agriculture area, the number of traffic accidents caused by drivers and pedestrians will increase for the mean time.
	Traffic accidents on tunnel road	D	B-	There is no road tunnel in Nepal yet. DOR does not have experience in road tunnel management.	**OPERATION PHASE :** With unfamiliar rule for Tunnel road, self-inflicted accidents are expected in and near the Tunnel. Until the Tunnel Management Office gets sufficient experiences and trainings, the operation of safety measures for the Tunnel traffic may be unreliable.
	Crime	B-	D	Human resource requirement in total will be between 50 to 130. The number of unskilled workers is expected to be between 18 to 34.	**CONSTRUCTION PHASE :** Since the limited number of unskilled workers, crime occurrence possibility is small when the workers are hired from local community. With migrant workers who do not have local community relationship, more careful monitoring and training may be necessary.
	Smuggling	D	D	The role of Nagdhunga Police Checkpoint against smuggling is not yet surveyed.	**OPERATION PHASE :** Coordination of police existence at West Portal shall be discussed in **Detailed Design Phase**.

No.	Items	Final Rating		Summary of Result	
		Planning & Construction Phase	Operation Phase	Baseline	Forecast
30	Climate change, transboundary impacts	D	B+	Baseline condition data will be available on the **Detailed Design Phase.**	**CONSTRUCTION PHASE :** No specific climate change and trans-boundary impacts are forecasted due to the site and the scale of the constructions. **OPERATION PHASE :** This Project will be contributed to adaptation measures (e.g. expansion capacity of the corrugated pipes in the drainage system) for expected increase on rainfall intensity as an adaptation option for climate change. But, necessary information/data for the prediction scenarios for expected climate change will be identified and available during the **Detailed Design Phase**.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.

Source: JICA Survey Team, 2014

13.3.12 Environmental Management Plan

A proposed mitigation plans during and after construction are shown in **Table 13.3-9**.

All cost for mitigation measures are to be finalized in the **Detail Design Phase**.

TABLE 13.3-9 ENVIRONMENTAL MANAGEMENT PLAN

No.	Parameters		Environmental Management Measures	Implementation Agency	Responsible Agency
1	Air	NO2	CONSTRUCTION PHASE : Appropriate preventive mitigation measures, such as selection of equipment and proper maintenance, will be taken. OPERATION PHASE : Control of the quality and amount of exhaust gas on the Approach Road will be difficult within the scope of road development project.	CONSTRUCTION PHASE : Contractor OPERATION PHASE : DOR	CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR, MOSTE, Traffic Police
		PM10	CONSTRUCTION PHASE : Appropriate preventive mitigation measures, such as spraying water at the work areas and washing the vehicles before they leave the construction sites, will be taken.	CONSTRUCTION PHASE : Contractor	CONSTRUCTION PHASE : DOR
2	Water (surface, public)	BOD	CONSTRUCTION PHASE & OPERATION PHASE : Appropriate capacity of septic tanks shall be installed at the facilities. The septic tanks shall be managed in appropriate manner.	CONSTRUCTION PHASE : Contractor OPERATION PHASE : DOR (Site office) Facility operators (Rest Area)	CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR
		SS	CONSTRUCTION PHASE : Turbid water discharged from the Tunnel construction site shall be appropriately treated at the Water Treatment Plant before discharge. Maximum turbidity avoidance measures shall be designed in the Construction Plan of the bridges and culverts.	CONSTRUCTION PHASE : Contractor	CONSTRUCTION PHASE : DOR

No.	Parameters		Environmental Management Measures	Implementation Agency	Responsible Agency
			Appropriate communication during the Construction Phase between the Contractor, water users and community leaders (i.e. VDC secretaries) and DOR shall be undertaken for information dissemination and grievance redress.		
3	Waste	Solid Waste	CONSTRUCTION PHASE & OPERATION PHASE : Necessary institutional coordination and budget plan for hiring collection and disposal service providers shall be undertaken. Workers and managers shall be trained for appropriate segregation and handling of solid wastes.	CONSTRUCTION PHASE : Contractor OPERATION PHASE : DOR (Site office) Facility operators (Rest Area)	CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR
		Soil Waste	PLANNING & CONSTRUCTION PHASE : Careful and thorough communication shall be undertaken in the Planning Phase so that the Disposal Site to be accepted. Design the Disposal Site so that the impacts on the water use downstream to be minimized.	PLANNING & CONSTRUCTION PHASE : Contractor	PLANNING & CONSTRUCTION PHASE : DOR
		Liquid Waste	CONSTRUCTION PHASE & OPERATION PHASE : Appropriate capacity of septic tanks shall be installed at the facilities. The septic tanks shall be managed in appropriate manner.	CONSTRUCTION PHASE : Contractor OPERATION PHASE : DOR (Site office) Facility operators (Rest Area)	CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR
4	Soil	Soil contamination	CONSTRUCTION PHASE & OPERATION PHASE : Education of the workers about the negative impacts of soil contamination. Training of good handling of the oils and chemicals to avoid soil contamination. Preparation of clear guidelines of handling, recycling and discarding the empty containers or bags of the chemicals. Designation of site managers who monitors condition of stock yards.	CONSTRUCTION PHASE : Contractor OPERATION PHASE : DOR (Site office) Facility operators (Rest Area)	CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR
5	Noise	Noise	CONSTRUCTION PHASE : Selection of low-noise type equipments and providing noise barriers at necessary locations. Control of work hours and days, i.e. stopping at night and weekends, near the vulnerable facilities and settlements. OPERATION PHASE : Proper management of the road to avoid unnecessary noise pollution.	CONSTRUCTION PHASE : Contractor OPERATION PHASE : DOR, Kathmandu Division Office	CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR
10	Ecology	Protected flora species	CONSTRUCTION PHASE : Avoid unnecessary disturbance of forest. Take all legal procedures, appropriate communication and coordination with the Community Forest User's Group and the Kathmandu Forest Office.	CONSTRUCTION PHASE : Contractor	CONSTRUCTION PHASE : DOR
		Protected vegetation	CONSTRUCTION PHASE : ditto.	CONSTRUCTION PHASE : ditto.	CONSTRUCTION PHASE : ditto.
		Protected fauna species	CONSTRUCTION PHASE : ditto.	CONSTRUCTION PHASE : ditto.	CONSTRUCTION PHASE : ditto.

No.	Parameters		Environmental Management Measures	Implementation Agency	Responsible Agency
11	Water regime	Surface water (Volume, speed, depth)	PLANNING & CONSTRUCTION PHASE : 1,2. Carefully select and decide the location and volume of the water intake to avoid disruption of important water use. Carefully and thoroughly take communication with the water users well before the commencement of the construction works.	PLANNING & CONSTRUCTION PHASE : Engineer, Contractor	CONSTRUCTION PHASE : DOR
			3. Continue the monitoring activities at important water use locations to examine the significance of the impact of tunnel construction. If the impact is found significant, mitigation measures, such as provision of alternative water source, shall be discussed with the water users. 4,5. Install sufficient capacity of rain water discharge facilities at the fill part of the Approach Road. Take good care of the discharge facilities to avoid clogging. If there are vulnerable areas or facilities, protection work shall be installed. OPERATION PHASE : Monitor the bridges and culverts to allow designed capacity of water flow.	OPERATION PHASE : DOR, Kathmandu Division Office	OPERATION PHASE : DOR
		Ground water (depth, location of aquifer)	PLANNING, CONSTRUCTION & OPERATION PHASE : Continue the monitoring activities through the Construction Phase and Operation Phase at important water use locations to examine the significance of the impact of tunnel construction. If the impact is found significant, mitigation measures, such as provision of alternative water source, shall be discussed with the water users.	PLANNING PHASE : Engineer CONSTRUCTION PHASE : Contractor OPERATION PHASE : DOR, Kathmandu Division Office or Tunnel Management Office	PLANNING PHASE : DOR CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR
		Springs	PLANNING, CONSTRUCTION & OPERATION PHASE : Continue the monitoring activities through the Construction Phase and Operation Phase at important springs to examine the significance of the impact of tunnel construction. If the impact is found significant, mitigation measures, such as provision of alternative water source, shall be discussed with the water users.	PLANNING, CONSTRUCTION & OPERATION PHASE : ditto.	PLANNING, CONSTRUCTION & OPERATION PHASE : ditto.
12	Geology	Slope stability	PLANNING & CONSTRUCTION PHASE : Adjust the Project design to comply with the safety standards, guidelines and good examples. OPERATION PHASE : Patrol the ROW to take preventive action for large scale slope failure.	PLANNING & CONSTRUCTION PHASE : Engineer, Contractor OPERATION PHASE : DOR, Kathmandu Division Office or Tunnel Management Office	PLANNING & CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR

No.	Parameters	Environmental Management Measures	Implementation Agency	Responsible Agency
13	Involuntary Resettlement and/or Loss of Properties	PLANNING & CONSTRUCTION PHASE: During the survey of the affected families to be resettled, information on the Project, the rights of the affected people, and Grievance redress system of DOR shall be disseminated. Resettlement Action Plan including land and asset evaluation, compensation and resettlement plan shall be implemented. When found necessary, Vulnerable Community Development Plan shall be implemented. Preference shall be given to the residents in the Affected Area who wish to work as unskilled labor in the Project. The advertisement of the recruitment shall be designed in the manner that as many local residents as possible has access to the information.	PLANNING & CONSTRUCTION PHASE: Engineer, Construction Supervisor	PLANNING & CONSTRUCTION PHASE: DOR
14	Poor	PLANNING & CONSTRUCTION PHASE: When found necessary, Vulnerable Community Development Plan shall be implemented. *<Limits of survey in Basic Design Phase>* *1. Only the list of the land owners shall be produced. Tenants of the farming land are not to be listed.* *2. The list of land owners shall be based on the information on the available Property Registration Form. Whether the information is updated or not shall not be examined.*	PLANNING & CONSTRUCTION PHASE: Engineer, Construction Supervisor	PLANNING & CONSTRUCTION PHASE: DOR
16	Local economy such as employment and livelihood	PLANNING PHASE: When found necessary, disadvantaged, marginalized, or other vulnerable population related to ROW shall be included as the target of the Vulnerable Community Development Plan. CONSTRUCTION PHASE : When found necessary and appropriate, trainings and consultation for job/skill improvement shall be operated.	PLANNING PHASE: Engineer CONSTRUCTION PHASE : Construction supervisor	PLANNING PHASE: CONSTRUCTION PHASE : DOR
17	Land use, Local resource use, Communal/ Common resource use rights	PLANNING & CONSTRUCTION PHASE : 1. Forest If there occur unexpected opposition against clearance of the forest in Detailed Design Phase or Construction Phase, with coordination of District Forest Offices, alternative source of the similar resource for the users shall be discussed. 2. Water If it is found that the planned water intake affects significantly to the existing water use in Detailed Design Phase or Construction Phase, consider developing alternative water source(s) to minimize the impact to acceptable level. Respect and reflect the access to important and popular water use spots by providing road crossings and other facilities that will benefit the water users.	PLANNING & CONSTRUCTION PHASE : Engineer, Contractor	PLANNING & CONSTRUCTION PHASE : DOR
18	Water Rights /Water use	PLANNING & CONSTRUCTION PHASE : If any water supply facilities are necessary to be destroyed by the Project, alternative facilities shall be provided as a part of the	PLANNING & CONSTRUCTION PHASE : Engineer,	PLANNING & CONSTRUCTION PHASE : DOR

No.	Parameters	Environmental Management Measures	Implementation Agency	Responsible Agency
		Project. If the planned water intake affects significantly to the existing water use, alternative water source(s) shall be provided to minimize the impact to acceptable level. Respect and reflect the access to important and popular water use spots by providing road crossings and other facilities that will benefit the water users. *For Operation Phase, see 'Water Regime.'*	Contractor *For Operation Phase, see 'Water Regime.'*	*For Operation Phase, see 'Water Regime.'*
19	Traffic/Public Facilities, infrastructures, Social services	CONSTRUCTION PHASE : If there occur unexpected, significant impact of the Construction on the access to public facilities and services, propose mitigation plan such as minimizing the number of days of the obstruction, or flexible opening and closure of the access for the convenience of the users of the facilities and services.	CONSTRUCTION PHASE : Contractor	CONSTRUCTION PHASE : DOR
21, 22	Uneven distribution of benefits and damages Local conflict of interests	PLANNING PHASE: Outside of the Project scope, DOR shall discuss with Kathmandu District Engineer and Baad Bhanjyang VDC about the possible measure to improve the road access condition in the VDC, including black topping of existing road or new provision of the access road to the Project Road and Tunnel.	PLANNING PHASE: DOR	PLANNING PHASE: DOR
		CONSTRUCTION PHASE : *(Same as 17)* If there occur unexpected opposition against clearance of the forest in Detailed Design Phase or Construction Phase, with coordination of District Forest Offices, alternative source of the similar resource for the users shall be discussed.	CONSTRUCTION PHASE : Engineer, Contractor	CONSTRUCTION PHASE : DOR
		CONSTRUCTION PHASE : *(Same as 16)* When found necessary and appropriate, trainings and consultation for job/skill improvement shall be operated.	CONSTRUCTION PHASE : Construction supervisor	CONSTRUCTION PHASE : DOR
23	Physical splits of Communities	PLANNING PHASE: Identified important / priority crossings shall remain either as underpasses or bridges, no matter the size of the existing passes.	PLANNING PHASE: Engineer	PLANNING PHASE: DOR
		CONSTRUCTION PHASE : Where the Approach Road passes a community, the construction and road control schedule shall be notified and coordinated with concerned community, well before the commencement of the construction work at the particular place.	CONSTRUCTION PHASE : Contractor	CONSTRUCTION PHASE : DOR
24	Historical and cultural resources	CONSTRUCTION PHASE : In case unexpected resources are found during the Construction Phase, careful and thorough communication with the local community shall be taken to find out the way to minimize the significance of the impact.	CONSTRUCTION PHASE : Contractor Construction supervisor	CONSTRUCTION PHASE : DOR
26	Gender	CONSTRUCTION PHASE : Avoid total closure of the important access to the market, water source or river as much as possible. If obstruction is not avoidable, information dissemination to the community regarding the	CONSTRUCTION PHASE : Contractor Construction supervisor	CONSTRUCTION PHASE : DOR

No.	Parameters	Environmental Management Measures	Implementation Agency	Responsible Agency
		timing of start and finish of the obstruction shall be carefully and thoroughly conducted in the manner that as many local women as possible has access to the information. Preference shall be given to the residents in the Affected Area who wish to work as unskilled labor in the Project without discrimination by sex. The advertisement of the recruitment shall be designed in the manner that as many local women as possible has access to the information. *(Same as 16, 21, 22)* When found necessary and appropriate, trainings and consultation for job/skill improvement shall be operated.		
28	Sanitation, Public Health Condition, Infectious diseases such as HIV/AIDS	CONSTRUCTION PHASE : Provide HIV test to the willing workers. Provide training on awareness about sanitation, hygiene, safe-sex and family planning for the workers. Provide sufficient care-taking staff to conduct cleaning and monitoring activities on camp site.	CONSTRUCTION PHASE : Contractor, Construction supervisor	CONSTRUCTION PHASE : DOR
29	Industrial safety and health, Working environment	CONSTRUCTION & OPERATION PHASE : Appropriate preventive measures will be applied. Special training shall be provided to the workers prior to the types of works not popular in Nepal. Insurance for each laborer shall be proposed.	CONSTRUCTION PHASE : Contractor OPERATION PHASE : Tunnel Management Office, DOR	CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR
30	Accidents, crime Traffic accidents	PLANNING, CONSTRUCTION & OPERATION PHASE : Appropriate preventive mitigation measures will be applied to reduce and avoid accident. Fulfill all the safety standards by DOR.	PLANNING PHASE: Engineer CONSTRUCTION PHASE : Contractor, Construction supervisor OPERATION PHASE : Tunnel Management Office, DOR Division Office Kathmandu	PLANNING PHASE: DOR CONSTRUCTION PHASE : DOR OPERATION PHASE : DOR
	Fire after traffic accidents	CONSTRUCTION & OPERATION PHASE : Necessary fire extinguisher and other emergency safety measures shall be provided. Necessary traffic control to prevent significant traffic accidents shall be imposed. (e.g. tankers carrying flammable chemical to be prohibited to pass the Tunnel).	CONSTRUCTION PHASE : Contractor Traffic Police OPERATION PHASE : Tunnel Management Office, DOR Traffic Police	CONSTRUCTION PHASE : DOR District Chief Office, Kathmandu OPERATION PHASE : District Chief Office, Kathmandu
	Crime	CONSTRUCTION & OPERATION PHASE : Appropriate preventive mitigation measures shall be proposed to reduce and avoid unsocial activities in the construction area, such as awareness raising education. Monitoring of such activities shall be proposed	CONSTRUCTION PHASE : Contractor Metropolitan Police, Traffic Police	CONSTRUCTION PHASE : DOR District Chief Office, Kathmandu

No.	Parameters	Environmental Management Measures	Implementation Agency	Responsible Agency
			OPERATION PHASE : Metropolitan Police, Traffic Police	OPERATION PHASE : District Chief Office, Kathmandu
	Smuggling	ditto.	ditto.	ditto.

Source: JICA Survey Team, 2014

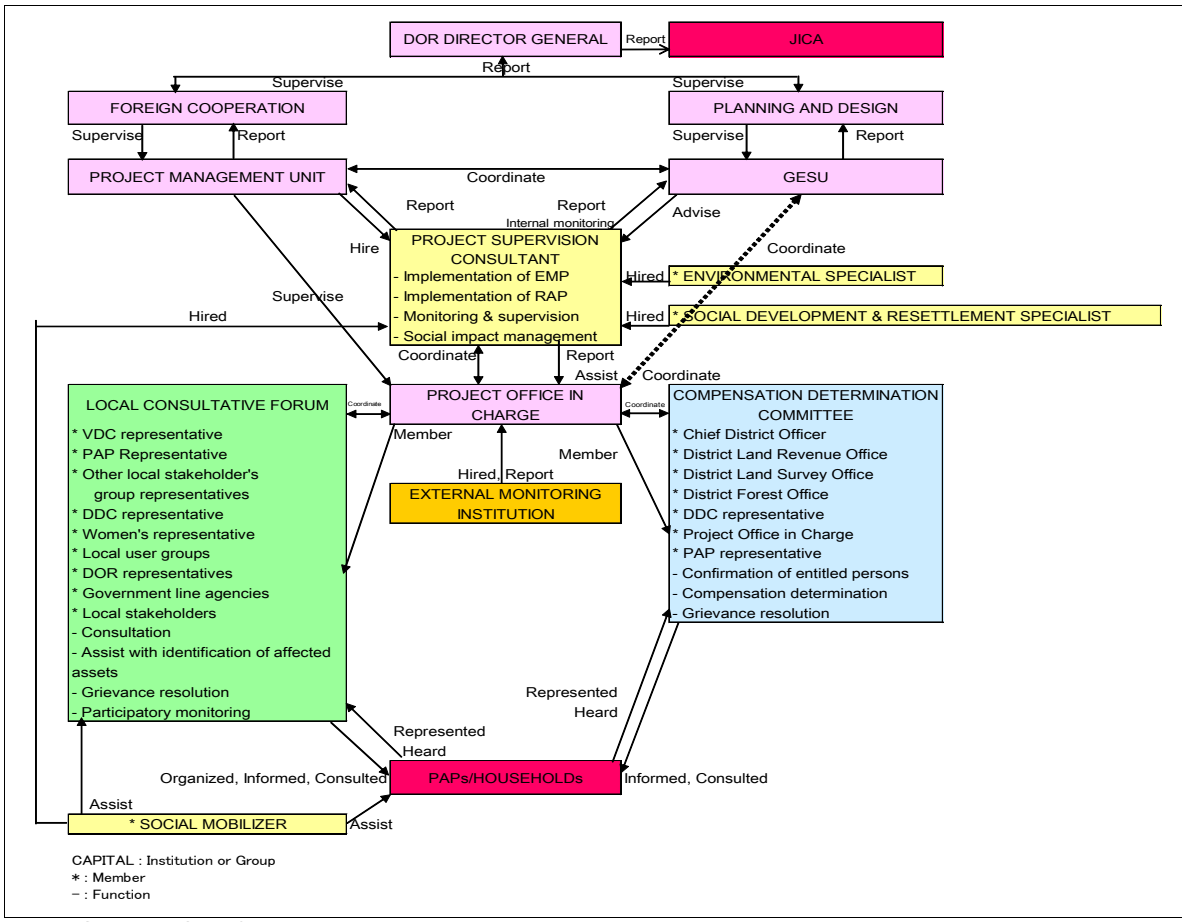
13.3.13 Environmental Monitoring Plan

(1) Institutional Arrangement

Monitoring and evaluation framework is established in ESMF 7.6.

Although Chapter 7 of ESMF is titled 'Resettlement Policy Framework,' the same framework is applied for environmental monitoring by DOR.

As shown in **Figure 13.3-2**, Institutions, consultants, specialists and Project Affected Persons/ Households will be coordinated as described in the following Figure in the implementation of RAP and Environmental Management Plan. DOR DG will be responsible for reporting to JICA.



Source: DOR, 2014

FIGURE 13.3-2 ORGANIZATION FRAME WORK FOR THE IMPLEMENTATION OF RAP AND ENVIRONMENTAL MANAGEMENT PLAN

(2) Funding for Implementation of Environmental Management Action Plan

Budget for the monitoring activities are negotiated with DOR and the funding agencies for each project.

In this Project, each organization listed in **Table 13.3-10** shall bear the responsibility for implementation of the Environmental Management Plan in the described Phases using JICA Loan or GON budget.

TABLE 13.3-10 FUNDING AND RESPONSIBLE ORGANIZATION FOR THE IMPLEMENTATION OF ENVIRONMENTAL MANAGEMENT PLAN

Funding	Phase	Responsible Organization
JICA Loan	Planning Phase (Detailed Design Phase)	Engineering Design Consultant
	Construction Phase	Construction Supervision Consultant or Construction Contractor. (Responsible organization to be decided in the beginning of the Construction Phase.)
GON	Operation Phase	DOR

Source: JICA Survey Team, 2014

(3) Environmental Monitoring Plan

1) Environmental Monitoring Plan

Among the environmental and socio-economic items studied in the EIA survey, items listed in the following **Table 13.3-11** and **Table 13.3-12** are selected for monitoring targets during the planning/construction phase and the operation phase.

TABLE 13.3-11 ENVIRONMENTAL MONITORING PARAMETERS IN PLANNING/CONSTRUCTION PHASE

1	Air	NO2
		PM10
2	Water	BOD
		TSS
3	Noise	Noise
4	Waste	Soil
		Solid Waste
		Liquid Waste
11	Water regime	Surface water (Volume, speed, depth)
		Ground water (depth, location of aquifer)
		Springs
12	Geology	Slope stability
17	Land use, Local resource use, Communal/ Common resource use rights	
18	Water Rights /Water use	
28	Sanitation, Public Health Condition, Infectious diseases such as HIV/AIDS	
29	Industrial safety and health, Working environment	
30	Accidents, crime Traffic accidents	
	Crime	

'13. Involuntary Resettlement and/or Loss of Properties' shall be monitored as the RAP/VCDP monitoring.
Source: JICA Survey Team, 2014

TABLE 13.3-12 ENVIRONMENTAL MONITORING PARAMETERS IN OPERATION PHASE

11	Water regime	Surface water (Volume, speed, depth)
		Ground water (depth, location of aquifer)
		Springs
12	Geology	Slope stability
18	Water Rights /Water use	

Source: JICA Survey Team, 2014

a) Reporting

The ESMF 7.6.2 requires quarterly reports of Internal Monitoring. Also, External Monitoring agency hired by the Project Implementing Units will conduct bi-annual review of EMP and RAP implementation. Both reports will be sent to the finding agency.

b) Environmental Monitoring Form

DOR, as the project owner, shall conduct periodical monitoring at each project phase, using the following monitoring formats.

■ Planning and Construction Phase

1. Air (Ambient air quality)

Item (Unit)	Measurement (24 hr)	Nepal Environmental Standard (24 hr)	Pre-Project Measurement (24 hr)	Survey Method
NO2 (micro gram/m^3)		150 (WHO) Maximum 80		**Location : 1** (West Portal), **2** (East Portal), **3** (East end point of the east Approach Road (Connectivity)) **Interval:** 1 measurement in every month (work day), or upon urgent request/complaint from local residents. **Survey method :** Continuous measurement for 1 hour to obtain the average concentration of the hour. Then take average of the 24 measurements.
PM10 (micro gram/m3)		70 (WHO) Maximum 120		
Other (Complaints, Observations)	Date : Location : Problem : Solution measures taken : Follow-up condition observation :			

2. Water (Public surface water quality)

Item (Unit)	Measurement	Nepal Environmental Standard	Pre-Project Measurement	Survey Method
				Location : 1 (Sisnekhola, downstream of the Soil Disposal Area (outside of the Work Area)), **2** (Balkhu Khola, culvert bridge near medical college, downstream of the east Approach Road Work Area) **Interval :** 1 measurement in every month (work day), or upon urgent request/complaint from local residents.
TSS		30-200 mg/L		**Survey method :** 1 to 3 sampling per measurement. Take average as the survey result.
BOD		50 mg/L		
Other (Complaints, Observations)	Date : Location : Problem : Solution measures taken : Follow-up condition observation :			

For Waste Water monitoring, see Liquid Waste.

3. Noise (Ambient noise)

Item (Unit)	Measurement (dBA)	International Environmental Standard (dBA)	Pre-Project Measurement (dBA)	Survey Method
Noise		WHO Uncomfortable :	On the existing HWY (expected	**Location :** Just outside of the following Work Areas : **Tunnel-1**

Item (Unit)	Measurement (dBA)	International Environmental Standard (dBA)	Pre-Project Measurement (dBA)	Survey Method
		120 - Very high : 90 - Medium : 70 - Peace : 50 -	level): At the Eastern Portal (peace condition):	(West Portal), **Tunnel-2** (East Portal), **Surface-1** (West Approach Road/Soil Disposal Area), **Surface-2** (East Approach Road) **Interval :** 1 measurement in every month (work day), or upon urgent request/complaint from local residents. **Survey method :** 10 minutes continuous measurement in one hour for at least 4 times in day time for all 4 Locations, and another 4 times in night time for Tunnel Locations.
Other (Complaints, Observations)	Date : Location : Problem : Solution measures taken : Follow-up condition observation :			

4. Waste

Items	Sub-items/Location	**Monitoring** (once in every month)
1) Soil	West excavation Disposal to construct the base for the west Approach Road	Planned volume : Excavated volume (m3, %): Remaining volume (m3, %): Disposal and/or storage condition : Problems/Concerns : Solution measures taken : Follow-up condition observation :
	East excavation Temporal Storage Area Reuse for road embankment Disposal or reuse for public/private purposes	Planned volume : Excavated volume (m3, %): Remaining volume (m3, %): Disposal and/or storage condition : Problems/Concerns : Solution measures taken : Follow-up condition observation :
2) Solid Waste	Construction work areas Tunnel (West) (East) Road/Bridge (West) (East)	Main types of the waste generated : Total volume for disposal : Date of disposal : Contractor name for disposal : Location of disposal : Cost of disposal : Reused/Recycled waste types :
	Stock yards (West) (East)	Main types of the waste generated : Total volume for disposal : Date of disposal : Contractor name for disposal : Location of disposal : Cost of disposal : Reused/Recycled waste types :
	Water Treatment Plant (Discharge from the tunnel)(West) (East)	Main types of the waste generated : Sludge Total volume for disposal : Date of disposal : Contractor name for disposal : Location of disposal : Cost of disposal :

Items	Sub-items/Location	**Monitoring** (once in every month)
		Reused/Recycled waste types :
	Other Rest houses(West, East)	Main types of the waste generated : Total volume for disposal : Date of disposal : Contractor name for disposal : Location of disposal : Cost of disposal : Reused/Recycled waste types :
3) Liquid Waste	Water Treatment Plant (Discharge from the tunnel)(West) (East)	**Location : 1** (West Plant discharge point), **2** (East Plant discharge point) **Interval :** 1 measurement in every month (work day), or upon any irregularity or request/complaint from local residents. **Survey method :** 1 to 3 sampling per measurement. Take average as the survey result.
	Other Rest houses(West, East) Construction facility areas (West, East)	**Location : 1** (West), **2** (East) **Interval : Everyday in morning and evening**. **Survey method :** Patrol observation by guard men and facility managers to check water flow in ditches, any abnormal odors etc. to indicate over flow from the treatment plants, or irregularity of seepage from the septic tanks

5. Water regime, water use

Items	**Monitoring (**1 measurement in every month, or upon any irregularity or request/complaint from local residents.**)**
1) Surface water sources	Location : Any change compared to Pre-Project condition : YES / NO If YES, describe : PHOTO : Related water users' association : Solution measures taken : Follow-up condition observation :
2) Groundwater sources	Location : Any change compared to Pre-Project condition : YES / NO If YES, describe : PHOTO : Related water users' association : Solution measures taken : Follow-up condition observation :
3) Spring water sources	Location : Any change compared to Pre-Project condition : YES / NO If YES, describe : PHOTO : Related water users' association : Solution measures taken : Follow-up condition observation :

6. Slope stability

Items	Monitoring (Everyday in morning and evening)
Slope stability	Location : Any abnormality from planned condition : YES / NO If YES, describe : PHOTO : Potential cause : Solution measures taken : Follow-up condition observation :

7. Land use, Local resource use, Communal/ Common resource use rights

Items	Monitoring (as occurrence of issues)
Community forest	Date : Communication originated by : Responded by : Issue : Field observation conducted by (Date) : PHOTO : Potential cause : Solution measures taken : Follow-up condition observation : Communication with Ranger Post / District Forest Office :

8. Work related issues

Items	Monitoring (as occurrence of issues)
Negative impacts on sanitation and public health condition involving the workers hired by the Project Infectious diseases such as HIV/AIDS involving the workers hired by the Project	Date : Issue : Field observation conducted by (Date) : PHOTO : Potential cause : Solution measures taken : Follow-up condition observation : Report / Communication with respective public offices :
Industrial safety and health, Working environment among the workers hired by the Project	Date : Issue : Field observation conducted by (Date) : PHOTO : Potential cause : Solution measures taken : Follow-up condition observation : Report / Communication with respective public offices :
Traffic accidents involving the vehicles hired by the Project	Date : Issue : Field observation conducted by (Date) : PHOTO : Potential cause : Solution measures taken : Follow-up condition observation : Report / Communication with respective public offices :
Crime involving the workers hired by the Project	Date : Issue : Field observation conducted by (Date) : PHOTO : Potential cause : Solution measures taken : Follow-up condition observation : Report / Communication with respective public offices :

■ Operation Phase

1. Water regime, water use

Items	**Monitoring (**1 measurement in every month, or upon any irregularity or request/complaint from local residents.**)**
1) Surface water sources	Location : Any change compared to Pre-Project condition : YES / NO If YES, describe : PHOTO : Related water users' association : Solution measures taken : Follow-up condition observation :

Items	**Monitoring (**1 measurement in every month, or upon any irregularity or request/complaint from local residents.**)**
2) Groundwater sources	Location : Any change compared to Pre-Project condition : YES / NO If YES, describe : PHOTO : Related water users' association : Solution measures taken : Follow-up condition observation :
3) Spring water sources	Location : Any change compared to Pre-Project condition : YES / NO If YES, describe : PHOTO : Related water users' association : Solution measures taken : Follow-up condition observation :

2. Slope stability

Items	Monitoring (once in every month)
Slope stability	Location : Any abnormality from planned condition : YES / NO If YES, describe : PHOTO : Potential cause : Solution measures taken : Follow-up condition observation :

13.3.14 Considerations of Adaptation Measures for Climate Change

(1) Basic Understanding of the Adaptation of Climate Change

In general, the adaptation (measures) in the road sector; including bridge, tunnel, and railway are to secure the safety of traffic as a requisite for roads, bridges, tunnels, and railways, and to mitigate the damages of related structures and for road users.

In case of roads, including tunnel project, it is considered that climate change may bring an increase in rainfall intensity, exceeding the drainage capacity of roads, and cause slope failures and landslides resulting in traffic disturbance. Likewise fatal damages for the residents is probable if the slope failures and landslide are large-scale in the area.

The occurrence of traffic accidents and traffic restrictions will increase, and it will slowed down the economic activities, damage traffic structures, and trigger other accidents.

1) Necessity of Adaptation for the Road Sector

For the road sector, the climate change would bring an intensified flooding, which may cause inundation, slope failures and landslides, affecting roads. There are certain risks in road functions and related facilities that are adversely affected or damaged due to climate change impacts.

2) Adaptation Measures

In order to improve the disaster (climate change related impacts) prevention capacity for road functions and related facilities, the following adaptation measures are mainly required in general:

- Slope stabilization
- Realignment or change of route
- Raising of roadbed
- Installation and enhancement of drainage facilities and capacity
- Flood prevention measures

- Raising, reinforcement or replacement of bridge
- Road related facilities, which can be used as evacuation areas during disasters
- Strengthening institutional and human capacity in facing adverse effects of climate change
- Adopt better preparatory activities in disaster situations
- Revision of standards, and design norms to accommodate anticipated adverse impacts.

3) Outcome of Adaptation Measures

The impacts of climate change related to structural damage, traffic restriction and interruption, as well as damage on related facilities and users will be mitigated.

(2) Understanding for Adaptation Measures of Climate Change for this Project

There are mainly five (5) landslide and collapse points exist along existing road (see **Section 6.2.3**). During a rainy season in 2008, the stream brought a huge amount of debris in the road at Jhapre Khola that created a huge problem for the passage of vehicles for about 7 hours. The similar event was repeated the following year but since then, it has not caused any disturbance to the traffic. Though landslide or collapse of cut slope caused in other points, there was no traffic closure due to improvement of slope protection as shown in **Table 13.3-14**. It is assumed that the major reason of landslide or collapse was mainly due to poor soil conditions such as Tistung Formation composed psammitic phyllite and phyllitc sandstone, but not due to climate change.

Though extreme rainfall was recorded on July 23, 2002 as shown in **Figure 13.3-3**, climate change did not be seen in the past 45 years (1968-2013). As the trend of annual rainfall shown in **Figure 9.14-1,** there was also no indication of climate change.

Currently there is no traffic closure due to landslide. Since slope protection was done and climate change was not seen, there will be no high risk of traffic closure due to landslide by heavy rain in the future.

As the project road section has the same geological conditions, there is no need to adapt new measures against climate change to the existing road.

Table 13.3-14 Landslide and Collapse points along Existing Road

Landslide and Collapse Points	Major incident
1. Near police check post at Nagdhunga	Around 2005, a new landslide started to move in the hillslope. Now a retaining structure has been constructed and the landslide is almost inevitable.
2.Near Chisapanidhara	About 3 years ago, a big landslide occured .Later retaining wall was constructed on the hillside and gabion wall was constructed in the valley side to stabilize the road.
3.At Jhapre Khola	At a rainy season of 2008, the stream brought a huge amount of debris in the road and created problem for the passage of vehicles for about 7 hrs. Since slope protection was done, it has not caused any disturbances to the traffic.
4.At a small tributary with little water flowing	10 years ago, there was a large landslide. No landslide now was recorded.
5.In front of a big Landslide north of the Sisne Khola	About 15 to 20 years ago, landslide was active and recurrent. A strong concrete support and bolting was done to stabilize the road.

Source: JICA Survey Team, hearing from local people

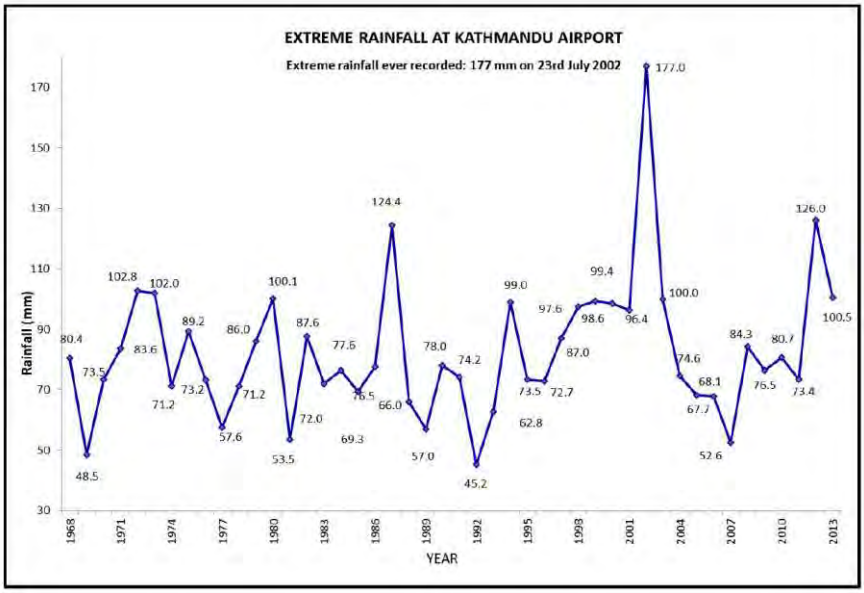


Figure 13.3-3 Extreme Rainfall at Kathmandu Airport

Source: Department of Hydrology and Meteorology, Climate Rainfall of each year

13.4 RAP OF THE PROJECT

13.4.1 Necessity of Land Acquisition, Resettlement, and Review of Alternatives

This Project Activity that will lead to land being expropriated or to people being resettled by the construction of the approach (access) road and tunnel, soil disposal site development by excavating of tunnel, and land use alteration for ancillary facilities.

(1) Project Main Components and Impact Area

1) Approach Road and Tunnel

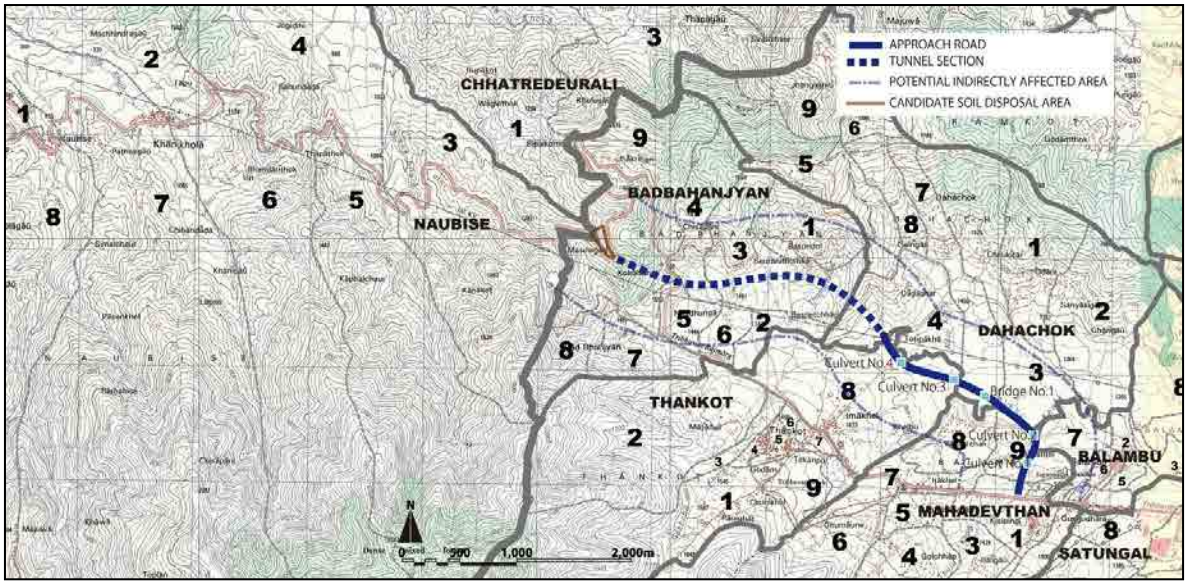
The two major components of the Project are newly construction of the access road (approximately 2.2 km length) and tunnel (approximately 2.5 km length).

The Project is located in two districts; Kathmandu and Dhading. The Project Affected Area, including 500 m 'indirectly affected area,' includes lands in six VDCs in two Districts.

TABLE 13.4-1 THE VDCS INCLUDED IN THE PROJECT AFFECTED AREA

District	VDC	Planned alignment			Existing road
		Approach road	Tunnel road	Soil disposal	Section of existing road to be bypassed
Kathmandu	Balambu	X			
	Mahadevsthan	X			Y
	Dahachok	X	X		Y
	Thankot	X			Y
	Baad Bhanjyang		X	X	
Dhading	Naubise			X	

X : 50 m ROW for surface road, and tunnel alignment. Defined as 'directly affected area.'
** : Within 500 m from the boundary of the ROW. Defined as 'indirectly affected area.'*
Source: JICA Survey Team



Source: JICA Survey Team

FIGURE 13.4-1 THE VDCS INCLUDED IN THE PROJECT AFFECTED AREA

2) Soil Disposal Site Development

The excavated material from the tunnel is expected to be approximately 250,000 m3. The elevation of the approach road shall be designed to balance the cut and fill volume as much as possible to minimize the disposal of soil. Excavation shall also occur at both tunnel portals.

The soil disposal site is planned at Sisnekhola, just across the western portal to minimize the transportation distance of the excavated materials and to avoid traffic generation on the already congested highway.

The surface stream of Sisnekhola basin shall be collected into the pipes at the bottom of the disposal site. Therefore, the water flow at the lower stream of Sisnekhola shall not be changed.

The existing irrigation canals on the slope that will be covered by the disposed material shall be studied further in the EIA survey so that the rice paddies connected to the canals shall not remain without water.

In case that the volume of soil for disposal exceeds the acceptable volume at the Sisnekhola site during the basic design and EIA survey phase, an additional disposal area shall be identified further west along the Tribhuvan Highway. The suitable conditions for the additional disposal areas are as follows:

- Valley-shaped area right next to the lower side (north-side) of the highway.
- Nobody is residing in the area
- No significant water use or registered community forest is affected by the disposal
- The area is as close as possible to the Western Portal.

(2) Review of Alternative Alignment

In the basic design phase, the following values shall be considered in the design of road alignment, to reach the most feasible and rational alignment.

- Secure the traffic and pedestrian safety on the Project Road and vicinity.
- Minimize the volume of soil disposal
- Minimize the number of persons required for involuntary resettlement
- Avoid or minimize negative impacts on resource usage, such as farmland, water and forest

- Avoid negative impacts on local cultural and religious places and activities.

1) Alternatives of the Technology That May Affect the Significance of the Project Impact

The Project Road is a National Highway and a quality standard in any aspect should not be compromised. The technology, including the selection of the construction equipment and the operational facilities, however, may have alternatives considering the following issues.

- Requirement to achieve the highest standard results.
- Availability in Nepal
- Suitability and duplicability in Nepali condition

2) Alternatives of the Raw Materials That May Affect the Significance of the Project Impact

Source of the raw materials for construction shall be examined in the EIA study whether to purchase from the local suppliers, to import from Japan or the third country, or to plan (such as queries) the Project specific sites.

3) Detail of the Construction Schedule That May Affect the Significance of the Project Impact

Construction time schedule shall be further studied during the basic design phase. Following Nepali-specific conditions shall be taken into consideration, formulate the most feasible and realistic schedule.

- Nepali calendar and holidays.
- Agriculture season and off-season in the surrounding area of the ROW
- Dry season and monsoon season.
- Acceptability of night shift working

4) Alternatives of the Energy Source in Operation Phase That May Affect the Significance of the Project Impact

Electricity/power supply for the tunnel has not been settled yet between the NEA and MOPIT. During the basic design phase, various discussions, coordination and agreement are expected to settle .

5) Alternatives of the Operation and Management Structure That May Affect the Significance of the Project Impact

Since the road tunnel is a new project in Nepal, the regular institutional structure for the following monitoring activities shall be reviewed considering the operation and management structure of the tunnel to formulate the most suitable distribution of responsibilities and funding.

- Environmental monitoring.
- Resettlement monitoring

13.4.2 Method of RAP Preparation and Activities

The methodology includes social impact assessment followed by a cadastral survey, a census of potentially affected persons and verification of their affected assets.

(1) Cadastral Survey

At first, it is mapped out the Project alignment and impact zones on the cadastral maps. The engineering survey team collected the cadastral maps of the Project Area from the District Land Survey Office at Kathmandu District and at Dhadine District during July to August in 2014. The Sub-contracted Survey Team, using the basic designs, the roadway width, carriage width, required RoW and the land areas to be acquired on the cadastral maps. Actually, these activities are divided into field verification, cadastral map scanning, cadastral survey in the field, and cadastral map digitization.

After that, the affected lands are measured at the site and the cadastral surveyors enumerate the premises. The social survey team conducted the census of affected households. The identified landowners and the plot number of the affected land are further verified in the land revenue office at the district headquarter to confirm the land ownership status.

(2) Preliminary Socio-Economic Survey, Census Survey and Asset Verification

Firstly a preliminary socio-economic survey within the zone of influence of the road was conducted on June 2014, by a JICA Survey Team and local social survey team. This survey covered 500 m either side of the road corridor as a zone of influence. The purpose of this survey was to assess preliminary possible social impacts of the road including the impact of land acquisition and compensation. During survey period, a questionnaire survey to the possible affected VDC's key persons was also conducted to assess the probable Project Affected Person (PAP) s and the land areas.

Furthermore, a Census Survey had conducted during October 2014. The objectives of the census survey are to prepare socio-economic profile of the PAPs, assess household income and expenditure, identify productive assets and income generating activities and plan for income restoration, as well as develop relocation options and develop social and economic support measures for vulnerable groups, if the vulnerable groups/communities are identified. This survey was also recorded demographic features of the PAPs and verification of lost assets ownership.

To confirm the actual loss of land and other property, the survey team collected the cadastral maps of the alignment and scans. The detailed engineering design superimposed on the scanned cadastral map to locate the center line of the road. By identifying the center line of the road, the affected land and property are measured accordingly.

The Census Survey team enumerated all types of loss due to the road improvement. During the Census Survey of the PAPs, the total land holding of the PAPs are enumerated. The lost land, houses and structures, number and types of expected affected trees and expected public properties like forest, land and structures are also enumerated.

However, this Census Survey at this Preparatory Survey stage could not cover all affected households due to difficulties to identify some land owners because of living outside from the Kathmandu Valley. It could not find their present residential address. According to the local peoples in the area, the absentee land owners have bought the land for business (investment) purposes. Therefore, the Census Survey needed to update at the Detailed Design Stage as well.

In terms of the Cut-off Date of a project in Nepal, the date of publication of preliminary notification for land acquisition as provisioned by the Land Acquisition Act 1977 will be treated as the Cut-off Date. It means that the real Cut-off Date will be the date of publishing for notification on the major newspapers in Nepal, after finalizations of the alignment at the Detailed Design State of the Project.

It is also recommended that the DOR could consider any countermeasures such as setting signboards of the notification of the alignment in the site, to avoid the encroachment.

For the non-titleholders such as squatters and encroachers, the Cut-off Date is the date of the Census Survey conducted by this JICA's Preparatory Survey.

(3) Asset Inventory

As a part of Census Survey, the inventory enumeration has conducted during October 2014. The survey team was consisted of social development experts, research supervisor, cadastral surveyors, enumerators, represented of District Land Survey, and other concerned District Level Officials.

(4) Social Impact Assessment

The social impact assessment is undertaken as a part of resettlement impact assessment. The

Study identified the following key social issues for investigation:

Loss of private property and other assets (land, houses and trees) and compensation modalities for these losses

- Population displacement
- Construction employment opportunities
- Potentiality for social development

(5) Scope of RAP

The government of Nepal has fixed a legal Right of Way (RoW) of 50 m for the highways and 30m for feeder roads, according to the Land Acquisition Act, 1977 and the Land Acquisition Guidelines 1989 in Nepal. This Project includes new roads both tunnel section and approach sections, which will be a part of Tribhuvan Highway. Therefore, the RoW of the roads is 50 m, according to the standards of Nepal.

The 50 m RoW for the surface road and tunnel alignment is defined as "directly affected area". In other words, directly affected area is defined as Corridor of Impact (CoI). Within 500 m from the boundary of the RoW is defined as "indirectly affected area".

In terms of the important facilities near the RoW within the 500 m (Corridor of Impact) from the boundary of the RoW of the Access Road, there are some local temples, cremation sites and other important facilities. But these important facilities are not located within the 50 m of the RoW.

The scope of RAP is basically applicable to persons who are directly affected by the loss of privately owned structure or community property within the CoI.

13.4.3 Socio-Economic Profile and Assets Loss

This section presents the socio-economic profile of the Survey Area. Main objectives to conduct the socio-economic survey are:

i) To assess socio-economic condition of Project Affected Families (PAFs) based on socio- economic survey across the project alignment sections;
ii) To assess local issues that should address in RAP;
iii) To assess various impacts and suggest more sustainable and equitable mitigation measures to the PAFs.

(1) Socio-Economic Profile

1) Demography

According to the Population Census 2011, total population of the project affected VDCs is 42,699, where the male and female population is 21,326 and 21,373 respectively. The population of the affected VDCs is presented in **Table 13.4-2.**

TABLE 13.4-2 THE VDCS INCLUDED IN THE PROJECT AFFECTED AREA

VDC	No. of HH	Male	Female	Total	Ave. HH Size
Mahadevsthan	3,731	7,731	7,783	15,514	4.1
Balambu	1,734	3,625	3,698	7,323	4.2
Thankot	2,820	6,106	5,941	12,047	4.2
Dahachko	878	1,991	2,045	4,036	4.5
Bad Bhanjyang	817	1,873	1,906	3,779	4.6
Total	**9,980**	**21,326**	**21,373**	**42,699**	**4.2**

Source: Census 2011, Central Bureau of Statistics (CBS) in Nepal

As revealed by the Census data, an estimated number of 1,026 Persons of 190 households likely to be affected due to resettlement affect their land and structures. Among them, information from the Census Survey could be actually obtained from 64 households due to the difficulties of the identification of the unconfirmed land owners, which are mentioned in the previous section. Therefore, the socio-economic information of the affected persons is based on the information obtained from 64 (33.7%) households of the total 190 affected households/landowners.

The population composition of project affected surveyed households is presented in **Table 13.4-3**.

TABLE 13.4-3 POPULATION DISTRIBUTION OF PROJECT AFFECTED HOUSEHOLD BY VDC

VDC	No. of HH	Male	Female	Total	Ave. HH Size
Mahadevsthan	26	83	74	157	6.0
Balambu	5	10	13	23	4.6
Thankot	29	74	80	154	5.3
Dahachok	4	11	12	23	5.7
Total	**64**	**178**	**179**	**357**	**5.4**

Source: Census/Socio-economic Survey of this JICA Preparatory Survey, October 2014

2) Ethnic Composition

Among the total affected household, about 75 % households are Newar ethnic groups where 14.1 % Janajati. Similarly, the percentage of Chhetrri and Brahmin are 7.8 and 3.1 % respectively. The VDC wise ethnic composition of the project affected households is presented in **Table 13.4-4**.

TABLE 13.4-4 ETHNIC COMPOSITION OF AFFECTED HOUSEHOLD

VDC	Newar		Janajati		Chhetri		Brahmin		Total HH
	No.	%	No.	%	No.	%	No.	%	
Mahadevsthan	15	23.4	9	14.1	2	3.1	-	-	26
Balambu	5	7.8	-	-	-	-	-	-	5
Thankot	25	39.1	-	-	2	3.1	2	3.1	29
Dahachok	3	4.7	-	-	1	1.6	-	-	4
Total	**48**	**75.0**	**9**	**14.1**	**6**	**7.8**	**2**	**3.1**	**64**

Source: Census/Socio-economic Survey of this JICA Preparatory Survey, October 2014

Actually, it was not confirmed any specific vulnerable groups/communities, who should need to be considered special assistances for possible adverse impacts by this Project in the affected households.

Based on the above understandings, DoR/GESU confirmed that separate Vulnerable Community Development Plan is not necessary to be prepared in this Preparatory Survey stage at least.

3) Occupational Status

The Census shows that about 23.9 % populations depend on trade/industry and 17.2 % population depend on service. A remarkable percentage (about 38.9 %) of affected peoples involve into the household works. The road alignment passes through semi- urban area where dependency on agriculture is low than the other occupations, only 13.3 % affected people depends on agriculture. Occupational status of the surveyed household is given in **Table 13.4-5**.

TABLE 13.4-5 OCCUPATIONAL STATUS OF SURVEYED HOUSEHOLD

Main Occupation	Gender	Balambu VDC	Daha chowk VDC	Mahadevsthan VDC	Thankot VDC	Total	%
Agriculture	Male	1	2	9	5	17	7.5
	Female	1	1	9	2	13	5.8
Trade/ industry	Male	3	3	11	31	48	21.2
	Female	-	-	1	5	6	2.7
Service	Male	-	1	24	9	34	15.0
	Female	-	-	3	2	5	2.2
Household work	Male	-	-	1	2	3	1.3
	Female	5	6	38	36	85	37.6
Dependent	Male	-	-	2	-	2	0.9
	Female	-	-	1	-	1	0.4
Agriculture labor	Male	2		1	-	3	1.3
Pension	Male	-	1	3	-	4	1.8
	Female	-	-	1	-	1	0.4
Other labor	Male	-	-	3	1	4	1.8
	Female	-	-	0	0	0	0.0
Total		12	14	107	93	226	100.0

Source: Census/Socio-economic Survey of this JICA Preparatory Survey, October 2014

4) Educational Status

The overall educational status of project affected population is generally high. The Census shows that about 95.2 % populations are literate. Of the total population, 16.8 % are having higher degree (Bachelor and above) where 8.7 % male and 8.1 % female are in this level. **Table 13.4-6** presents the educational status of the project affected people.

TABLE 13.4-6 EDUCATIONAL STATUS OF THE PROJECT AFFECTED POPULATION

Education Level	Gender	Balambu VDC	Daha chowk VDC	Mahadevsthan VDC	Thankot VDC	Total	%
Less than 5 Year	Male	-	1	2	4	7	2.0
	Female	1		1	3	5	1.4
Illiterate	Male	-	2	4	1	7	2.0
	Female	-	2	6	2	10	2.8
Literate but no schooling	Male	1	3	10	7	21	5.9
	Female	4	3	17	11	35	9.8
Grade 1-10	Male	6	2	26	24	58	16.2
	Female	4	5	24	30	63	17.6
SLC Pass	Male	1	2	12	7	22	6.2
	Female	1	-	7	9	17	4.8
Certificate level Pass	Male	1	1	13	17	32	9.0
	Female	2	2	5	11	20	5.6
Bachelor level or above	Male	1	-	16	14	31	8.7
	Female	1	-	14	14	29	8.1
Total		**23**	**23**	**157**	**154**	**357**	**100.0**

Source: Census/Socio-economic Survey of this JICA Preparatory Survey, October 2014

Based on the results of the Census/Socio-economic survey, any specific gender and social weak group issues, which should be considered special assistances for possible adverse impacts by this Project, was not confirmed in the affected area.

5) Land Holding Size

The project alignment passes through semi-urban area however agriculture is still predominant activities over there. The land is also utilized as intensive commercial agriculture such as tomato farming, mushroom farming by outsiders while other cereal crops such as rice and wheat are produced as traditionally. The landholding size of the project affected households is lower than other rural area of Nepal in general. However, both the productivity of land and the value of land are high. The land holding size of the project affect households is presented in

Table 13.4-7.

TABLE 13.4-7 DISTRIBUTION OF HOUSEHOLDS BY LAND HOLDING SIZE

VDCs	Less than 0.025 ha	0.025-0.05 ha	0.05-0.1 ha	0.1-0.2 ha	Above 0.2 ha	Total HH
Mahadevsthan	1	6	7	7	5	26
Balambu	5	-	-	-	-	5
Thankot	3	5	8	10	3	29
Dahachko	-	1	1	1	1	4
Total	**9**	**12**	**16**	**18**	**9**	**64**
Percent	**14.1**	**18.7**	**25.0**	**28.1**	**14.1**	**100**

Source: Census/Socio-economic Survey of This JICA Preparatory Survey, October 2014

6) Annual Household Income, Income range of affected households

The Census revealed that majority (68.8 %) of the project affected people's annual household' income range in between NRs 200,000 to 500,000. Average annual income of the project affected HHs by VDCs is shown in **Table 13.4-8**.

TABLE 13.4-8 AVERAGE ANNUAL INCOME RANGE OF THE SURVEYED HOUSEHOLDS

Income Range	Balambu	Daha chowk	Mahadevsthan	Thankot	Total	%
less than 50,000	-	-	1	-	1	1.6
50,000 to 100,000	-	-	-	-	-	0.0
100,000 to 200,000	-	1	4	2	7	10.9
200,000 to 500,000	5	2	15	22	44	68.8
more then 500,000	-	1	6	5	12	18.8
Total	5	4	26	29	64	100.0

Source: Census/Socio-economic Survey of this JICA Preparatory Survey, October 2014

7) Income by Different Sources

Business, service, house rents have been reported as the major income sources of the affected households. Among them business is the main sources of income of affected households. On an average the annual household's income of the affected households has been reported to be NRs 265,818. As per Central Bureau of Statistics (CBS) survey 2011, the less than NRs. 9,567 as per month/per family (5.57 persons) (equivalent to NRs. 114,804 annual households' income) is considered as below poverty level. By comparing with these criteria, the project affected families are not considering as below poverty level for most of the affected households.

8) Food Sufficiency from Own Agriculture Production

Food sufficiency is measured in terms of months that the families' sufficiency of own production to household need. The Census also shows that agriculture is not prime source of income at project area, however small pieces of land can provide sufficient production for the small size family due to fertile land. The household survey revealed that only 9.4% households have produced sufficient food for whole year. About 56.3 % households have food sufficiency for 6-12 months by their own production, remaining households depends on other income sources for their living. It has categorically analyzed by the food sufficiency status up to 3 months, 3 to 6 months, 6 to 12 months and above 12 months. The food sufficiency status of surveyed household is presented in **Table 13.4-9**.

TABLE 13.4-9 FOOD SUFFICIENCY MONTHS OF THE HHS FROM OWN PRODUCTION

Food sufficiency	Balambu	Daha chowk	Mahadevsthan	Thankot	Total	%
Less than 3 months	4	-	5	11	20	31.3
3 to < 6 months	-	-	2	-	2	3.1
6 to 12 months	1	4	15	16	36	56.3
> 12 months	-	-	4	2	6	9.4
Total	5	4	26	29	64	100.0

Source: Census/Socio-economic Survey of this JICA Preparatory Survey, October 2014

13.4.4 Project Impacts and Assessment

This section describes the details of the project affected persons, and the affected assets due to this Project Implementation.

(1) The Project Affected Units (PAUs) and the Affected Persons (APs)

The summary of the number of the PAUs and the APs is shown in **Table 13.4-10**.

TABLE 13.4-10 SUMMARY OF THE NUMBER OF PAUS AND THE APS

Type of Loss	No. of PAUs			No. of APs		
	Legal	Illegal	Total	Legal	Illegal	Total
Required for displacement						
1. HH (Structure owner on Gov. land)	0	2	2	0	10	10
2. HH (Structure and Private land)	3	0	3	17	0	17
3. HH (Tenants)	0	0	0	0	0	0
4. CBEs (Structure owner Gov. land)	0	0	0	0	0	0
5. CBEs (Structure owner on Private land)	0	0	0	0	0	0
6. CBEs (Tenants)	0	0	0	0	0	0
7. Community owned structures including physical cultural resources	0	0	0	0	0	0
Not required for displacement						
8. Land owner	185	0	185	999	0	999
9. Wage earners	0	0	0	0	0	0
10. Grand Total (1-9)	188	2	190	1,016	10	1,026

Note: HH (House Hold), CBEs (Commercial and Business Enterprises)
Source: Census/Socio-economic Survey of this JICA Preparatory Survey, October 2014

(2) Loss of Structures and Factories

The proposed Project will cause resettlement of the total five residential houses and two factories along the proposed RoW of the project in this Preparatory Survey stage. On the other hand, none of the community and government structures falls under the road alignment section. The resettlement needed private structures and factories are presented in **Table 13.4-11**.

TABLE 13.4-11 RESETTLEMENT NEEDED PRIVATE STRUCTURES AND FACTORIES

No.	VDC	Type	Description	Present Use
1	Thankot	House	1 story RCC building with cemented plaster	Residential
2	Thankot	House	2 story RCC building with cemented plaster	Residential
3	Thankot	House	1 story Corrugated sheet roofing house with brick wall	Residential
4	Bad Bhanjyang	House	Corrugated Galvanized roofing sheet with brick wall	Residential+business
5	Naubise (*Dhading District*)	House	Corrugated Galvanized roofing sheet with brick wall	Residential+business
6	Thankot	Factory	Bhola Ganesh Brick Klin	Business
7	Mahadevsthan	Factory	United Concrete Pvt. Ltd	Business

Source: Census/Socio-economic Survey of this JICA Preparatory Survey, October 2014

(3) Loss of Land

The cadastral survey shows that approximately total 11.6 ha. is belonging to private land and approximately total 0.6 ha. is belonging to governmental land in the affected area. These lands will be required for the proposed Project.

The VDC wise land requirement of the private land for the Project is presented in **Table 13.4-12**.

TABLE 13.4-12 VDC WISE LAND REQUIREMENT OF THE PRIVATE LANDS

S.N.	VDC	Land Requirement (ha.)
1	Mahadevsthan	3.9
2	Balambu	0.2
3	Dahachok	3.5
4	Thankot	4.0
Total		**11.6**

Source: Cadastral Survey of this JICA Preparatory Survey, October 2014

(4) Loss of Private Trees and Crops

Based on the results of the Census Survey, none of the private trees were confirmed with the affected land owners within the RoW. There are not private trees with the affected households because there are newly resettled areas.

In terms of the required lots and the types of cultivated crops, only tomatoes are cultivated for approximately 0.4 ha. at Dahachok VDC and for approximately 0.7 ha. at Thangkot VDC within the ROW in the affected area.

For compensation for the crops in general practices in Nepal, there will not be necessary to pay compensation for the crops, if a Project provides sufficient time (at least 6 months) to the crop farmer for harvesting the crops. However, there will be required to be paid the compensation for the crops, in the case of short notification (less than 6 months) of the Project to the crop farmers.

(5) Loss of Public Resources and Utilities

Based on the results of the Census Survey, none of the community structures or public utilities was found to be relocated. During considerations of the road alignment in this Preparatory Survey, the public utilities were avoided at all. 17 affected parcels are belonging to government land parcels; but, there is no provision to compensate such the land parcels. One community forest namely: Subbako Ban lies in the west portal of Tunnel site where 128 different trees will be cut down.

(6) Temporary Loss of Land

Temporary loss of private land will be undertaken within the framework of the Public Road Act 1974. This project will also take land temporarily to the construction activities. The temporarily land will require in the west and east portal of Tunnel side, vehicle parking side and so on in general. The compensation for the temporary occupation of land will be provided to the affected owners. Contractor will be responsible to negotiate a contract agreement on the rental rate with the owner for temporary acquisition of land. The practice is that if the government land is available, the project will use such type of land with the coordination of concerned government agency.

(7) Associated Social Issues and Action during Construction

Following health and safety measures are proposed for both project staffs and local people.

- The child below 16 years of age will be strictly prohibited to use as child labor, although it is regulated by a Napali Law.
- There will be same wage rate for men and female workers for same types of work.
- The contractor(s) will be made responsible to adopt Safe Construction Practices (SCP) in order to minimize construction related accidents
- Trainings will be provided to all construction workers about health and safety measures
- Protective gear such as helmets, boots, gloves and masks will be provided to construction workers, supervisors and visitors
- Warning signs/posts will be installed for informing the local people about the potentially dangerous areas such as quarry site, weir site (dam site), tunnel outlets and tailrace outlet
- Only authorized persons will be given responsibility to operate machinery and other

heavy equipment

- Temporary support structures will be constructed to avoid rock falls, erosion and landslides during construction. Soil excavation during monsoon in unstable areas will be minimized, if not totally avoided
- Adequate lighting and ventilation facilities will be maintained at all construction sites
- Emergency equipment like first-aid kits, flashlights, fire extinguishers, siren, emergency vehicles and phones will be made available at construction sites
- Qualified medical personnel will be appointed at the construction sites to oversee emergencies related to occupational health and safety
- An Emergency Response Contingency Plan will be prepared to appropriately deal with emergencies. The workers will be trained to follow the plan in case of accidents
- The contractor(s) or the client will obtain insurance against any possible injury to all project staff/workers including client's personnel. Furthermore, the responsible party will also obtain third party insurance against any possible injury to visitors and possible victims
- A health center will be established in the project area for attending health matters of workers and local population during construction phase
- The construction contractor is responsible for all preparatory works and ensuring drinking water and sanitation facilities required for construction workers before the commencement of work
- A solid waste collection and storage system will be established in all the construction related camps and construction sites. The collected waste will be segregated as to the property of the waste such as degradable, glass, metals, plastics, cloths and leather etc. and will be stored in separate bonded areas. These materials will be disposed as to the recommendations and approval of the project environmental officer. The contractor will be made responsible for the measure
- Garbage containers of adequate size will be placed at critical places in the construction related camps and construction sites. The garbage will be collected daily and segregated while storing. The contractor will be made responsible for the measure.

13.4.5 Public Consultation

(1) Introduction and Strategy of Public Involvement

Public consultation process with local people, various stakeholders has been initiated to involve public and other stakeholders from the feasibility stages of the Project to share the information of the Project, get their view, concerned and suggestion regarding the different aspect of the Project site and value.

The aim of these public consultations is to aware publics and to provide good understandings and disseminate substantial information of the Project and its modality of implementation and operation. It also aims to understand the viewpoint of the stakeholders and to respond to their concerns and suggestions about each and every possible aspect of the Nagadunga Tunnel Road Project. It is expected that this process will continue through all stages of the project in order to accommodate stakeholders' aspirations and to orient the stakeholders positively towards the project implementation and harnessing cooperation to facilitate timely completion.

Public consultation is also one of the basic tools and best sources of information for identifying the missing Project Affected Persons (PAPs) and helping group to estimate the cost for lost assets. The public are local stakeholders and have social as well as personal relationship among all concerned persons. There are different types of publics in connection to development projects, those who deserve detail knowledge about each other, so they can help the RAP Survey Team member in many respects to obtain corrected information.

In parallel to the Public Consultation, the following public involvement activities, which will be lead deeper understandings among the Project implementers, local stakeholders, and local residents, shall be set up, which are described in the Monitoring and Evaluation Section of this

RAP Report.. DOR and related agencies shall be considered and be conducted in the course of the Project progress from the Preparatory Survey Phase to the Contraction Phases:

- Interaction Meetings
- Socio Economic Surveys for the affected persons
- Focus Group Discussions

(2) Types of Consulted Persons

Each representative of the governmental organizations and the community groups such as the following organizations and groups were participated in the Project.

- Village Development Committee (VDC) Representatives: though there are no elected VDC representatives at present, but the VDC secretary has deputed as VDC chief or office-in-charge by law, so the VDC secretary was included as a responsible source of information and major stakeholders in the area.
- The group of women in different sections were consulted to understand and to assess the access to development infrastructures as well as the pattern of economic subsistence.
- Political party representatives from different political ideologies were consulted to facilitate the discussion.

(3) Methods of Public Consultation

The task of public consultation was carried out in different settlements during the project preparation. In fact, from the earlier stage of the reconnaissance survey to the period of census, the process of consultation remained continuous varying over different times. The number of participants and the other facts in each consultation is shown in **Table 13.4-13**.

TABLE 13.4-13 OVERVIEW OF THE PUBLIC CONSULTATIONS AND INTERACTION MEETINGS

Date	Interaction Location	Number of Participants			Participants from:
		Male	Female	Total	
12th July 2014	Naubise VDC hall, Dhading	34	6	40	Naubise VDC ward no. 2,3,4-kanakot,5,6- Bhandari Gaun, Khanikhola 7- Naubise Bazaar,8,9; Dharke; Gajuri; Khanikhola
19th July 2014	Kot Ghar, Thankot VDC, Kathmandu	66	1	67	Mahadevsthan VDC ward no. 1,7,9; Balambu VDC; Dahachowk-4; Thankot VDC ward no. 3,5,6,7,8,9 and Baad Bhanjyang VDC ward no. 3, 5, 6, 7.
2nd September 2014	Mahadevsthan VDC	46	3	49	Affected persons at Mahadevstan VDC (Interaction Meeting)
2nd September 2014	Badbhanjyang VDC	55	5	60	Affected persons at Badbhanjyang VDC (Interaction Meeting)
9th October 2014	Mahadevsthan VDC	9	0	9	Affected persons at Mahadevstan VDC (Interaction Meeting)
9th October 2014	Dahachok VDC	7	0	7	Affected persons at Dahachok VDC (Interaction Meeting)

Source: This JICA Preparatory Survey, 2014

(4) Issues Raised in Public Consultation

The major queries were raised by the participants and response during the Public Consultation at Naubise VDC and at Tankot VDC, as well as interaction meetings are summarized in **Table 13.4-14**, **Table 13.4-15**, and **Table 13.4-16** respectively.

TABLE 13.4-14 MAIN PARTICIPANT'S QUESTIONS AND PROJECT IMPLEMENTER'S EXPLANATIONS OF THE PUBLIC CONSULTATION AT NAUBISE VDC

Participants' Questions / Opinion/ Sought	Project Implementer's Explanations presented
1. Why the tunnel has 3 lanes tunnel as compare to the 2 lanes on approach road?	Two lanes are planned for incoming and outgoing purpose. The third one is planned for the maintenance of the vehicle (in case it needs some maintenance and other worst cases).
2. When will be the construction of this project is intended to be carried out?	The feasibility study is going on. If it is feasible the detail engineering design will be carried out and then the construction work is intended to be completed by 2020.
3. How the private property and assets to be acquired by the project be compensated? What will be in case if the Government rate may not be acceptable by the locals?	Valuation of such properties will be made based on the existing evaluation guidelines. Survey will be carried out in proper and appropriate way with mutual understanding and coordination with the locals.
4. How the natural resources, forest resources and existing water supply and irrigation facilities will be protected?	The project will try to avoid such natural and forest resources; if not possible will do the best to minimize and mitigate the adverse impact on resources and facilities with the compensatory approach.
5. Is the proposed Sisne Khola site is sufficient for the disposal of soil from the tunnel?	The project is seeking others suitable places for the disposal of the mud from the tunnel apart from the Sisne khola if it requires.
6. Will the proposed project provide employment opportunities to local people?	The employment opportunity to the local is possible during implementation and will be based on the needs of the project and expertise and experiences of the skill and unskilled labor. First priority will be given to the locals and project affected peoples for the employment during construction work.
7. Why proposed 2 tunnel projects (Nagdhunga tunnel construction and Sitapaila Dharke Tunnel) are so closer?	The feasibility studies of the both projects are being undertaken by the Government and DOR. Based on the study, result, acceptance by the local people and technical feasibility of the project government will implement accordingly.
8. Near the Khatripauwa there is a public organization building and during the extension of the road that building might be affected so what will be the alternative or the compensation mechanism regarding such situation.	At this stage the project alignment is up to the upper hill side of the Sisne khola and it might not be affected and the extension of the road does not fall in the scope of this project. If it gets affected by this project then at that stage the detail study will be carried out and compensated accordingly.
9. Peoples residing on the lower level of the Sisne Khola are fully dependent on the Sisne khola as the major source of drinking water. What will be the alternative management for this matter if the soil will be disposed at the place and the source gets affected?	The project will try to avoid such problem of change in water level source. If the affect is unavoidable in that case the project will mitigate the adverse impact of water supply with the alternative and compensatory approach.
10. There is the Fertile agricultural land situated at the lower west side of the Sisne Khola, if the soil/muck are to be disposed on the Sisne Khola it might flow/slide down to the agricultural land disturbing the locally build irrigation canal by the debris.	The soil/muck will not be just thrown/pileup/ dispose in the Khola without the proper precaution, compaction, and management with engineering structures for the protection of such action.
11. It was notified that there is cremation site located around 200m below the Sisne Khola.	This matter will be noted and will be consider during the detail EIA study.
12. It is suggested that the excessive soil that is generated from the Tunnel can be managed by filling the unleveled places on the side of the road having narrow turnings and protecting it with the Check dam so that the sharp narrow turns of road will be widen.	The suggestion was noted and will be taken care wherever possible.

Source: This JICA Preparatory Survey, 2014

TABLE 13.4-15 MAIN PARTICIPANT'S QUESTIONS AND PROJECT IMPLEMENTER'S EXPLANATIONS OF THE PUBLIC CONSULTATION AT TANKOT VDC

Participants' Questions / Opinion/ Sought	Project Implementer's Explanations presented
1. How the private assets/ properties will be acquired and compensated?	Valuation of assets/properties will be made based on the existing laws. Detail survey will be carried out in this regard.
2. How the resources and facilities will be protected?	The project will try to avoid such natural and forest resources; if not possible will do the best to minimize the adverse impact on resources and facilities.
3. Will the proposed project provide employment opportunities to local people?	The employment opportunity to the local is possible during implementation and will be based on the needs of the project and expertise and experiences of the skill and unskilled labor.
4. Why the tunnel is proposed instead of the extension of the existing Tribhuwan highway?	Tunnel is proposed to reduce the distance and curved section of the road between Nagdhunga to Naubise, and also because of the high slope gradient between Nagdhunga to Sisnekhola.
5. Will Nepal oil corporation depot be affected by the project?	No, the depot will not be affected by the project in fact it is at a distance of around 400 m from the road alignment.
6. How do you handle the quarrel of land acquisition?	Appropriate compensation for the affected land will be provided according to the land price set by the compensation committee. Moreover the land price will be set considering the existing market rate.
7. While constructing the tunnel what happens to the land above it, does the government acquire all the land above it?	No the government doesn't need to acquire the land above it. But for the land just above the tunnel some rules might be regulated like no deep boring is allowed as it might disturb the tunnel structure.
8. There are existing sources of water just above the tunnel. Will the source of water be affected by the tunnel?	The detail study about the sources of water above the tunnel is still going on. If such sources are found then alternative route will be considered.
9. Is this project a different one from the one being studied from Sitapaila to Dharke? If yes, is there a need for two similar projects?	This project is different from the Sitapaila route. Whether or not Sitapaila route will be realized is not known at present. This project envisages improving the most critical section of the Tribhuvan Highway.
10. Why need a tunnel? Why not make an open cut route?	From economic, environmental and technical aspects, it is not feasible.
11. How the private assets/ properties will be acquired and compensated?	Valuation of assets/properties will be made based on the existing laws. Detail survey will be carried out in this regard.
12. How the resources and facilities will be protected?	The project will try to avoid such natural and forest resources; if not possible will do the best to minimize the adverse impact on resources and facilities.

Source: This JICA Preparatory Survey, 2014

TABLE 13.4-16 MAIN PARTICIPANT'S QUESTIONS AND PROJECT IMPLEMENTER'S EXPLANATIONS OF THE INTERACTION MEETINGS

Main Participants' Questions / Opinion/ Sought	Project Implementer's Explanations presented
1. How the acquired land will be compensated? (2nd September at Mahadevsthan VDC)	After the Detail Design stage, the land will be identified which needs to be acquired. After that the Compensation Determination Committee (CDC) will be formed under the Chairmanship of Chief District Officer that will decide the compensation rate considering the various factor after that the name of the land owner will be published in the newspaper for the compensation process.

Main Participants' Questions / Opinion/ Sought	Project Implementer's Explanations presented
2. Will there be replacement cost for the farmers whose land will be acquired? (2nd September at Mahadevsthan VDC)	We will provide the replacement and relocation cost will be provided to the affected land owners and household owners.
3. How to consider the compensation cost? (9th October at Mahadevsthan VDC)	Resettlement Action Plan (RAP) will recommend compensation rate taking into account of government price and reasonable market price.
4. Local people should be involved in the road construction works. Employment should be given to the project affected people (9th October at Mahadevsthan VDC)	Priority will be given to the local people in road construction Priority will be given to the project affected people.
5. Fair compensation at current rate. Employment opportunity for affected people. Safety measures for public transportation (9th October at Dhachock VDC).	RAP will address the concern of affected people and give employment priority and safety measures to local people during project construction.

Source: This JICA Preparatory Survey, 2014

Based on the results of the public consultations and internal meetings, it could be understood that the peoples expressed generally their positive remarks about tunnel project, and there were no reasonable strong opposite opinions for the Project implementation.

On the other hand, many of the possible affected persons very concerned compensation prices. Because, the peoples expressed that there were some Project cases, which were big differences between each governmental compensation price and each market-based compensation price. It was not applied the market-based compensation costs for the past Projects, according to the local peoples.

13.4.6 Resettlement Policy and Entitlements

(1) Related Acts and Policies in Nepal and the World Bank Guidelines

In Nepal, there are different laws interrelated to each other such as for construction of road there are independent acts like road act, forest act, land act and the property right mentioned in the constitution and some guidelines to be entertained for this RAP. The relevant Acts and Regulations in Nepal is reviewed in this RAP as prescribed in the Environmental and Social Management Framework (ESMF) as the main guideline for environmental and social issues associated with new road construction and upgrading in Nepal. Some of the acts and regulations are relevant to EIA and resettlement policies in Nepal. On the other hand, the World Bank Guidelines is one of the most important legal documents for the RAP, so this is also reviewed and summarized of this RAP Report..

1) Government Acts and Policies

In the past, the size of affected population in development project was not significant so that requirement of resettlement policy was not so important for the development projects. Now, resettlement, rehabilitation, land acquisition, and compensation are key issues for all types of development projects in Nepal. However there is lack of comprehensive national resettlement and Rehabilitation policy to address the issues of resettlement and rehabilitation. A draft national resettlement policy has been prepared under technical assistance of Asian Development Bank (ADB) in 2006 again reviewing in 2013; it will takes further more time to came into execution. However, resettlement policy has more guided by donor agencies that applied by Asian Development Bank and the World Bank.

The Land Acquisition Act (1977) and its subsequent amendment in 1993 specify procedures of land acquisition and compensation. The Act empowers the Government to acquire any land, on the payment of compensation, for public purposes or for the operation of any development project initiated by government institutions. There is a provision of Compensation Fixation Committee (CFC), which is also called as "Compensation Determination Committee (CDC)"

chaired by Chief District Officer and other members are representative of District Development Committee (DDC), Chief of District Land Revenue Office, and Chief of the Project to determine compensation rates for affected properties. Steps of Land Acquisition plan as per Land Acquisition Act 1977 are presented in **Figure 13.4-2**.

FIGURE 13.4-2 LAND ACQUISITION PROCESS (BASED ON LAND ACQUISITION ACT 1977)

2) World Bank Guidelines

Land acquisition, compensation and resettlement will comply with World Bank Operational Directive 4.30 (being reissued as Operational Policy 4.12 and Bank Procedure 4.12), dealing with involuntary resettlement and compensation for losses associated with development projects. The overall principle of OP/BP 4.10/OP 4.12 is that PAPs are provided with prompt and effective compensation for all loses directly attributable to the project, with lost assets valued at full replacement cost. The value of benefits to be derived from the project is also not deducted from the valuation of the affected asset, not is depreciation of the asset or the value of salvage materials.

Apart from legal titleholders, OP/BP 4.10/OP 4.12 additionally specifies the compensation entitlements of different categories of non-titleholders. Those, with no legal rights at the time of the census and verification exercise, who have a claim to such rights under domestic law (from uninterrupted use of public land with no official eviction orders) should qualify for the full range of entitlements, provided that "such claims become recognized under the laws of the country through a process identified in the resettlement plan." Other PAPs who occupy land in violation of domestic laws are entitled to compensation for assets such as buildings and standing crops but not to compensation for land losses. Where they have had uninterrupted possession of the land "for at least one year prior to the commencement of census, they are entitled to resettlement assistance in lieu of compensation for land."

(2) Entitlement Matrix

Through the acquisition of private and public assets, the Project will affect property owners, their dependents and the communities and the local peoples. This Entitlement Matrix accordingly will specify compensation and/or rehabilitation measures for each different targets

such as i) House and other Structure, ii) Land, iii) Other privately Owned Resources, iv) Community Structures and Resources, v) Rehabilitation Assistance, and vi) Governmental Property, of entitlement individuals including affected individuals and their households, and groups.

1) Compensation Policies for this Project

Compensation to the affected households for their private property will be provided. Furthermore, displacement allowance will be given to the residential house owners. During the time of replacement, the factory owners may lose their income due to disturbance in their business therefore; project has managed to allow them some amount of displacement allowance. In the case of permanent and temporary loss of land and other structure, compensation will determined with equal to replacement cost and with mutual negotiation between two parties

2) Displacement Allowance

In addition to compensation for asset losses, some households who are losing houses will qualify for the displacement allowances. Households, which require to be relocated, will receive a housing displacement allowance equal 90 days minimum wage rate as established at the national or local level.

A package of cash compensation will be provided to the affected households. The package includes cash compensation for the structure at replacement cost, and displacement allowances, which includes any necessary administration fee such as land registration fee, transfer tax, and leveling fee, if needed.

The provision of displacement allowance is that the house owners are free to demolish the affected house and can carry away to reuse the materials for new housing. The displacement allowance is a provisional compensation for facing trouble for the transitional period. It is recommended by the public consultation in different place that three month (90 days) period is sufficient for replacement of households since they have their another house nearby areas and villages, so they can shift in new residence within three months.

Owners of factories, who require to be relocated, will receive land improvement/ factory establishment cost, business closure allowance and labor allowance. The cost of this item is calculated based on existing market price discussion with factory owner and other relevant stakeholders.

3) Rehabilitation Measures

In the RAP there is provisioned for Livelihood Enhancement Skill Training (LEST). One person of each affected households belonging to low income group will be provided LEST according to their choices. The trainings will be conducted based on result of training need assessment report. Apart from the above mention provision, the PAPs will be getting additional support through preferential access to employment as per their willingness and capabilities to work in road construction. The PAPs will be employed in a construction project with a high priority. It does not mean that all PAPs are economically weak and willing to work in the construction project. All rehabilitation activities will be monitored by Social Development and Resettlement Expert

4) Government Property

Government infrastructure and facilities affected by the project will be repaired or replaced in consultation with the relevant department and ministry. But there are none of government infrastructures except government land and forest will be affected by the project. There is no provision of compensation of the government land. The DOR acquires government land and forest in coordination with the Ministry of Forest. Clearance of trees is undertaken taking permission of Department of Forestry (DOF). The legal provision is that the DOR is responsible to plant 25 seedlings in the government land against one tree cutting. The cut down

logs are the properties of DOF. DOR is responsible to establish nursery in an accessible areas of new plantation, supply seedlings, and bear the cost for five years to take care of new plantation to get the plant mature. But the execution part is of the Department of Forestry.

In this Preparatory Survey stage, the entitlement matrix is proposed in **Table 13.4-17**.

TABLE 13.4-17 ENTITLEMENT MATRIX

Type of Loss	Entitlement Unit	Description of Entitlements	Implementation Measures
1. House and **Other Structure**			
1.1 Loss of own house and residential plot	Titleholder	Cash compensation for full or partial loss of house at replacement cost, according to house type.	• Compensation rates of land and structures negotiated by Compensation Determination Committee (CDC) taking reference to succeeding bullet 2 and 3 (which is legal authority), • Land valuation undertaken by District Land Survey and Revenue Office (mostly negotiated) on the reference of local market price and government rate fixed for land registration; • Building valuation undertaken by project authorities (on the basis of standard norms of Department of Urban Development and Building Construction and existing local market price) ; Material may be salvaged with no deduction from compensation. • Displaced households will receive a housing displacement allowance. • Notice to vacate will be served at least 35 days prior to acquisition. • An appropriate compensation advance and housing displacement allowance to be paid at time of notice to vacate; balance payable prior to possession of property. • Compensation for partial losses payable prior to acquisition. • To ensure fair compensation, determination of rates will be done not more than one year prior to property acquisition.
1.2 Loss of commercial establishment	Titleholder Non-titleholder	Cash compensation for full or partial loss at replacement cost, according to building type.	• Compensation determination, notice to vacate, and compensation payment as for 1.1. • Owners of displaced commercial establishments will receive a business displacement allowance.
1.3 Loss of other private structures	Titleholder	Cash compensation for full or partial loss at replacement cost, according to structure type.	• Other structures include: sheds, water reserve tank, etc. • Loss of structures other than houses and commercial establishments does not entail payment of a displacement allowance.

Type of Loss	Entitlement Unit	Description of Entitlements	Implementation Measures
2. Land			
2.1 Loss of private land	Titleholder	Provide compensation at full replacement cost Provide cash compensation at full replacement cost based on current market rate or Government rate whichever is higher. Resettlement assistance in lieu of compensation for land occupied (land, other assets, employment) at least restore their livelihoods and standards of living to pre-displacement levels. In the case of farmland, the PAP will be entitled the cultivation disruption allowance equal to one-year production.	• A list of affected and entitled persons and the area of land loss is required. • Notice to vacate will be served at least 35 days prior to acquisition date. • Case-wise compensation will be either by cash or check, depending on the owner's preferences. • To ensure fair compensation, determination of rates will be established not more than one year prior to property acquisition.
2.2 Temporary loss of private land	Titleholder	Compensation for crop, land productivity and other property losses for the duration of temporary occupation. Compensation for other disturbances and damages caused to property. Contractor to negotiate a contract agreement on the rental rate with the owner for temporary acquisition of land. Land should be returned to the owner at the end of temporary acquisition period, restored to its original condition or improved as agreed with owner.	• A temporary occupation contract will be signed with the affected landowner, specifying; - Period of occupancy - Formula for the calculation of production losses (the market value of crops normally produced on the land) and annual inflation adjustments - Frequency of compensation payment; and - Land protection and rehabilitation measures. • The land will be returned to the owner at the end of temporary acquisition, restored to its original condition.
3 Other Privately Owned Resources			
3.1 Loss of non-perennial crops	Titleholder; other evidence of ownership	Advance notice to harvest crops. Net value of crops where harvesting is not possible.	• Crop market values will be determined by the CDCs coordinating with District Agriculture Office
3.2 Loss of privately-owned trees and perennial crops	Titleholder; other evidence of ownership	Advance notice to harvest crops. Net value of crops where harvesting is not possible. Right to all other resources from privately owned trees	• Crop market values and production losses will be determined by the CDCs with assistance from a local resource specialist. • The Departments of Agriculture and Forestry will be requested to assist affected owners and communities with the reestablishment of new trees and other perennial crops.

Type of Loss	Entitlement Unit	Description of Entitlements	Implementation Measures
3.3 Potential regulation of land-use activities (land use right) above the Tunnel	Titleholder; other evidence of ownership Non-titleholder Tenant	Restoration of the land use right, which will be followed by a newly preparation of the land use guideline above the tunnel alignment.	• If any house or physical assets are damaged during tunnel construction, it will be addressed by CDC • Development activities (Land use change) above the tunnel alignment will be regulated and secured by the newly preparation of the land use guideline
4 Community Structures and Resources			
4.1 Community buildings and Structures	Local Community	Restoration of affected community structures to at least previous condition, or replacement in areas identified in consultation with affected communities.	• Affected community buildings/ structures include: schools, temples, health posts, water points, irrigation canals, trails etc. will be rehabilitated by project.
4.2 Land and trees	Local community or user groups	Assistance with improvement of remaining grazing areas. Restoration of access to community resources.	• The Departments of Agriculture and Forestry will requested to assist communities so that benefits from grazing areas are adequately mitigated.
5 Rehabilitation Assistance			
5.1 Displacement of household	Titleholder Non-titleholder	Housing displacement allowance for loss of own residential accommodation. Rental stipend for loss of rented accommodation.	• The housing displacement allowance will be based on two months per capita poverty level income (PLI), as established by the Nepal Living Standards Survey, for a household of 5.5 members. The value of the allowance will be adjusted annually for price escalation. • The rental stipend will be based on 0.5 months PLI as defined above. • Allowances will be paid at the time of serving the notice to vacate. • Displacement allowances (housing, business and cultivation) will be paid severally.
5.2 Displacement of commercial enterprise	Titleholder Non-titleholder	Business displacement allowance for loss of commercial establishment.	• Calculation as for housing displacement allowance. • Payment as detailed in 5.1.
5.3 Severe disruption to cultivation	Titleholder Tenant	Cultivation disruption allowance for severe disruption to household cultivation levels.	• The following cultivation disruption allowances will apply to; - Households with total landholdings of 0.25 ha and smaller who lose more than 10 percent of their landholdings; - Households with total landholdings above 0.25 ha who lose more than 25 percent of their landholdings; - Households whose production levels are to be severely affected. • The cultivation disruption allowance will be equal to one season's production on the area of land lost, based on the norms of District Agriculture Office for the year of acquisition.

Type of Loss	Entitlement Unit	Description of Entitlements	Implementation Measures
5.4 Vulnerable social categories	Any identified groups/peoples, who identified as vulnerable group/peoples	In this Preparatory Survey stage, it was not confirmed any vulnerable group/peoples. If, any vulnerable social categories identified during the Detail Design/ implementation Phase, it will be considered.	-
6 Government Property			
6.1 Loss of Infrastructure	Relevant agency	Facilities will be repaired or replaced.	• To be undertaken in consultation with the relevant department or ministry.
6.2 Loss of forest areas	Community Forest/Department of Forest	Mitigation by means of afforestation.	• Cash compensation by DOR payable to the Community Forest/District Forest Offices equivalent to 25 sampling plantation to clearance of 1 tree with 15 cm diameter or larger. • To be undertaken in consultation with Community Forest Users/Department of Forestry.
6.3 Loss of other Government Land	Relevant agency	No provision of compensation.	• Consultation with relevant government agencies.
7 General Counseling			
7.1 All project impacts	Persons within and adjacent to the road corridor	General counseling on project impacts; construction schedules and acquisition dates; valuation, compensation, and grievance resolution mechanisms; construction employment procedures; and local development initiatives.	• This will be achieved through the periodic distribution of information sheets and consultation with local officials. • Cooperation with GoN ministries and departments such as Departments of Agriculture, Forest, and Local Development to support effective resource utilization and community development.
7.2 Priority in poverty reduction /social development programs	All APs	Below poverty line HH due to loss of physical asset.	• Participation of APs with priority in saving credit scheme facilitated by the Project. • Participation of APs with priority in life skills, income generation, and other entrepreneurship.
8. Additional Assistance			
8.1 Preference in employment in wage labor in project activities	All APs	Below poverty line* HH due to loss of physical assets.	• Construction contracts include provision that APs will have priority in wage labor on project construction during implementation. • APs shall be given priority after construction for work as maintenance worker, mandated in local body agreement

Type of Loss	Entitlement Unit	Description of Entitlements	Implementation Measures
8.2 Skill training and income generation support	One member of each PAF belonging to below poverty line.	Below poverty line HH due to loss of physical asset.	• Skill training and income generation support financed by project • RAP to include a need assessment and skill training program for APs.
8.3 Priority in poverty reduction /social development programs	All APs	Below poverty line HH due to loss of physical asset.	• Participation of APs with priority in saving credit scheme facilitated by the Project. • Participation of APs with priority in life skills, income generation, and other entrepreneurship.
9 Damage caused During Construction			
9.1 Public and private building and structures, infrastructure, land crops and trees	All categories of entitled persons as defined in clause 1, 2 and 3 above in this table.	Appropriate countermeasures should be taken by contractors to avoid damaging public and private property unnecessarily	• Where damages do occur to public or private property as a result of construction works, the affected families, groups, communities, or government agency shall be compensated for damages to crops and trees; damage land, structure, and infrastructure shall be restored to their former conditions.

Note: Below poverty line* means that less than NRs. 9,567 as per month/per family income (5.57 persons) (equivalent to NRs. 114,804 annual households' income) is considered as below poverty level*

13.4.7 Resettlement and Rehabilitation

(1) Compensation and Livelihood Restoration

Key impacts on affected households are land acquisition and loss of structures. The census data revealed that all the respondents have preferred cash compensation for all types of loss. Most of the affected land is of high quality and productive from agricultural point of view. The cash compensation has high value in such semi-urban areas because they can buy similar quality of land or operate businesses to mitigate land loss. Besides, the project will have given high priority for project affected people for construction related jobs during project implementation period.

(2) Relocation Needs and Approach

The project Affected Persons (APs) who lose their land, house or other property due to project will get compensation. Altogether five houses and two factories need to demolish due to this proposed Project. The resettlement needed households are scattered individually along the road alignment. The Interaction meetings during the Preparatory Survey with the affected households show that there is no need of group resettlement (relocation site) due to scatter households in different places. All the affected households expressed their opinions that they preferred to get cash compensation. Therefore, it is not necessary to consider the relocation site by this Project.

A package of cash compensation will be provided to the affected households. The package includes cash compensation for the structure at replacement cost, and displacement allowances, which includes any necessary administration fee such as land registration fee, transfer tax, and leveling fee, if needed.

Furthermore, employment priority will be given to the displaced households during road construction. Cash compensation and support allowance will be provided to the affected households or families for lost assets. It will be a main income restitution measure envisaged for this project. As far as possible, the project will provide job opportunities through contractor

for the affected people during the project implementation, in order to enable families to earn sufficient to restore their income, if needed.

(3) Livelihood Enhancement Skill Training

One member of each affected household may belonging to low income group, will be provided income restoration measures under the Livelihood Enhancement Skills Training (LEST) program. LEST will include trainings on income generating activities which will be delivered through trainings and other supplementary investments. These programs are expected to re-establish APs' lost livelihood options and development of new income generating opportunities.

The trainings will be based on the need assessment of the affected families. It is estimated that 48 persons (25 % of total affected households) will be selected through training need assessment. Training will be conducted according to their desire. The cost of the training program is included in the RAP.

(4) Temporary Acquisition of Land

Temporary acquisition of private land is also required for the dumping construction material and equipment at project site. The compensation for the temporary acquisition of land will be provided to the land owners as a rental payment. The rental payment will be equal to the cost of standing crop loss during the acquisition period. Contractors will be responsible for the rental payment and the restoration of the land to its previous productive status after construction.

(5) Public Health

Health awareness programs for the local people as well construction labors shall be organized by the project and contractor on a regular basis (prior to construction commencement and in an yearly interval) to provide knowledge to construction workers and local population on health including the dangers and consequences of STD and HIV/AIDS. Additional training for awareness rising will be given by the professional health workers in association with social supervision consultant on health aspects of STD and HIV/AIDS and human trafficking.

The awareness program related to public health, HIV/AIDS and human trafficking will be organized inviting public health expert (specially a medical practitioner of the concerned districts and concern district police officer). The social Development and Resettlement Expert will highlight the social impacts of the STD and HIV/AIDS plus human trafficking in project affected area. The role of social mobilizer and resettlement expert will be to neutralize the conflicting relationship between contractors and local stakeholders, outside labors and local labors, in relation to competition over natural and economic resources.

13.4.8 Implementation Arrangement

For the RAP implementation, reasonable organization framework must be considered. It also discusses monitoring requirements, before concluding an overview of the major planning, administrative and logistical requirements for the successful implementation of the RAP.

As the project authority, DOR should be retained overall responsibility for the management procedures of the RAP as well. Key activities to be undertaken to ensure effective implementation of resettlement, compensation and rehabilitation activities are:

- Implementation of procedures to (i) minimize adverse social impacts including acquisition of land and assets throughout the planning, design and implementation phases and (ii) accurate recording of all project-affected persons, by means of census and asset verification and quantification exercises, and the issuing of identification;
- Establishment of systems and procedure for the co-ordination of resettlement and compensation activities;
- Establishment of grievance re-dresses committee to address the social issues with participation of affected people. The objectives of this participation program will be to: (a) ensure ongoing dissemination of project information to affected households, (b)

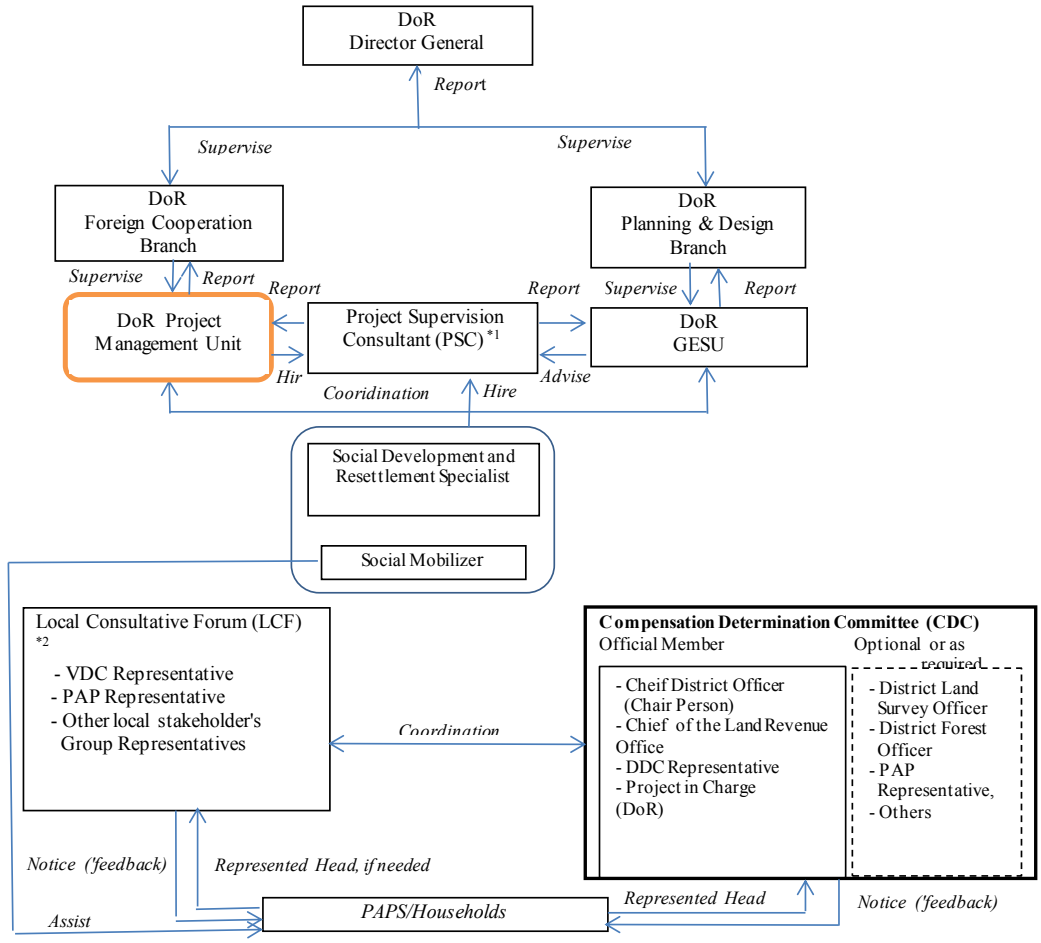
structure, regulate and strengthen communication between roadside communities, (c) involve affected communities and local government structures in social impact management, grievance resolution and monitoring.

- Capacity-building initiatives to create a supportive environment for the implementation of RAP activities, including training on accepted resettlement and rehabilitation practices, training in the establishment of compensation plans for affected household;
- Co-ordination with other government line agencies like Department of Forestry and Ministry of Local Development to ensure effective delivery of mitigation and rehabilitation support measures; and
- Disclosure of RAP will be at two levels:
  - At the first level this report will be submitted to the DoR and the JICA preparing both hard copy and electronic version. The electronic version will be attached in the website of DoR and JICA.
  - At the second level summary of RAP will be translated into Nepali and distributed among the concerned stakeholders at national as well as local level, especially focusing to the Project Affected Households.

(1) Organization Framework

An organizational setup for RAP implementation is necessary for effective coordination to ensure compliance with policies and procedures, land acquisition and resettlement activities and implementation of mitigation measures. To ensure the achievement of these activities, organization for RAP implementation and management will occur at both central and project level.

Figure 13.4-3 shows proposed organization framework for RAP Implementation. The details each role for the related organizations and persons are described in **Section 13.10** as well.



Note 1): PSC is the actual implementation body for RAP.
2): LCF is also the locally established as a "Grievance Redress" committee, communication link between the PAPs, and the Project as well as the PSC.
3): PAP is project affected person
4): GESU is Geo-environment and Social Unit, DOR
Source: Prepared by JICA Preparatory Survey Team

FIGURE 13.4-3 PROPOSED ORGANIZATION FRAMEWORK FOR RAP IMPLEMENTATION

1) Central Level Arrangement

The central level arrangement of resettlement starts from the financial management for land acquisition and compensation. The required money for compensation will send to the Project Management Unit (PMU) through the Department of Road (DOR). The DoR PMU will be responsible for overall project coordination and management of the RAP implementation. The Geo-Environment and Social Unit (GESU) will also lead the overall management of social issues, review and approval of RAP and monitoring of timely and successful implementation of RAP.

2) Project Level Arrangement

While central level arrangements are necessary for coordination of RAP activities, project level arrangements are required for effective RAP implementation. The Compensation Determination Committee (CDC) is chaired by Chief District Officer (CDO) of the concerned districts. The CDC determines the rate of compensation in consultation with PAPs and local stakeholders, categorizing land, and structures. Other relevant district officials will be deputed during the land and assets acquisition process when required. As the project authority, the PMU will resume overall responsibility for RAP implementation. This will require:

- Implementation of procedures to minimize adverse social impacts throughout the planning, design and implementation phases

- Implementation of procedures for the recording of all project affected persons by means of census and asset verification and quantification exercises;
- Establishment of procedures for the coordination of resettlement and compensation activities;
- Implementation of information dissemination campaigns
- Capacity building initiatives to create a supportive environment for the implementation of RAP activities;
- Coordination with other government line agencies, local stakeholders, NGOs to ensure effective delivery of mitigation and rehabilitation support measures.

3) Funding for Implementation of RAP and Reporting of the Monitoring Results for RAP

As mentioned in **Section 13.3.13** of this Report, budget for the monitoring activities for Environmental Management Plan (EMP) are negotiated with DOR and the funding agencies for each project. The budget for the monitoring activities for the RAP is also negotiated with DOR and the funding agencies for this Project as well.

In this Project, each organization listed in **Table 13.4-18** shall bear the responsibility for implementation of the Environmental Management Plan as well as RAP in the described Phases using JICA Loan or GON budget.

TABLE 13.4-18 FUNDING AND RESPONSIBLE ORGANIZATION FOR THE IMPLEMENTATION OF EMP AND RAP

Funding	Phase	Responsible Organization
JICA Loan	Planning Phase (Detailed Design Phase)	Engineering Design Consultant
	Construction Phase	Construction Supervision Consultant or Construction Contractor. (Responsible organization to be decided in the beginning of the Construction Phase.)
GON	Operation Phase	DOR

Source: JICA Survey Team, 2014

In terms of reporting of monitoring activities, the ESMF 7.6.2 requires quarterly reports of the Internal Monitoring. Also, the External Monitoring Agency hired by the Project Implementing Units will conduct bi-annual review of EMP and RAP implementation. Both reports will be sent to the funding agency such as JICA in each above phase.

(2) Grievance Redress Mechanism

Grievance redress mechanism will be established so that project affected people can appeal any disagreeable decisions, practices, and activities arising from compensation for land and assets to the responsible authority. Project affected people have formal option to appeal CDO and Ministry of Home Affairs in case of grievance under regulations specified in Land Acquisition Act 2034 (1997).

There is the potentiality for two types of grievances: grievances related to land acquisition and resettlement requirements, and grievances related to compensation or entitlement. The PAPs will have access to both locally constructed grievances redress committees specified under ESMF i.e. Local Consultative Forum (LCF) and formal courts of appeal system. Under the latter system every PAP can appeal to the court if they feel that they are not compensated appropriately. They may appeal to appellate court within 35 days of the public notice given to them.

Proposed mechanism for grievance resolution is given below:

Stage 1:

Complaints of PAPs on any aspect of compensation, relocation, or unaddressed losses shall in

first instance be settled verbally or in written form in field based project office. The complaint can be discussed in an informal meeting with the PAP by the concerned personnel to settle the issues at the local level. The community consultation, involvement of social/ resettlement experts will be helpful in this regard. It will be the responsibility of Project In-charge to resolve the issue within 15 days from the date of the complaint received.

Stage 2:

If no understanding or amicable solution reached or no response from the project office, the PAP can appeal to the CDC. While lodging the complaint, the PAP must produce documents to support his/her claim. The CDC will provide the decision within 15 days of registering the appeal.

Stage 3:

If the PAP is not satisfied with the decision of CDC or in absence of any response of its representatives, within 35 days of the complaint, the PAP, in his/her last resort, may submit its case to the court.

(3) Implementation Schedule

The project authority will ensure that funds are delivered on time to CDC and the implementing consultants for timely preparation and implementation of RAP, as applicable. Generally, civil works contracts will not be awarded unless required compensation payment has been completed. In the context of this project compensation process as well as income rehabilitation measures may continue and be completed even after civil works has begun. Tentative implementation schedule for RAP is given in **Table 13.4-19**.

TABLE 13.4-19 TENTATIVE IMPLEMENTATION SCHEDULE FOR RAP

S.N.	Tasks	2014	2017	2018												2019				2020				2021		
		Dec	Jan	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul - Sep
1.	Submission of Draft RAP to DOR	♦																								
2.	Submission of Final RAP to DOR for approval		♦																							
3.	Submit final report to CDO for compensation determination			♦																						
4.	Notice publication of affected land			♦																						
5.	Consultation and Grievance resolution				♦																					
6.	CDC meeting and Compensation Determination				♦																					
7.	Inform APs for the compensation claim				♦																					
8.	Collect application from the PAPs for compensation				♦																					
9.	Verify the application and prepare final list of PAPs				♦																					
10.	Pay compensation for eligible PAPs					♦																				

S.N.	Tasks	2014	2017	2018												2019				2020				2021		
		Dec	Jan	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul - Sep
11.	Contract agreement with Contractors						♦																			
12.	Transferring the land ownership						♦																			
13.	Internal Monitoring of RAP implementation progress							♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
14.	External monitoring of RAP implementation																				♦			♦		

Source: Prepared by JICA Preparatory Survey Team

13.4.9 Cost Estimation

This section provides the estimated costs in this Preparatory Survey stage for the implementation of the RAP activities described in preceding chapters under the following items.

(1) Cost Estimation for Private Land

The Land Revenue Office of Kathmandu district has fixed the minimum land cost which is basically used for land transaction purpose. During the Census and Socio-economic survey, the Affected Persons (APs) expressed that they will not accept the government rate which is very low than current market rate. The estimated cost of affected land is calculated based on current government price and current market price.

It is assumed that the current market price denotes the replacement cost by which the APs can purchase similar types of land nearby project area with the compensation amount. It covers the land registration fee and the other necessary fee such as leveling fee, if needed, within this cost. The current market prices are estimated based on a Replacement Cost Survey of this JICA Preparatory. Each estimate market price is derived from relevant information from the local peoples such as real estate planner, indirect affected persons, and direct affected persons in the Area.

All of the affected lands by the Project are located within the urban areas. Therefore, each estimation cost is basically calculated based on the distances from the main roads with actual land conditions such as undulation, but without considerations of the types (farm land, housing land, or commercial land) of the land.

The estimated compensation for private land is summarized in **Table 13.4-20**.

TABLE 13.4-20 ESTIMATED COMPENSATION FOR PRIVATE LAND

Confidential

(2) Cost Estimation for Private Structures

The Census and Socio-economic survey at the basis of cadastral map shows that 3 various types of residential structure need to be demolished due to project. The estimated costs for the houses/ structures are presented in **Table 13.4-21**.

TABLE 13.4-21 ESTIMATED COMPENSATION FOR PRIVATE STRUCTURE

Confidential

(3) Cost Estimation for Private Factories

There are two factories located along the road alignment namely: United Concrete Pvt. Ltd. and Bhola- Ganesh Brick Klin. This factory requires 6 month relocation cost for shifting another place. The relocation cost covers land improvement and factory establishment cost, structure cost, factory relocation cost, rent of land, labor cost and business closure allowance. Estimated compensation for private factories is presented in **Table 13.4-22**.

TABLE 13.4-22 ESTIMATED COMPENSATION FOR PRIVATE FACTORIES

Confidential

(4) Housing Displacement Allowances

The displacement/rehabilitation allowance basically covers the housing displacement allowance for residential houses. Displacement/rehabilitation allowances are based on 90 days minimum wage as established at the national or local level. The national minimum wage rate is NRs 500.00/day in Nepal. The estimated cost for the displacement/rehabilitation allowances is shown in **Table 13.4-23**.

TABLE 13.4-23 DISPLACEMENT AND REHABILITATION ALLOWANCES

Confidential

(5) Livelihood Enhancement Skills and Training (LEST) Program

48 persons from project affected family (25 % of total affected households) selected through training need assessment of all affected households will be provided Livelihood Enhancement Skills Training (LEST) program. The training cost for each participants is estimated NRs 65,000 (including lodging, foods, transportation, trainer cost etc., so total training cost = 48 person x NRs. 65,000 = **3,120,000**.

(6) Resettlement Action Plan (RAP) Implementation Cost

There are several RAP implementation activities need to be carried out during the project implementation period such as public consultation and information dissemination, the Compensation Determination Committee (CDC) meeting, RAP updating etc. The estimated cost for RAP implementation is presented in **Table 13.4-24**.

TABLE 13.4-24 ESTIMATED COST FOR RAP IMPLEMENTATION

Confidential

(7) Total Cost Estimates

The total estimated cost, which includes the affected private land, private structure, private factory, displacement, LEST Program, and the RAP implementation cost, is presented in **Table 13.4-25**.

TABLE 13.4-25 SUMMARY OF THE COMPENSATION COST

Confidential

13.4.10 Monitoring and Evaluation

The Project has objective to ensure that the economic condition of affected households shall not be worse than that of their situation without the Project intervention.

Regular monitoring is essential and only an instrument to understand the socio-economic condition of the affected household. Two types of monitoring, internal and external will be administered in three levels: (i) process level (ii) output level and (iii) impact level of*:* (a) record and assess project inputs and the number of persons affected and compensated and (b) confirm that former subsistence levels and living standards should be reestablished.

(1) Internal Monitoring

A quarterly report of internal monitoring will be prepared by GESU in consultation with Social Development and Resettlement Specialist. The Project Management Unit (PMU) will maintain a record of all transaction in their resettlement data, followed by entitlement records signed by the affected persons and survey based monitoring of resettlement and land acquisition progress. The Local Consultative Forums (LCF) will play an important role in monitoring providing feedback on community concerns, grievances, and requests. Internal monitoring focuses and ensures the followings:

- Verification that there are not outstanding or unresolved land acquisition issues with respect to the project and that property valuation and economic rehabilitation in accordance with the provision of plan
- Information campaign, discrimination and consultation with affected persons
- Status of land acquisition and timely payments on land compensation
- Value of entitlement received equal to that of actual land and structure acquired
- Use of entitlement and check its misuse
- Compensation for affected structures and other assets
- Payments for loss of income
- Relocation of affected persons and supports provided
- Implementation of economic rehabilitation and income restoration measures
- Effective operation of the Grievance Redress Committees
- Funds for implementing land acquisition and economic rehabilitation activities as timely manner and sufficient for the purposes and spent in accordance with the plan

The Social Development and Resettlement Specialist will submit reports to GESU on a quarterly basis. The Social Mobilizers prepare the monthly progress report to the Social Development and Resettlement Specialist. Project field offices will be responsible for monitoring the day-to-day resettlement activities. The Social Mobilizers will play an important role to assist the project field office in course of regular monitoring.

A performance data sheet will be developed to monitor the project at the field level. Social Development/Resettlement Specialist will monitor the RAP implementation and proceeds quarterly reports to DOR and the JICA, received from the Social Mobilizers from the field offices.

The proposed internal monitoring is presented in **Table 13.4-26**.

TABLE 13.4-26 PROPOSED MONITORING FORM FOR THE INTERNAL MONITORING

Indicators	Issue	Procedure	Timing	Responsibility	Results
Process level monitoring					
RAP implementation in project works	Employment of local labor including women and children	Site observation, attendance record, interaction with laborers and contractors	Monthly	Project/social mobilizer /SDRS	
	Campsite management including lodging arrangement and campsite facilities	Site observation, interaction with laborers, contractors	Monthly	Project/social mobilizer/SDRS	
	Use of health and safety measures	Site observation, interaction with laborers, contractors	Quarterly	Project/SDRS	
	Temporary leasing of private land and house	Site observation, contractors, check contract agreement	Monthly	Project/social mobilizer/SDRS	
	Discrimination of wage rate between male and female workers	Interaction with laborers, labor survey, record of wage payment	Monthly	Project/social mobilizer/SDRS	
Output level					
Land Acquisition	Encroachment into public land like grazing land, temples etc.	Visit the identified public land interact with local people, take photographs	Biannually	Project/social mobilizer /SDRS	
	Development of new settlements/slum along the roadside	Observation, recording of sites, photograph	Quarterly	Project/social mobilizers/ SDRS	
	Migration to the road side/displacement of local people	Review of land holding records, discussion with local people	Quarterly	Project/social mobilizer/SDRS	
	Incidence of road accidents	Discuss with local people, health institutions' records	Biannually	Project/SDRS	
	Incidence of communicable diseases like respiratory, STD, HIV/AIDS etc.	Discuss with local people, health workers/ health post/ center	Annually	Project/social mobilizer/SDRS	
Input level					
Change in household level income and economic activities	Changes in the land price, land use and agricultural practices, productivity and crop export	Discuss with farmers and extension workers, agricultural statistics of District Agriculture Office	Annually	Project/social mobilizer/SDRS	
Social safety	State of social harmony and social security like alcoholism, narcotism, etc.	Police records, discussion with local residents	Annually	Project/SDRS	
	Changes in the living standard of people	Interview with families, VDC records, discussion with local leaders, CBOs	Annually	Project/SDRS	
Cultural impact	Condition of cultural and historical areas and aesthetic qualities	Visit the area, discuss with people, observation and photographs	Annually	Project/SDRS	

Note 1: Social mobilizer: Field level staff hired by the Project Supervision Consultant.
Note 2: SDRS: Social Development and Resettlement Specialist hired by the Project Supervision Consultant.

(2) External Monitoring

The actual external monitoring will be carried out by annually by an independent monitoring agency. The external monitor will review the internal resettlement implementation activities. The external monitoring involves on:

- Review of internal monitoring Reports
- Review of compensation status
- Monitor Rehabilitation support program
- Information disclosure system
- Process and mechanism of compliance redress
- Employment status of the PAPs
- Effectiveness of Livelihood restoration program
- Effectiveness of Awareness in HIV/AIDS and human trafficking

Based on the above mentioned activities the external monitor will focus on:

- Evaluation of social and economic impact of land acquisition and economic rehabilitation of the project affected persons.
- Verify the objectives of enhancement of economic condition PAPs, or at least restoration of income levels and standard of living of the affected persons.
- Furnishing creative suggestions and modifications in land acquisition and economic rehabilitation, if necessary.
- Making to ensure all resettlement and land acquisition activities are properly conducted.

The external monitoring agency will require the following activities to be performed:

- Verification of internal monitoring to ensure the appropriateness of activities carried out by program implementation unit in the field.
- Evaluation of delivery system to the PAPs and assess impacts of entitlements to determine the approved resettlement action plan.
- Evaluation of consultation and grievance redress procedures to identify the levels of public awareness of grievance-redressed procedures, accessed by project affected persons and households for information and rapid conflict resolution.
- Evaluation of actual operations of grievance committee to assist project affected persons as required and to act as observers.
- Declaration of successful implementation for summing up of activities related to entitlements, distribution, and resettlement.
- Recommend follow up action relating to outstanding actions required to complete achievement of objectives of the RAP and resettlement policies, additional mitigation measures for project affected persons

The proposed external monitoring is presented in **Table 13.4-27**.

TABLE 13.4-27 PROPOSED MONITORING FORM FOR THE EXTERNAL MONITORING

Indicators	Procedure	Timing	Results
Employment of local labor including women and children	Site observation, attendance record, interaction with laborers and contractors	Annually	
Campsite management including lodging arrangement and campsite facilities	Site observation, interaction with laborers, contractors	Annually	
Use of health and safety measures	Site observation, interaction with laborers, contractors	Annually	
Temporary leasing of private land and house	Site observation, contractors, check contract agreement	Annually	
Discrimination of wage rate between male and female workers	Interaction with laborers, labor survey, record of wage payment	Annually	
Encroachment into public land like grazing land, temples etc.	Visit the identified public land interact with local people, take photographs	Annually	
Development of new settlements/slum along the roadside	Observation, recording of sites, photograph	Annually	
Migration to the road side/displacement of local people	Review of land holding records, discussion with local people	Annually	
Incidence of road accidents	Discuss with local people, health institutions' records	Annually	
Incidence of communicable diseases like respiratory, STD, HIV/AIDS etc.	Discuss with local people, health workers/ health post/ center records	Annually	
Changes in the land price, land use and agricultural practices, productivity and crop export	Discuss with farmers and extension workers, agricultural statistics of District Agriculture Office	Annually	
State of social harmony and social security like alcoholism, narcotics etc.	Police records, discussion with local residents	Annually	
Changes in the living standard of people	Interview with families, VDC records, discussion with local leaders, CBOs	Annually	
Condition of cultural and historical areas and aesthetic qualities	Visit the area, discuss with people, observation and photographs	Annually	