# Preamble

## 1. Background

Recent years have witnessed significant changes in all fields in Vietnam, especially in major urbanities. This is attributed to the open door policy and global integration which help promote the urbanization process. Hanoi is a clear and specific example of urbanization. High population density, strong economic growth rate, dense traffic network and increasing traveling demand has ended up in great pressure on the City's current traffic system.

In Hanoi City, the increasing traveling demand and the surge of private traffic means (particularly motorbikes) constitutes the main cause of traffic congestion, pollution and traffic accidents.

Currently, the Hanoi's public traffic system can meet the public demand only partially. The public transit comprises mainly buses, taxi.. which constitutes a small proportion and shares the routes with other means of transport. This is sometimes the principal cause of traffic jam.

In face of the above situation, the Hanoi People's Committee has conducted research to find out the proper solutions for traffic problem in the capital City. Numerous researches has agreed on the use of urban Railway, which is a modern, comfortable public transit with high capacity, meeting the ever-increasing traveling demand of the City dwellers.

In 2004 - 2005, with the approval of the Hanoi People's Committee, the French SYSTRA Consultant has carried out a research to build the Urban Pilot Railway line, section from Nhon to Hanoi Railway Station. The research has completed in 2005.

This Urban Railway will help to satisfy the traffic demand in the East-West artery and celebrate the 1000$^{th}$ Anniversary of Thang Long-Hanoi in 2010. This also contribute to ease the traffic jam, enhance traffic

safety, improve the environmental condition, and create new traveling practice for Hanoi people, enhancing the City's modernity.

## 2. Legal documents and technical basis for EIA-study

### 2.1. Legal Documents

The Emvironmental Impact Assessment (EIA) report for the project: "Ha Noi Pilot Metro Line Project" is compiled based on the following legal documents:

- The Vietnam's Law on Environmental Protection, 2005.
- Degree No. 80/2006/N§-CP of the Prime Minister dated 09/08/2006 guilding on the implementation of the Law on Environmental Protection
- Circular 08/2006/TT-BTNMT of the Ministry of Natural Resources and Environment issued 08/09/2006 providing Guidance on strategic EIA, EIA and environmental protection committment.
- Sectorial Standards 22TCN 242-98, dated 27/3/1998 of the Ministry of Communication and Transport on the EIA procedures during preparation of feasibility study and construction design for transportation work.
- Temporary regulations on environmental monitoring-anslysis methods and data management the National Environmental Agency-Ministry of Science, Technology and Environment, 1999.
- Vietnam Standards promulgated by the Ministry of Science, Technology and Environment since 1995 to date (TCVN 5937, 5944, 5945).

  + Maximum allowable for noise in public places and residential areas (TCVN 5949-1998)

  + Ambient air quality standards (TCVN 5937: 2005, TCVN 5938: 2005);

  + Maximum permissible level of vibration (TCVN 7210: 2001)

  + Surfacewater quality (TCVN 5942:1995);

  + Groundwater quality (TCVN 5944:1995)

- Decision 22/2006/Q§-BTNMT dated 18/12/2006 of the Minister of Natural Resources and Environment enforcing the use of Vietnamese Environmental Standard.
- Decision 108/1998/Q§-TTg dated 20/06/1998 of the Premier on adjustmetn of the Hanoi Master Plan to 2020.
- Decision 60/2002/Q§-TTg dated 13/05/2002 fo the Premier on the approval of Hani Social-economic Development Master Plan in 2001-2010 period.
- Decison 206/2004/Q§-TTg dated 10/12/2004 of the Prime Minister approving the Vietnam Trasportation Strategy to 2020.
- Decision 2707/Q§-UB dated 23/4/2002 of the Haoi People’s Commitee on the preparation of Pre-feasibility study report (now the Investment report)
- Decision 6329/Q§-UB dated 28/09/2004 of the Hanoi People’s Committee approving on the Cost estimation for investment preparation of the Hanoi Urban Pilot Railway Line Project.
- Decision 3891/Q§-UB dated 08/06/2005 of the Hanoi People’s Committee approving on the supplemented investment preparation of the Hanoi Urban Pilot Railway Line Project.
- Document No. 67/TTg-CN dated 12/01/2006 of the Primer Minister approving the Pre-feasibility Study of the Hanoi Urban Pilot Railway Line Project, and allowing Hanoi People’s Committee to prepare the Feasibility Study (Project Investment and Construction).
- Decision 909/Q§-UB dated 20/02/2006 of the Hanoi People’s Committee approving the task for investment preparation of feasibility report for the Hanoi Urban Pilot Railway: Nhon-Hanoi Railway Station Line.
- Decument No. 622/TTg-Cn dated 24/04/2006 of the Premier on the “Hanoi Urban Pilot Railway: Nhon-Hanoi Railway Station Line

## 2.2. Technical Basis

- Pre-feasibility Study for the Hanoi Urban Pilot Railway, 2005.
- Pre-feasibility Study for the Hanoi Urban Pilot Railway: Nhon-Hanoi Railway Station Line, 2005;
- Pre-feasibility Study for the Hanoi Urban Pilot Railway: Nhon-Hanoi Railway Station Line, Jan 2006;
- The collected data on hydrological, topographical and soil condition of the project area;
- Survey results and measurement in the project site conducted by the Center for Environmental Protection in Transportation- Institute of Transportation Science and Technology;
- Socio-economic survey data conducted in the project sites;
- Other relevant research documents, reports.

# 3. EIA Implementation

To comply the Law on Environmental Protection, 2005, the Hanoi Urban Railway Management Unit (The Hanoi Tram and Public Transport Development Management Unit) has coordinated with environmental Consultants: the Center for Environmental Protection in Transportation (CEPT)- Institute of Transportation Technology and Science to carry out EIA-study for the Hanoi Urban Pilot Railway: Nhon-Hanoi Railway Station Line in order to evaluate and anticipate positive and negative project impacts; and propose mitigation measures for environmental adverse impacts.

- EIA Consultant: **Center for Environmental Protection in Transportation (CEPT) - Institute for Transportation Technology and Science**
- Director: Mrs. **Dang Thi Phuong Nga**
- Address: **1252 Lang Street, Dong Da, Hanoi**

The EIA Team comprises:

1. M.S.c. Dang Thi Phuong Nga CEPT Act. Director
2. M.S.c Nguyen Huu Nhat CEPT Deputy Director
3. M.S.c Vu Tien Dung CEPT Deputy Director
4. Eng. Bui Van Chiem CEPT Socio-economic surveyor
5. M.S.c. Nguyen Trung Thanh CEPT Environmental Technology
6. B.A Phan Minh Hoa CEPT Air Environnent
7. M.S.c Bui Thanh Huyen CEPT Water Environment
8. B.A Nguyen Van Chien CEPT Resettlement
12. B.A Phan Tien Sy CEPT Geology
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and others.

# Chapter I
# Project Description

## 1.1. Project Title

**Hanoi Urban Pilot Railway Line (Nhon-Hanoi Station Section)**

## 1.2. Project Owner

- Investor: Hanoi People's Committee
- Investor's Representative: Ha Noi Metropolitan Railway Transport Project Board

Director: Mr. Ha Huy Quang

Address: No.8, Ho Xuan Huong, Ha Noi

Tel: 04.9445350 - Fax: 04.9435126

## 1.3. Project boundaries

The intended railway line stretches 12.5 km long from Nhon to Hanoi Railway Station in Hanoi City. The line traverses districts likes Tu Liem, Cau Giay, Dong Da, Hoan Kiem and Ba Dinh.

- Depot Station: Land Plot No.4 in Notheastern conrner in National Road No.32 and Road No.70 crossway, belonging to territory of Tay Tuu commune, Tu Liem District, Hanoi City.

- Starting point: Km0 in Nhon on National Road 32 oposite Hanoi Industrial University.

- Ending point: Km12+500 at Hanoi Railway Station in Tran Hung Dao street.

Total study length: 12.5km, of which:

- Underground: 2,9 km
- Fly-over: 9,6 km

Ref. Map 1.1 Direction of Ha Noi Pilot Metro Line Project

(Nhon - Hanoi Raiway Station section)

**Fig 1.1: Direction of pilot urban railroad (Nhon-Hanoi station Line)**

## 1.4. Project Components

### 1.4.1. Direction

The Nhon-Hanoi Railway Station Line as per Option V1A has total length of 12.5km, including 9.6km fly-over and 2.9km underground. There are totally 15 Stations, including 11 elevated and 4 underground stations. The Fly-overs is from Nhon to Kim Ma and the underground from Kim Ma to Hanoi Raiway Station. The Metro is proposed under this Option.

The Line as proposed in Option V1A is dedicated one, divided into 04 sections:

**Section 1: From Nhon to Ring Road No. 3 (elevated)**
***- Km0+000 - Km3+450 (Nhon-Cau Dien)***

Start: starting point of the Railway line from Km0, at the location where the Fly-over connects down the access road to Depot.

The Flyover will run through the planned roads under the National Road 32 project and the National Railroad.

***- Km3+450 - Km5+500***

The National Road 32 in this section is currently being enlarged to 50m wide with 04 carriageways.The proposed Rialway route lies between the median of the expanded National Road No.32.

At Km.4+100: the Railway runs through the intersection of National Road 32 and Le Duc Tho street, then passes through the interection to My Dinh stadium at Km.4+600.

At Km.5+500, there is an existing fly-over to Ring Road 3, thus the proposed Railway will be raised to 14.50m high in compliance to current Vietnamese road span standards (5.30m).

**Section 2: From Ring Road No.3 to Swedish Ambassy (elevated)**

Between Ring Road No. 3 and Ring Road No.2, the proposed Railway will runs in a road, 20-30 wide. This road includes a strip of land as median and dual carriageway, each 10m wide. The road section from Cau Giay

to Daewoo Hotel is relatively narrow with 10.5m wide roadway. From Cau Giay, the road is grade-saperated by a retaining wall.

Section from Deawoo Hotel to Swedish Ambassy is Kim Ma road, a wider dual carriageway 03 lanes road, each lane 12-15m wide. A ancient tree row is planted at 4m wide median. Running in paralel to Kim Ma road is another smaller dual carriageway 2-lane road, each lane being 5-8 wide, and separated to Kim Ma road by a strip of land (4-10m wide) planted with trees. The proposed Raiway runs in this land strip on the left shoulder of Kim Ma road, next to the sidewalk (between Kim Ma road and the other paralleling smaller road).

**Section 3: from Swedish Ambassy to Van Mieu (Underground)**

The Line leaves Kim Ma road at Swedish Ambassy and turns into Nui Truc street. This road is rather narrow with 5m wide roadway for both direction.

After making a left-turning to Giang Vo treet, the Line follows the right side of Giang Vo street. Giang Vo street has 2x3 lanes in each side, each lane is 12m wide separated by 4m-wide median. The street intersect Giang Van Minh and Cat Linh street at Horison Hotel. This is the interchange with Ha Noi-Ha Dong BRT and LRT route.

The intended Line turns into Cat Linh street with 8m wide roadway then follows Quoc Tu Giam street to Van Mieu Quoc Tu Giam.

**Section 4: from Van Mieu to Hanoi Railway Station (Underground)**

From Van Mieu, the Line will be placed underground at Level 3 (-17m) passing through Ngo Sy Lien and Hanoi Railway Station, and ends at the end the Tran Hung Dao street (in front of Hanoi Railway Station)

### 1.4.2. Location and Scope of Stations

**** Location of Stations***

According to selected Option in the feasibility study, there are 15 Stations, their location are as follows:

- **Station 1:** elevated station in front of Industrial College with passenger footbirdge on both sides. With this footbridge, passengers can cross the road and access to the Station. The Startion's centerline is Km0+420.
- **Station 2:** locating centrally in industrial zone, East of a new road to be paved in the near future in serve for the Southern area of National Road 32. Passengers can access the Station by footbridge, at the Station's center is at Km1+545.
- **Station 3:** in the west of the National Railway and the intended intersection with the new road. Passengers access the Station by 2-storey footbridge, Station's center is at Km2+549.
- **Station 4:** opposite Cau Dien market, east of Nhue river. Passengers access the Station by 2-storey footbridge, the Station's center is at Km3+300.
- **Station 5:** behind the intersection between Ho Tung Mau road and access road to My Dinh National Sport Complex to pick up passengers from the Complex. The designed Station is opposite the existing bare land. Accessibility to the Station is from 2-layer footbridge. The Station's ceterline is at Km 4+290.
- **Station 6:** locates in the area of universities likes University of Commerce, University of Stage and Cinema, University of Ballet to ensure smooth traffic. Accessibility to the Station is from the 2-storey footbridge, at Km5+030.
- **Station 7:** locates Eat of Ring Road 3, opposite HITC Building. This Station is intended to serve for passengers from such universities as Hanoi National University, Hanoi Teacher Training University No.1, Foreign Language Teacher Training College, Academy of Press and Propaganda. Accessibility to the Station is from 2-storey footbridge, at Km5+729.

- **Station 8:** locates near Nguyen Phong Sac road, east of the intended National Road 32 extended to the South. The Station location will be identified according to development plan of this road and urban areas. Accessibility to the Station is from 2-storey footbridge, at Km6+708.

- **Station 9:** behinds the curve in front of Duong Quang Ham street. Similar to Station 8, Station No.9 will be defined according to urban development. Accessibility to the Station is from 2-storey footbridge, Station's center is at Km7+477.

- **Station No.10:** lies in Cau Giay Street, opposite University of Communication and Transport. This is the interchange of variou transport means, thus allowing for connection with Bus stations.

  Passenger transfer between Bus and the Pilot Raiway will be facilitated through an 25m-long overpass. All the lower road will be dedicated for pedestrians and buses to minimize impacts to this area. The Station's center is at Km8+103.

- **Station 11:** lies in front of Lieu Giai-Kim Ma intersection, opposite Daewoo Hotel. This Station is the interchange with the future Raiway route from Hoa Lac to Noi Bai Airport. The Station's center is at Km8+967.

- **Station No.12:** underground (Level 1) station in Kim Ma road, opposite the Diplomatic Corps. The Station's dimension is 80m long and 15m wide.

  This Station has 4m-wide platform in both sides, surrounded by waiting rooms with stairs to sidewalks in Kim Ma street. The waiting rooms includes service part (for ticket selling and checking). The 04 stairs are open on both sides of the ground-level intersection to facilitate acccessibility by passengers. From the Station, the Raiway follows the first curve to turn into Nui Truc street. The Station's center is at Km9+885.

- **Station No. 13:** located underground of Giang Vo, Giang Van Minh and Cat Linh intersection. The Station is sited South of the Railway to make it easier for

transfering to other means of transport, and help to minimize influences on the row of trees as well as traffic flow, particularly BRT routes during construction period.

The Station is designed underground at level 1. With length of 80m (excluding technical section), the Station has 4m-wide platform and surrounded by waiting rooms with stairs to sidewalks in Giang Vo street.

This Station will serve as an interchange with the railway route to Ha Dong and the terminus station of BRT. Here, a multi-purpose interchange is designed to facilitate passengers and minimize the transfer time. 06 stairs is proposed on both sides of intersection so that passengers can access the Station easily, 02 of which is dedicated for Hanoi-Ha Dong BRT and LRT. The Station's center is at Km11+520.

- **Station No.14:** locating underground of Cat Linh road, east of Ton Duc Thang intersection (next to Horison Hotel). This Station is similar to Station No.12 and 13 in term of technical specifications and fuctions. The Station's center is at Km11+520.

- **Station No.15:** locating in front of Hanoi Railway Station, in Tran Hung Dao street. This Station is level-3 underground of the Hanoi Station's main Building. Its dimension is as follows:

+ Length: 80 m.

+ Width: about 17 m (depending on the safety limit of the respective mean of transport selected, and the width of neccessary platforms)

+ Depth: 17 to 18 m, suitable to vertical alightment of the tracks underground, which is approximately 17m.

This Station is connected to Hanoi Raiway Station by an underground corridor in Le Duan street. The 05 stairs connecting to the ground-level Station at the existing lounge or next to Le Duan street will facilitate passenger transfer to buses and trains. elevators or escalators shall be installed at this deep tube Station to facilitate passengers accessibility at Level-3 depth.

**B¶ng 1.1. List of Stations**

| Station | Km. | Location |
|---|---|---|
| S1 | Km0+425 | National Road 32, entrance of Hanoi Industrial Collge, Tu Lien district |
| S2 | Km1+550 | National Road 32, next to entrance to Pre-fabricated Steel Enterprises, Tu Liem dist |
| S3 | Km2+560 | National Road 32, adjacent ot Military Base Depot No.101, Tu Liem district |
| S4 | Km3+330 | National Road 32, in front of Cau Dien market, Tu Liem district |
| S5 | Km4+280 | National Road 32, in front of Mai Dich cemetary , Cau Giat disctrict |
| S6 | Km5+050 | Ho Tung Mau streets, next to Commerce University, Cau Giay district |
| S7 | Km5+725 | Xuan Thuy road, in front of Teacher Training College, Cau Giay district |
| S8 | Km6+715 | Cau Giay district, next to Gas Station No.9, Cau Giay district |
| S9 | Km7+465 | Cau Giay Road, Cau Giay Post Office, Cau Giay district |
| S10 | Km8+110 | Opposite the University of Communciation and Transport, Ba Dinh district |
| S11 | Km8+975 | Kim Ma road, near Daewoo Hotel, Ba Dinh district |
| S12 | Km9+875 | Kim Ma road, in front of Diplomatic Corps, Ba Dinh district |
| S13 | Km10+705 | Giang Vo street, Dong Da district, in front of Ministru of Health |
| S14 | Km11+520 | Ton Duc Thang-Cat Linh intersection, Dong Da district |
| S15 | Km12+500 | Tran Hung Dao road, in front of Hanoi Railway Station, Hoan Kiem district |

**** Station Specifications***

a) Over-head Station (11 stations):

- Dimension: Width 17m-18m, length: 80m.

- 2-storey Station: including carriageway and platform, the platform is 4m wide and 80m long. The upper layer is for platform and tracks line, the lower for passenger transfering, auxiliary works, ticket selling and checking

- Space is provided for elevators and escalators.

b) Underground Station (4 stations):

- Shallow underground stations:

+ Rectangular section, 16.7m wide, 9.15m high. Thickness of the diaphragm wall is 0.8m, floor and ceiling 1.0m. Cast in-stu reinforced concrete.

+ Station has 02 layers: the lower layer is for platform, tracks; the upper layer for passenger transfering, auxiliary works, ticket selling and checking, ventilation and air conditioning....

+ Space is provided for elevator and escalators.

- Deep tube station: has 03 floors, cast in-stu RC structure.

+ Bottom floor: for platform, tracks, service and technical areas. The Station has rectangular section, width and height of 17.2m and 9.5m respectively, thickness of the diaphragm wall is 0.8m, bottom 1.0m and roof 0.5m. The whole length is 80m.

+ Middle floor: for tracks alternation. The floor has rectangular section, 17.2m wide, 4m high, wall thickness is 0.8m, bottom 0.5m and length 80m

+ Upper Floor: for passenger transfer to other means of transport. Rectangular section, width and height is 28.5m and 6.5m respectively, thickness of diaphragm wall is 0.5m.

+ Space is provided for elevator and escalators.

### 1.4.3. Depot Station

***1. Location of Depot Station and connection to the main Line***

The Depot is located in the land plot No. 4, covering area 15ha in the Northeastern conrner of intersection between National Road 32 and National Road 70 as prescribed in the detail Plan of Tu Liem district and Landuse Plan approved by Municial People's Committee.

Connecting direction of the main line to Depot: comply with the selected direction in Feasibility Study: from Station 1 in National Road 32, the main Line is connected to Depot at the intersecting point of National Road 32 and National Road 70 by R150m curve.

The starting point at Km0+000 of the Pilot Railway Line in Nhon-Hanoi Station direction will be the grounding point of Fly-over to Depot.

The Starting point at Km0+000 mentioned above is also the base for calculating the Station of the main Lines in Deport

The railway connecting to ground-level Depot will be 02 double tracks with necessary length to ensure favourable accessibility by trains to the Depot in 02 directions likes in the main elevated Line,

The Centerline of Track No.2 (the track in Hanoi-Nhon direction) is $\geq$ 4.00m away from the red boundary of extended National Road 70

The interval between the Track No. 1 and Track No.2 is 4.00m (in consistent with the interval of 02 tracks in the main Line)

The ramp shall ensure gradient of 4-6%, and must be in the outer part of National Road 32 sidewalks to avoid influences on the prescribed clearance of the elevated Line with National Road 32 as in conventional Line acrossing the road with clearance $\geq$ 4.5m.


**Fig 1.1: Location of Depot Station**

***2. Depot Station***

Depot station of the railway line comprises the following section and components:

- Maintainance bays
- Wash-up areas
- Parkings
- Workshops
- Wheel maintaining equipment
- PCC
- Tracks and traffic roads
- Administration areas
- Training Center
- Overhaul areas, base Depot.

### 1.4.4. Water Supply, Drainage and Wastewater Treatment System

** Water Supply*

Water is connected to the City's water supply system. Total estimated volume is 250 $m^3$/day

** Drainage system*

- At underground Stations: pumps are placed at the lowest point, 02 pumps for each station, pump capacity is 60$m^3$/hour

- Inside the tunnel: pumps are placed at the lowest point, capacity 100 $m^3$/hour

- Bridges: use of lengthwise gutters and vertical pipe drains

- The water collection and drainage system shall be connected to the City's combined system

** Wastewater Treatment system*

- At elevated and underground Stations: sewerage is treated before being discharged into the City's drainage system

- In depot, industrial and domestic wastewater shall be treated in prior to discharging into the area's drainage system.

**B¶ng 1.2: Water Supply and Discharge Volume of Depot**

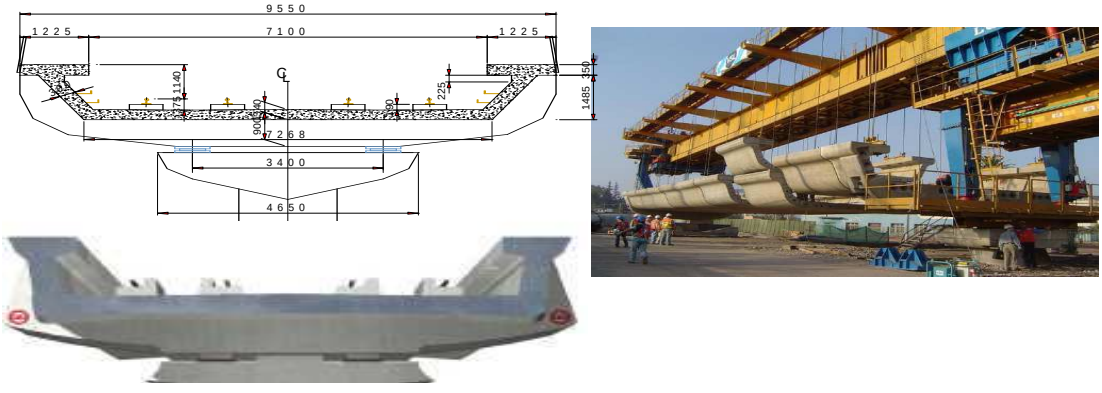
| | | | | | | |
|---|---|---|---|---|---|---|
| | Wash water of carriages | 24 | Car | 60,000 | 2,500 | L/car |
| | Water for leak checking | 8 | Car | 16,000 | 2,000 | L/car |
| | Wash water of detailed accessories | | | 12,000 | | |
| | Water for engine capacity check | | | 3,000 | | |
| 2 | Domestic water | | m3 | ***65,660*** | | |
| | Supply water for dining-room ( 200m2 | 100 | person | 2,500 | 25 | L/man |
| | Suply water for Administration Buildin | 336 | person | 45,360 | 135 | L/man |
| | Supply water for training center | 150 | person | 3,750 | 25 | L/man |
| | Supply water for forgery workshop | 200 | person | 9,000 | 45 | L/man |
| | Supply water for metal workshop | 202 | person | 5,050 | 25 | L/man |
| 3 | Area of road for sprinkle | 27,500 | m2 | ***8,250*** | 0.3 | L/m2 |
| 4 | Area of green vegetation for watering | 16,200 | m2 | ***64,800*** | 4.0 | L/m2 |
| 5 | Water for fire prevention | 18 | each | ***162,000*** | 5.0 | L/s |
| **II** | **Drainage** | | | | | |
| 1 | Industrial wastewater | | m3 | ***72,000*** | | |
| | Wastewater from carriage washing | 24 | Car | 60,000 | 2,500 | L/car |
| | Wastewater from detail parts washing | | | 12,000 | | |
| 2 | Domestic wastewater | | m3 | ***65,660*** | | |
| | Wastewater from dining room (200m2 | 100 | person | 2,500 | 25 | L/man |
| | Wastewater from Administration Build | 336 | person | 45,360 | 135 | L/man |
| | Wastewater from training center | 150 | person | 3,750 | 25 | L/man |
| | Wastewater from forgery workshop | 200 | person | 9,000 | 45 | L/man |
| | Wastewater from metal workshop | 202 | person | 5,050 | 25 | L/man |
| | | | | | | |
| | | | | | | |

## 1.4.5. Fly-over bridges

### *1.4.5.1. High bridge with simple beam spans in common section*

***Beam: U beam for double track***

**Figue 1.2. *U beam for double track***



- Beam height h=1835cm in middle span and 2735 cm in bearing, width 30cm.
- Beam is fabricated by 4000mm sections, section length in bearing 2450mm.
- Cross section composed of 1 beam, distance between 2 tracks 3.6m.

- The beam segments are produced in workshop and transported in each span for being erected ( erected, pre-stressed and grouted) on the site ( erected, pre-stressed and grouted) .

***Detailed design plans for each intersection***

**1) Intersection to Depot:**

❖ *Specification*

- The route to Depot with R150m horrizontal curve. And the fly over length is 66m.

- For bridge in curve, the width of bridge deck is wide, that caused to super elevation. So the width is wider if the longer span is used.

- On the construction site, site clearance work can be done during implementation. Traffic line shall be shifted temporarily to the remained lane of National road no 32.

- Afer studying, the structure option is as follows: Balance cantilever span with 45m + 70m + 45m shall be used. The cross section of this beam is similar to the one in other section, which creates homogeneous. Bridge is cast in place so can be curved with bridge center line in any place and save the space. Two pier tables are cast on staging and other segments are cast in balance cantilever method and closure in the midle span. The traffic shall not be influenced during construction.

**(2) Nhue River bridge - Dien bridge**.

❖ *Specification*

- Nhue bidge in the center of nation road No32 and. Structure is 6+33+6 m.

- The are many alleys to residential areas at either bridge ends.

- Dien bridge structure 6+33+6 m. Concrete bridge with structure 45+70+45 mentioned above is used.

**(3) Mai Dich fly-over**

❖ *Specification*

- Mai Dich Fly-over bridge: Mai Dich intersection is included interchange and fly-over bridge. At the heart of railway is the highest point of Mai Dich fly-over. And the bridge is 244,8 m long

Balance cantilever span with 45m + 70m + 45m shall be used.

- The cross section of this girder is similar with the one in other section, which creates homogeneous. Bridge is cast in place so can be curved with bridge center line in any place and save space.

- Two pier tables are cast on staging and other segments are cast in balance cantilever method and closure in the midle span. The traffic shall not be influenced during construction.

**(4) Cau Giay fly-over**

❖ *Specification*

- Cau Giay fly-over crosses over two double-lane roads along the river + Cau Giay bridge (33m long), Cau Giay interchange + Flyover at No.2 ring road Interchange

- The height of Cau Giay bridge must be over No. 2 ring road Fly-over.

- Balance cantilever span with 45m + 70m + 70m + 45m shall be used for intersection place. Other spans is simple beam.

**(5) La Thanh Road fly-over**

❖ *Specification*

- Crossroad over Thanh Dike road with fly over section is in R150 horizontal curve and essential length is 75m

- Balance cantilever span with 45m + 70m + 45m shall be used

- The cross section of this beam is similar to the one in other section which creates the homogeneous. The bridge is cast in place so can be curved with bridge center line in any place and save space. 2 pier tables are cast on staging and other segments are cast in balance cantilever method and closure in the middle span. The traffic shall not be influenced during construction.

**(6) Daewoo fly-over**

❖ *Specification*

- Fly-over crosses Nguyen Chi Thanh – Kim Ma interchange and in front of Deawoo Hotel. The required span is long and can be influence to that intersetion and sight-view of Deawoo Hotel. The required span is 75m concerning intersection rehabilition project by JICA.

- Balance cantilever span with 45m + 70m + 45m shall be used

- The cross section of this beam is similar to the one in other section that creates the homogeneous. The bridge is cast in place so can be curved with bridge center line in any place and save the space.

- Two pier tables are cast on staging and other segments are cast in balance cantilever method and closure in the midle span.

- The traffic shall not be influenced during construction and minimize the impacts on surrounding views.

### *1.4.5.2. Bridge structure in station areas.*

Two-floor Station is selected. The first floor is for passenger room and service, the second floor is platform and main tracks. Full station structure is placed on three spans

*Pier structure*: the piers are placed in the city. The line will go through the heart of the road so the slim and narrow structure is selected. Pier appearance should be aesthetic, simple and free of impact on urban traffic views.

2 pier form options are recommended:

+ Column pier with cross section of round, oval or hexagon.

+ Trangular frame with slim components.

Pier body is cast with steel, plastic or plywood mould that helps create the smooth and even finish.

*Foundation structure:* Foundation structrure ensures of safety during construction. And when in operation it should keep other adjacent structures and traffic out of bad impacts. and not hamful to adjacent structures nor influent to traffic. For these reasons above, bored piles with 1m – 1.5m in diameter are selected. The bored pile execution does not cause noise and its quantity is small.

### 1.4.6. Means of Transportation

In respect of pilot means of transportation in Hanoi, Metro is selected on the ground of its development prospect, high life expectancy and low cost.

#### *1.4.6.1. Metro Features*

A three - car train begins operation to meet the demand for a number of expected passengers by 2010. Passengers can go from and to between its compartments.

Metro is a return means of transportation, or rather driving cabs are available at both end of the train. And the driver only has to do is to change ends at terminals.

There are two doors on each side of a car, which allow passengers easily get on and off at any station.

It is expected the height from metrorail to its floor is 1.1m. And the height is fixed for all compartments to help passengers move conveniently.

Average life expectancy of a metro lasts 40 years and train maintenance should be done once in the middle period of its life.

### *1.4.6.2. Car Features.*

Car Dimensions:

+ Length : 19 m - 20 m
+ With : 2.6 m - 2.8 m
+ Height : 3.7 m - 3.9 m
+ Platform Height : 0.9 m - 1.15 m
+ Maximum axial load : 14.0 T

### *1.4.6.3. Exploitation Capacity*

Dimensions, efficiency and exploitation capacity will determine transportation capacity and total number of vehicles needed.

**Table 1.3. Exploitation Capacity of Train.**

| Acceleration | Value |
|---|---|
| Maximum Acceleration at start | 1 $m/s^2$ |
| Average Accelaration (0 - 40km/h) | 0,85 $m/s^2$ |
| Average Accelaration (40 - 80km/h) | 0,48 $m/s^2$ |
| Minimum Accelaration at 80km/h | 0,3 $m/s^2$ |
| Normal Deceleration | 1,1 $m/s^2$ |
| Deceleration at sharp-brake | 1,4 $m/s^2$ |
| Maximum Velocity | 80 km/h |

In respect of metro route, weight and maximum velocity, the number of motored change direction device is 66% at minimum, or rather there are 4 motored change direction devices and 2 non-motored direction devices for 3 - car train.

### *1.4.6.4. Train Transportation Capacity*

Given Pr EN 13452 European Standard, transportation capacity of a vehicle is shown by number of seats and stands with different transportation/delivery rate.

It is expected the pilot metrorail in Hanoi can carry 6 stands/$m^2$ and seats accounted for 20%, which ensures comfortability.

**Table 1.4. Train Transportation Capacity**

| Transportation Model | Total | Seats | Stands |
|---|---|---|---|
| Comfortable Transportation: 4 stands/$m^2$ | 4312 | 119 (27%) | 312 (73%) |
| Normal Transportation: 6 stands/m2 | 587 | 119 (20%) | 468 (80%) |
| Special Transportation: 8 stands/$m^2$ | 743 | 119 (16%) | 624 (84%) |

### *1.4.6.5. Driving Operation/Management*

The operation of train will be automatically controlled. The train runs on the right. Normally passengers get off the train on the right, but also may get on and off on the left in case some train stations are located there or the train returns. The train will be operated in the front cab.

All the devices for the control of train acceleration or brake, open or close and safety in operation are equipped in cabin.

Train cabin is partitioned off with a locked glass door and used by the train operator and conductor only.

Some expected operation managements:

*Automatic Operation:* This is used for commercial purposes and in conformity with the velocity limits. The driver is responsible for supervising passenger services and train departure process.

*Manual Operation:* This is used by the driver in case automatic devices in trouble. To keep safety, the train velocity will be controlled by speed control system.

*Separate Operation:* This is used in case incidents occur at Depot and maintenance station or the train moves backwards. And it keeps train velocity less than 18km/h.

### *1.4.6.6. Accessibility, Comfortability and Lay-out of train*

- *Rail-to-FloorHeight:* The train designed is easy of access for different passengers (including the handicapped). In the metro system, the application to same level of access is encouraged, i.e the floor height 1,100 – 1,200mm is fit for platform-edge.

- *Facilities and seat arrangement:* The facilities of the train, at least the same as ones of bus or car, are able to attract attention from passengers. The seat width must be followed international standard (minimum at 50cm wide). Passenger seats can be arranged in vertical or horizontal rows.

- *Movability of the train cars:* The train designed allows passengers to easily move from this end to the other end. The train cars are connected with folding roof.

### *1.4.6.7. Safety Limits.*

Operation limits are properly calculated with all conditions of train exploitation (e.g when the train bends on the curve line). Limited distance is carefully computed for each specific curve radius.

Safe limited distance means no devices can access within the distance. It is also determined concerning attrition factors in the line exploitation. Safe distance is determined from operation and safety limits of the train.

### *1.4.6.8. Adaptability in Hanoi climate:*

- *Ventilation and air-conditioning system:* The train must be equipped with ventilation and air-conditiong system which is suitable with Hanoi climate. The system is designed concerning stop intervals, i.e every two minutes the metro will keep open in 20 seconds

- *Climate Condition*: The train can be normally operated in cruel weather of Hanoi:

• Maximum Temperature: 40°C,

• Minimum Temperature: 5°C,

• Maximum Humidity: 100%

• Anually average rainfall: 1600mm to 1700mm

• Wind Velocity: average wind velocity changes 2-2,9m/s each month.

- *Fire Prevention & Fighting Capacity:* Underground metro must be followed the international standard (NFPA 130 and Pr EN 45 545) on fire prevention and passenger evacuation .

### 1.4.7. Power Supply

#### *1.4.7.1. Power relay type*

Two following systems can be used for power supply:

- The third rail with power relay device, V = 750DC.

- The power line overhead, V = 1.500V-DC

**Table 1.5. Power Relay Type Comparison**

| Criteria | Third rail 750V | Overhead 1500V | Evaluation | |
|---|---|---|---|---|
| | | | Third rail | Overhead |
| Structure & power supply reliability | Simple structure, high reliability, controllable without break | Complex structure, Elevated system, latent with break | **** | *** |
| Construction and operation | Assembly, Construction and operation are simples | Assembly, Construction and operation are complex | **** | *** |
| Occupied space | Third rail installed near the track, there are not a occupied elevated space. | There are a occupied elevated space. The tunnel dimension is increase, Construction cost is raised. | **** | ** |
| Initial investment | Optimization of the tunnel diameter, system investment is low. The rolling stock is not changed. | The tunnel dimension is increase, system investment is high. The rolling stock is not changed. | **** | *** |
| Longivity | 60 years | 15 years | **** | * |
| Aesthetic, combination in urban | Not influenced to urban view, anyway elevated structure or at grade. | Impact to the urban view, especially in the case of elevated structure. | **** | * |
| Power supply distance & | Short power supply distance, especially | Short Power supply distance is high, power loss is low | ** | **** |

| | | | | |
|---|---|---|---|---|
| power loss | while train density is high. | | | |
| Dispersion current | Low dispersion | High dispersion | **** | *** |
| Use of recycled power | Low effect | High effect | ** | **** |
| Electromagnetic disturbance for environment | Electromagnetic disturbance is not harmful for environment | Electromagnetic disturbance is not harmful for environment | *** | *** |
| Electric safety in operation | Safety solutions for maintenance staffs and passengers, the current is broken while staffs work in track | The elevated electric line does not influence to staffs and passengers. Safety solution is simple. | *** | **** |
| Influence of flood and storm | Influence of flood while the line is at grade, not influence of storm wind | Not influenced by flooding, but influenced by wind, storm, especially in the city area with many high trees on the road sides | **** | *** |
| **Total evaluated points** | | | **42 *** | **37 *** |

Proposal: The feasibility study phase report by SYSTRA advisors proposed to use the power line overhead of continuous voltage 1500V. Based upon the table above, however, the power relay used third rail of continuous voltage 750V-DC is recommended.

### *1.4.7.2. C¸c tr¹m biÕn ¸p Transformer Stations (SSR)*

The number of SSR transformer stations ensures metrorail exploitation maintained even when some transformer stations in trouble. For V1A metro project used 1500V-DC, the number of transformer stations is 10 along the line and 1 for Depot terminal at total capacity 2500KW.

SSR transformer stations includes:

• 01 terminal box included small swiches that helps to protect the auxilary transformers. A 22kV box including

• 01 transformer

• 01 transducer

• 01 electric swich with motor to protect transformers

### *1.4.7.3. Structure and Capacity of Power Supply System for Underground Section*

For sake of power system, it is estimated that electric map system in underground section is independent

of power supply system for the train. Thus, there is a vertical axle for two medium voltage lines along underground one to supply power for PEF (eletric stations used for light and train engines)

### 1.4.8. Ventilation System

** At underground*.

- Deliver ventilation air to each underground section by air bag systems.

- Recycle part of air in the underground area, mingle it with new air, then make cool and inject to underground stations.

- Filter and cool ventilation air at air filtration and treatment center.

- Proposed air cool part: Air compressor with spiral fan.

** At tunnel:*

In normal condition, the tunnel is ventilated by the piston effect generated by running train. The middle ventilation shaft is automatically closed meanwhile the air bags at stations open. The air flow generated by running train will mainly discharged through these air bags.

### 1.4.9. Telecommunications System

#### *1.4.9.1. Transmission System*

It ensures transmission of sound, data between functions and SAE exploitation assistance system, passenger information system (PIS), central operation department PCC, energy management department and telecommunications systems at various points along the line (Operating control center, Depot terminal, train stations along the line,...). It also combines with radio communication system to create a complete network connecting the ground to the means.

#### *1.4.9.2. LAN Network at Operation Centre PCC.*

LAN network is installed at operation centre to help connect servers of different systems namely Exploitation Assistance System – SAE, Passenger Information System – PIS, Central Technical Management System GTC....

LAN network links to multi-function transmission through convertible circuit system.

An optical board in operation centre office helps the staff comprehensively and frequently observe the train operation on the whole line. The following information is often displayed on screen:

- Observation and navigation of the means on the whole line.
- Route status and metrorail signal control (i.e operation signal at terminals and areas accessed to Depot terminal)
- Status of power supply source for the whole route.

#### *1.4.9.3. Radio Communication System*

Radio Communication System transmits audio/data signals between Operation Centre and mobile devices (the means, assistance devices), information between operation staff using fixed telephone and other related people using cell phone (drivers, natural hazards prevention staff, maintenance and repair technicals, security staff). The system is a part of muti-service system RMS, which is main tool to control the means.

#### *1.4.9.4. Telephone System at work*

The system is used to connect various metro divisions. It provides technical contacts between staff at operation centre, train stations and Depot terminal,...to make emergency phone calls in case incidents happen.

#### *1.4.9.5. System for Exploitation Assistance - SAE*

This system is a computer system controlling the exploitation of metrorail. The computer system combines with other systems on the line, devices in train control

cab and ground signal devices along the line. The combination is operated by multi-function transmission system and radio communication system.

#### *1.4.9.6. Passenger Information System (PIS)*

This system helps announe passengers about train schedules and time await for the following train. It consists of a computer system linked to system for exploitation assistance (SAE). It receives information from SAE system, then visually and audibly delivers it to train stations or trains. The information delivered to passengers can keep updated to latest news by operation centre.

#### *1.4.9.7. Central Technical Management System (GTC)*

This system helps inform the operation status of devices installed on the route, monitor and control fixed devices at train stations, on the route, at operation centre, at radio communication delivery spot, in the tunnel and at Depot terminal.

It allows supervision of repair and maintenance work, statistics and data archive. It is a computer system connected to all other systems on the route and at operation center.

In underground section, it allows the control of smoke ventilation, fire alarm device, electric devices,...

#### *1.4.9.8. Closed Circuit Television System (CCTV)*

This system is set up at different spots of the line for monitoring of train stations such as ticket room, waiting room, train stops, automatic elevators...), important transportation spots, sensitive spots on the line such as terminals, areas adjacent Depot terminal, entrance and exit of the tunnel. ..All images received will be recorded and managed at operation centre.

#### *1.4.9.9. Synchronous Clock System*

During train operation, it is essential that time displayed on all system devices be exactly synchronous.

Thus, a synchronous clock system is badly needed to ensure the whole metrorail system work smoothly.

#### *1.4.9.10. Depot Communication System*

This system must meet the technical requirements of Depot operation, ensure the flow of train operation control run well , which increases effectiveness of running train and transportation capacity as well.

### 1.4.10. Land Clearance

Estimated land acquisition of the project is **239.870** $m^2$, including:

**Table 1.6. Land Clearance**

| TT | Land clearance Items | Unit | Quantity |
|---|---|---|---|
| **A** | **Depot area** | | **150.550** |
| 1 | Agricultural land | $m^2$ | 149.550 |
| 2 | Residential land | $m^2$ | 1.000 |
| 3 | | | |
| **B** | **Access from Tay Tuu Road to Depot (Old Road 70)** | | **9.460** |
| 1 | Agricultural land | $m^2$ | 2800 |
| 2 | Residential land | $m^2$ | 6100 |
| 3 | Public land | $m^2$ | 560 |
| 4 | Households to be moved | hé | 50 |
| **C** | **Planned Southern Roads of Depot to be temporarily managed.** | $m^2$ | **10.160** |
| 1 | Agricultural land | $m^2$ | 10.160 |
| **D** | **On the line** | $m^2$ | 69.700 |
| 1 | Electric stations on the line | $m^2$ | 1.500 |
| 2 | Train stops | $m^2$ | 6.600 |

| | | | |
|---|---|---|---|
| 3 | Households to be moved | household | 140 |
| **E** | **Land clearance during construction of underground sections by open excavation method** | $m^2$ | **3.150** |
| **F** | **Land for lane construction** | $m^2$ | **38.500** |
| **G** | **Land for underground section construction** | $m^2$ | **23.500** |

### 1.4.11. Construction Plan

#### *1.4.11.1. Fly-over construction*

*Implementation Steps:*

The launching girder rear leg is supported on the pier table segment of the already erected deck, and the front leg is supported on the pier cap of the next span.

An average of erection time of 48 hours per span can be reached after the learning curve.

Hereafter are detailed the main phases of span erection:

- The segments to be erected are stored on the ground;
- The segments are lifted and suspended to the launching girder with keeping a gap of 20 cm between them;
- The last typical segment is suspended at a lower level in order to permit the gap between segments;
- Segments gluing is done with epoxy and temporary prestress;
- The pier table segments are supported on temporary bearings when the definitive prestress is tensioned;
- Suspension cables are removed;
- Launching girder ready to erect next span. Experienced contractors for assembly

Construction steps depend on Construction organization of foundations and piers in entire line. In general, beams are assembled after the Construction of pier.

Execution can be divided into many separated parts, this division depend on the topography

All the process from beginning to the end lasts 48 hours.

### *1.4.11.2. Underground construction Sites.*

**Table 1.7: The Execution Project of underground construction Site.**

| Position | The length | Construction site Type |
|---|---|---|
| Kim Ma | 140 m | Open Dig |
| Kim Ma Station | 80 m | First level Railway Station |
| Kim Ma - Gi¶ng Vo Traffic Button | 740 m | Open Dig |
| Giang Vo Station | 80 m | First level Railway Station |
| Cat Linh and Quoc Tu Giam | 740 m | Open Dig |
| Ton Duc Thang Station | 80 m | First level Railway Station |
| Cat Linh and Quoc Tu Giam | 340 m | Open Dig |
| Take an under way through the areas of Water Factory and Railway Station. | 500 m | Deep dig Tunnel |
| Hanoi Railway Station | 80 m | The third level Station |
| Behind Hanoi Railway Station | 120 m | Open Dig |

Shallow Tunnel: Divide the way into halves, execute the work piecemeal so that means of transport can be able to move in other half, using open Dig Method. Ferro-concrete cover of the tunnel is poured on the spot.

Deep Tunnel: Using a traditional dig method: digging up step by step, both digging and proping up at the same time. Before digging the tunnel, we will have to dig open-cast well to gather the machines and labours, then start digging into 2 direction. The position of pit will be the Stations in the future. Prefabricated ferro-concrete cover of the tunnel is put together.

a. Executing the underground tunnel section by using open dig method.

* Sequence of executing.

Based on field situation of model route and the request about safety guarantee for above infrastructure as well as minimizing the affect to urban traffic during the execution of the work.

- Digging Position:

Start digging from 2 direction, the first position is at Km9+600 ( at the gate of ....Embassy), the second position is at Km12+100. The pit at the second position will be the starting dig well for executing unobstructive underground tunnel as well.

- The digging Sequences:

For the section with dig length < 12m:

+ Step 1: Locating the digging bound, installing the strengthen system for future pit by using steel set stake (these set stake is lowered by pressing or shaking method.)

+ Step 2: Digging out all gravelly soil just in scope of two steel set stake row, reach to the high designed.

+ Step 3: Installing set shape to pour concrete structure of the main tunnel.

+ Step 4: Drawing out steel set stakes, occlude the land above the tunnel so that the original status of above infrastructure is returned.

For the section with digging length > 12m:

+ Step 1: The strengthen system for above steel set stake pit is replaced by conductive concrete wall.

+ Step 2: Digging out all gravelly soil above the top of future tunnel, reach to the suitable hight based on the real hight of permanent structure. Pouring concrete to make above defending floor. Based on real digging depth, a cross-throw bed system made by ferro-concrete may be set to strengthen the stability of conductive direction wall.

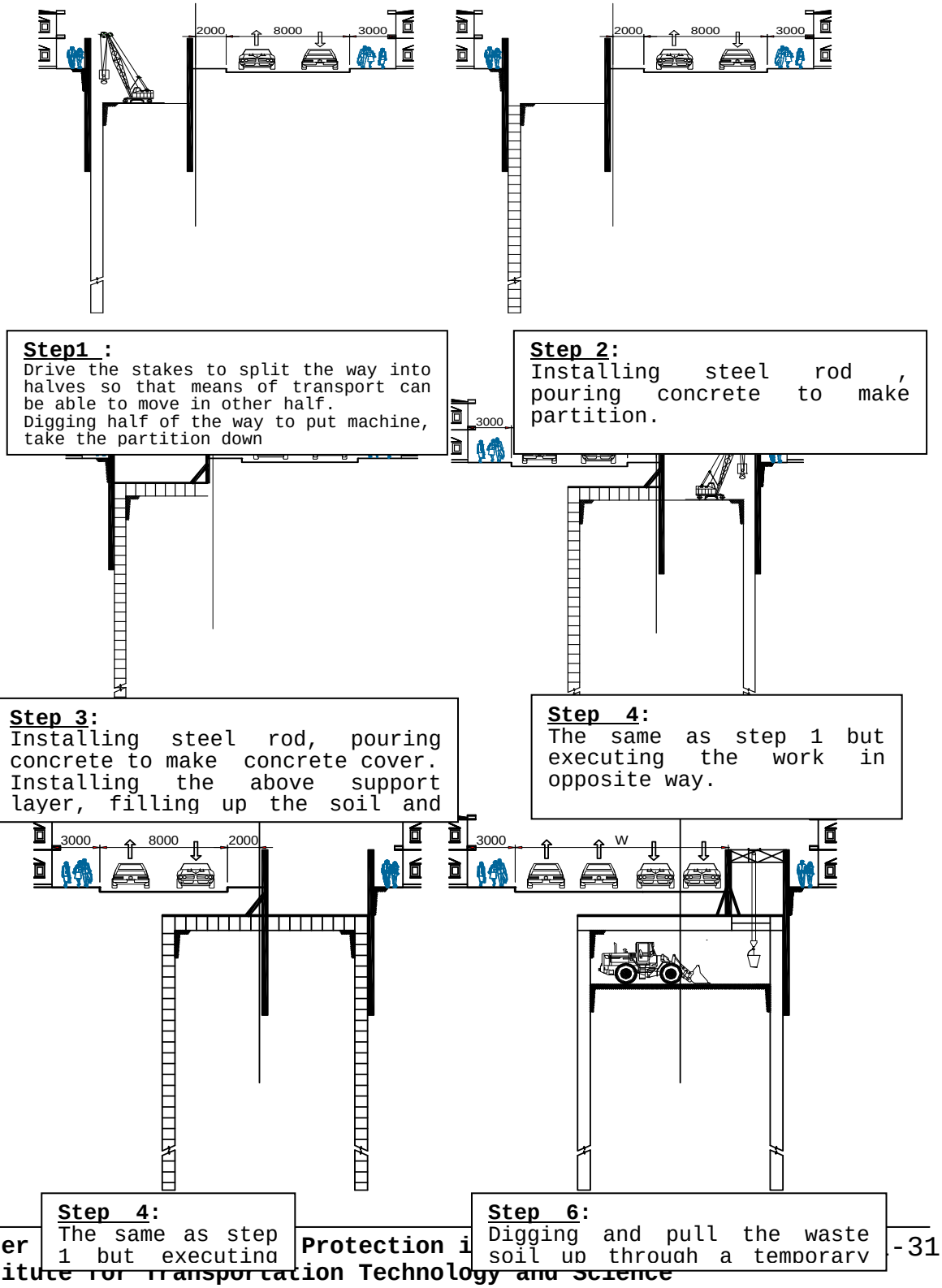
+ Step 3: Occlude the land above the defending floor.

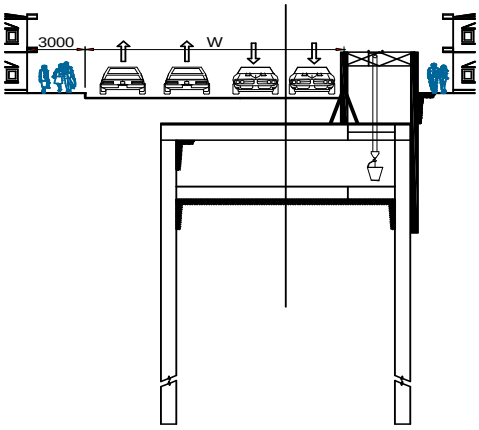
+ Step 4: Starting digging from the under of defending floor from up to down by using digging machine. Gravelly soil is pull up to the ground in a vertical direction by an up-down system

+ Step 5: Installing the concrete casing to pour concrete for the main tunnel structure.

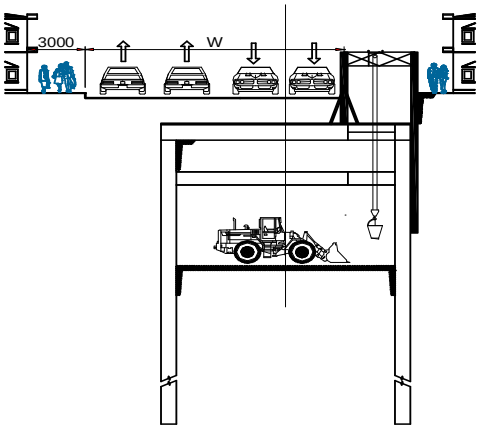
+ Step 6: Filling up all empty holes under the defending floor with soil. Return the original status of above infrastructure.

**Picture 1.3: Steps of executing the underground tunnel by using open digging method**

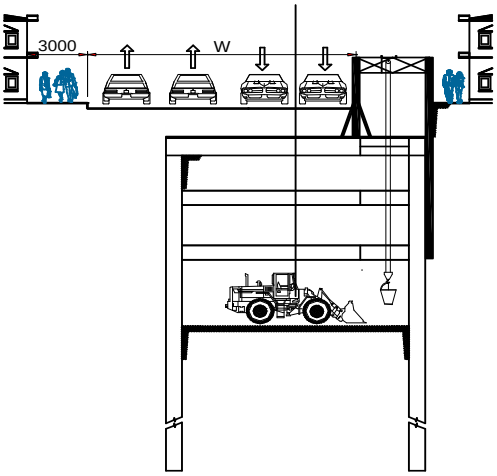




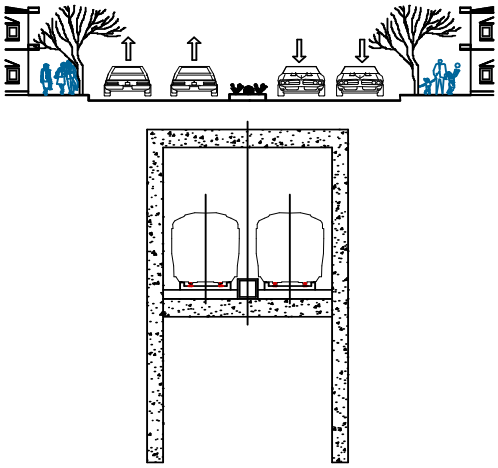

**Step 7**:
Pouring concrete to make temporary prop




**Step 8**:
Continue digging from under of the temporary




**Step 9**:
Continue doing that when reaching the designed



**Step 10**:
Return the original surface for the road

*b. Executing the underground tunnel by extracting step by step.*

Hanoi is situated on the fourth cubic meter of earth with following main features: the soil layers have different thickness, petrography feature is multiform and is placed among the city without the rules of depth and scale, come between together not identical so that making an unidentical enviroment, has a big difference in durability and absorbent, hydrated limit; mud layers, mud bag sometimes have organic sidement of Hai Hung, Thai Binh formation, appear in many places with different depth; pebbles –sand layers have good tight block, small sink but some places has pebbles >2mm, take 77 %. Those features with thick constructive density, small and narrow roads of

Hanoi and the higher and higher requirement for clean and clear enviroment are all difficulties, obstacles and challenges for executing work of underground tunnels.

The features of hydrography, underground water layer of Hanoi has an important meaning to underground section from Kim Ma to Hanoi railway Station. Based on those feature, we can give out the suitable executing solution to avoid risk which can happen. Data analysis and collected showing that there is a water layer with the surface is quite near the ground. This water layer is not adjoining each other because it has the root from water bag with sand belonging to mixed soil layers which contain sand, pebble and clay. These water bags can be sucked dry by using pump. In deeper layers which contain sand is existing a very large water storey. This water storey has stable supply from Red River. It will be very difficult, even we can't suck dry this water storey by using pump systems, and there is one way left, building a wall to prevent water. Along Red River, there is a pebble layer flooded in water and water pressure at there is very high and dangerous. But this model route is not related to this area and we don't have to solve this problem.

(1) Extract digging step by step method applied for section from Ngo Sy Lien through Hanoi Railway Station.

This is the most reasonable method. Besides, this method is very feasible about technology but with a condition that we need to seperate digging time in the most suitable way to guarantee the highest safety.

To execute this method, there are 2 executing projects as follow:

❖ The first Project:

This project is applied at the difficult areas such as under of high buldings or the place has bad geology condition

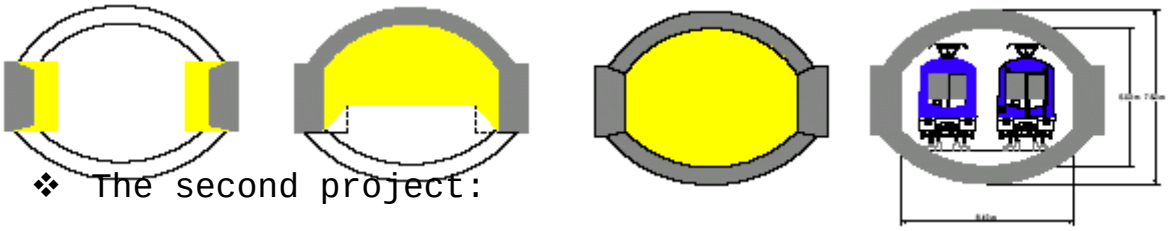
This method is carried out with 3 periods:

- Building border abutent for construction.

- Building dome ( using prefabricated building components) based on border abutent.

- Building low part and put floor components of deep tunnel which unite closely with border abutents.

- Executing work stage is implement according to the following diagram:



❖ The second project:

This second project is not modern as the first one. It has 2 executing stages:

- Digging the soil on the top of the tunnel and building dome leaning permanently to hard soil on two sides.

- Building the low part and put floor components of the tunnel

Using this method, we have to dig a larger space at the dome than the first method, so there will be more soil needed to be digged and risk of subsidence wil be bigger.

With a condition that support components are set up such as: metal dome and support bars ( metal or wood), the stablity, homogenerous, the hardness of red clay layers, we will be able to make “a natural dome inside the earth” without digging much.

(2) Executing Organization

Building a deep tunnel line for model road diagram by using seperated digging time method need to applied for many holes at the same time so that we can fullfill the work in time. A starting digged- well is opend at Tran Quy Cap Station, at the west of present railway lines. At this point , we can execute the work follow 2 directions:

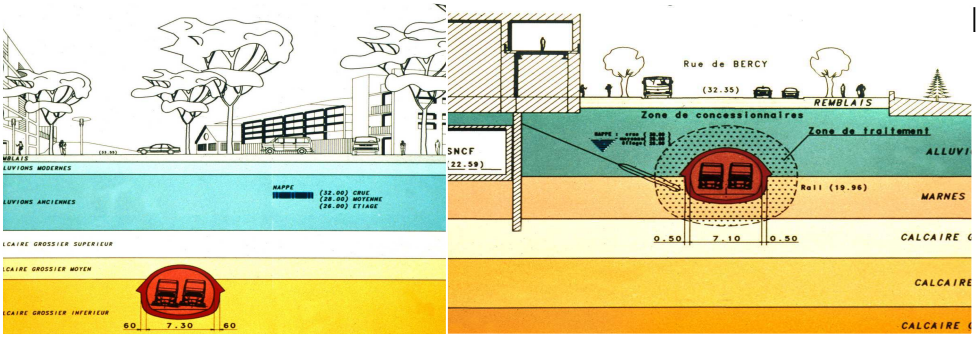
- The first digging direction is about the East, to the direction of Hanoi Railway Station

- The second direction is about the West, to the direction of Ngo Sy Lien Water Factory.

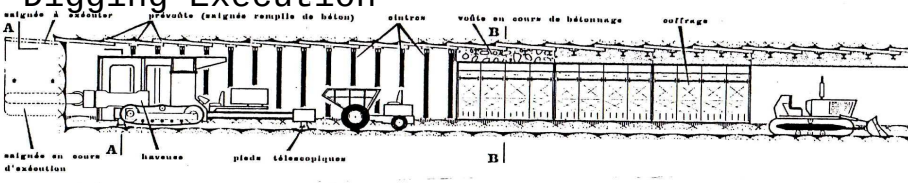
Beside these two main starting point, the third point can be started if it is neccessary to do, started from Hanoi Railway Station to main Station Building.

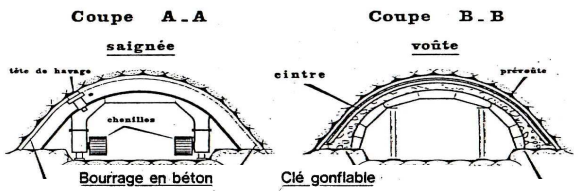
(3) Some diagram of executing the underground tunnel by using extracting step by step method:

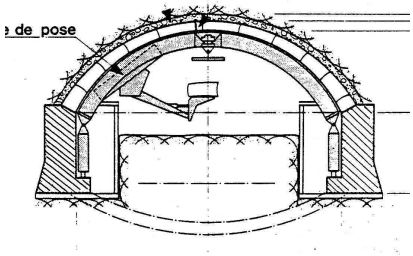
ls and build




- Digging Execution






### 1.4.12. Total cost of investment

**Picture 1.8: The summary of total cost for investment**

| No | Investment Articles | Investment Cost | | % Rate |
|---|---|---|---|---|
| | | Million of VN§ | Million of EURO | |
| 1 | Construction Cost | 4.029.590 | 202,61 | 44,2 |
| 2 | Cost for systems | 2.168.280 | 114,12 | 24,9 |
| 3 | Cost for transport | 1.026.000 | 54 | 11,8 |
| 4 | Cost for compensate, resettle and clear the ground | 250.010 | 10,79 | 2,4 |
| 5 | Cost for consultant | 724.850 | 38,15 | 8,3 |
| 6 | Arising Cost( insurance and other costs) | 724.850 | 38,15 | 8,3 |
| | ***Total investment*** | ***8.698.580*** | ***457,82*** | ***100*** |

*Mobilizing Fund Project for the Project:*

- On January 25th 2006 and On February 21st 2006, Planning and Investment Ministry has send an official text to Trading Department of France Embassy and Agency of France Development to propose these organizations to raise the preferential fund for the Project: France Government raises fund from 165 million Euro to 225 million Euro, and ADF raises fund from 40 million Euro to 140 million Euro, guarantee that the preferential Fund for Project reach to 80 percent of total investment cost , 20 percent left ( approximately to 93 million Euro) is corresponding fund from Vietnam. To this moment, AFD has agreed to raise the investment fund from 40 million Euro to 80 million Euro, and Finance Misnistry of France will give the answer at the end of May 2006 and expect that the Fund will be raise from 165 million Euro to 205 million Euro. So the preferential Fund ability for the Project is 80 + 205 = 285 million Euro/ 485 million Euro of total investment cost ( take approximately 62% of total investment cost). The missing fund need to be mobilized continuely is 173 million Euro ( take 38%)

- On April 2006: The Investment and Planning Ministry has proposed Hnoi People Committee to give out their ideas about mobilizing nearly 100 million Euro more for the Project from Europe Investment Bank (EIB) or Asia Development Bank (ADB). This is two borrow trading fund, with time borrow condition is 20 years, 7 years of grace, and interest is about 4,4 -5% per year.

- The official Document number 622/TTg-CN on April 24, 2006 of Prime Minister has affirmed the Fund for the Project: ODA fund, mobilizing fund from issueing bonds. The financial Solving for the Project is as follow:

+ Total fund according to report of feasibility study phase: 458 million Euro.

+ Borrow ODA fund from France Government: 205 million Euro (45%)

+ Borrow ODA fund from Agency of France Development (AFD): 80 million Euro (17%)

+ Corresponding Capital (Central and provinces authorities budget): 82 million Euro (18%)

+ Mobilizing Capital from Urban Bonds: 91 million Euro (20%)

### 1.4.13. Time marks and main work:

Based on striving target above, the minimum executing time is from 3,5 to 4 years, test operating time is 3 months, The Department proposes the progress of project as follow:

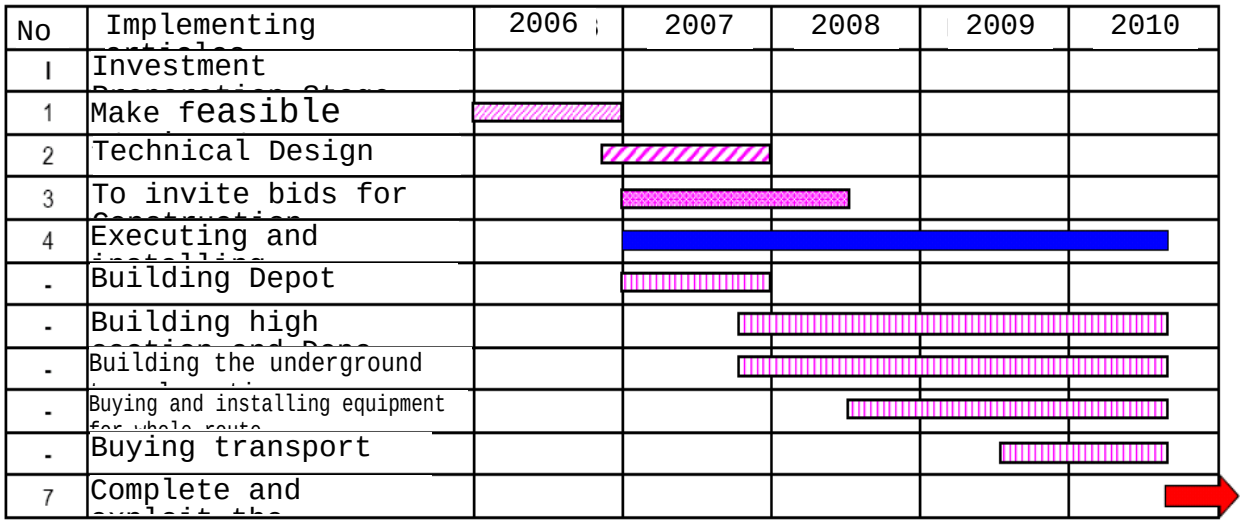
- In the year 2006, completed the investment Preparation and a part of Preparation for Executing the Project, start work the Depot infrastructure at the fourth quarter of the year 2006

- From year 2007 to the end of second quarter of the year 2010: Completed the Preparation for Executing the Project, starting the construction, supply and install the equipment

- At the third quarter of the year 2010: testing operation, check and hand over the building, make use of the project.

- In October 2010: Operating and Developing the Project.

**Picture 1.9: The Schedule of rating Implementation of the Project**



# CHAPTER 2

# Natural, environmental and social-economic characteristics

## 2.1. natural and environmental conditions

### 2.1.1. Geographical and Geological Conditions

#### *2.2.1.1. Geographical Conditions*

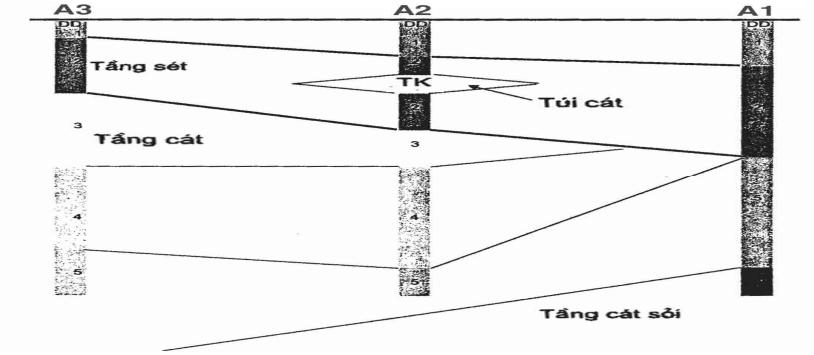
Locating in Hanoi City, the project area bears the common topographic characteristics of the Red River Delta, which is relatively flat terrain, with average elevation from 5-20m as compared to sea level. The terrain gently inclines in the direction from North to South and West to East, which are clearly shown in the direction of major rivers flowing across Hanoi

The project sites are characterized by alluvial plains, sedimented by rivers with modern flood-plain, high flood-plain and grades. Intercalating in the modern flood plains and high flood plains are low land with lakes and dams (relics of ancient river).

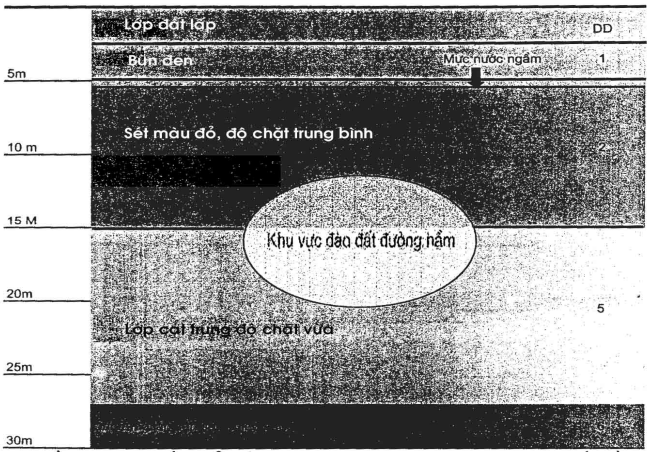
#### *2.1.1.2. Geological Setting*

The geological setting plays an crucial role to the project feasibility and selection of construction options, particularly regarding in-ground structures. The geological characteristics of the areas with open excavation and deep in-ground structures construction have been investigated through 03 boreholes drilled from June 2005.

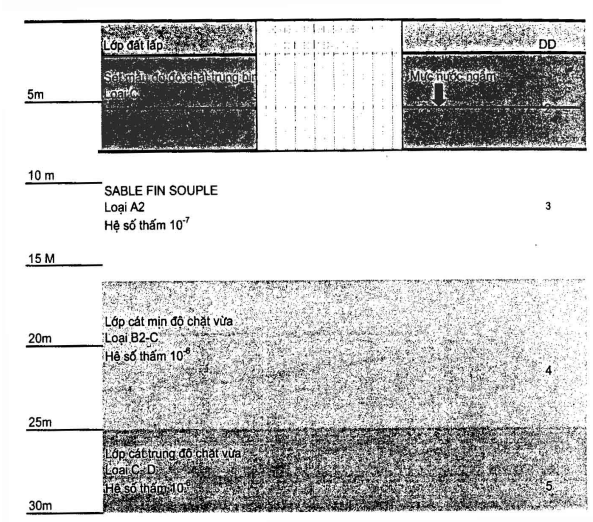
The first borehole (A1) was drilled within the railway lines area inside Hanoi Railways Station where the deep in-ground tunnel is constructed. The other two boreholes (A2 and A3) is drilled in front of Van Mieu and Horizon Hotel, where the shallow tunnel is constructed using open method. The below geological cross section reveals the layers of clay and sand in the study area:

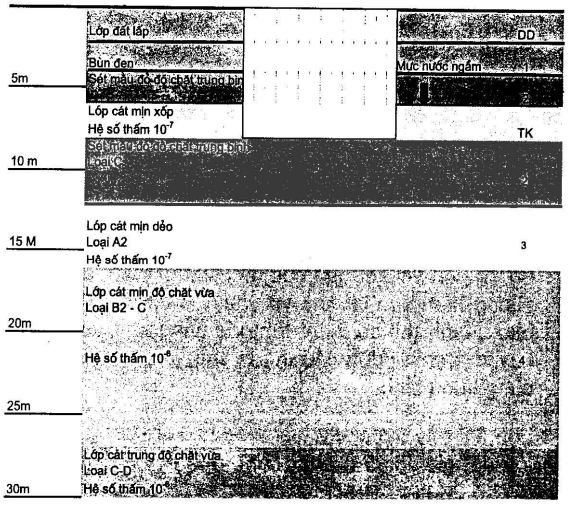



* Borehole A1: The above figure show that the deep tunnel in this area can utilize a natural cover composed of dense red clay, medium hard. This layer has high bearing capacity. The ground water table detected in this borehole is at 5.5m.




* Borehole A2, A3: the earthwork includes principally soil of high plasticity, composed of plastic black clay in the surface part, and red clay underneath. Below are fine sands, medium to average dense.



## 2.1.2. Meteorological and Hydorlogical Characteristics

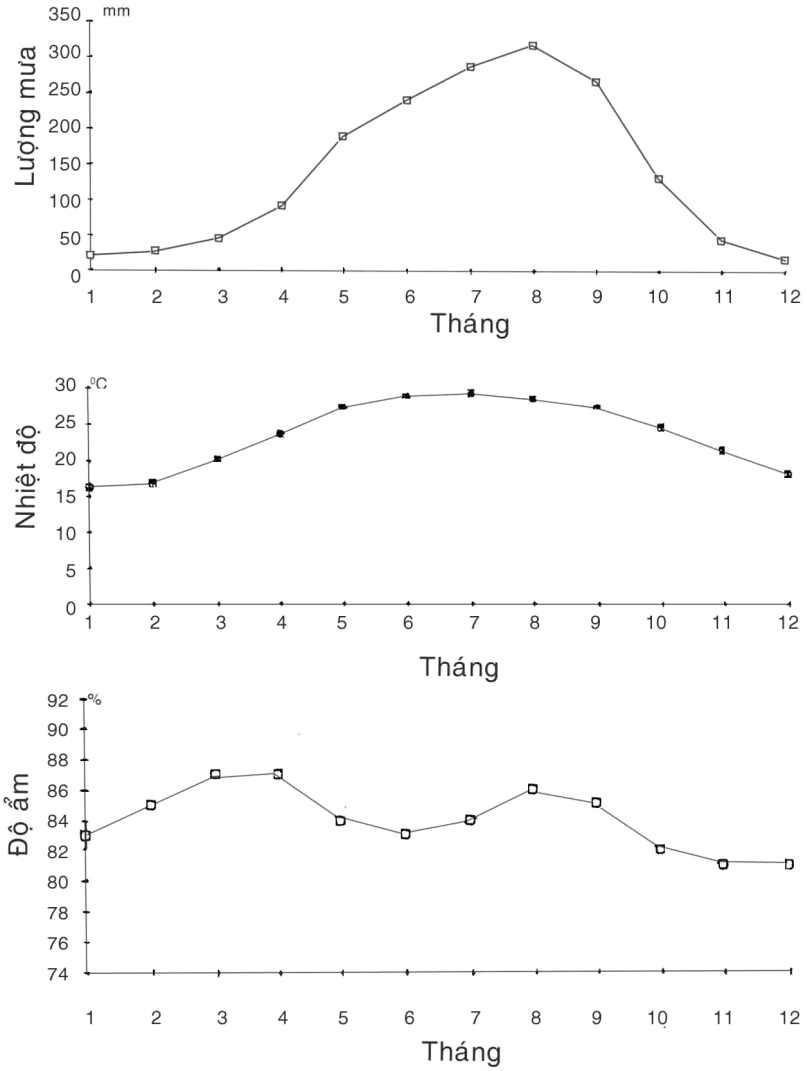
### *2.1.2.1. Meteorology*

The project locates in the tropical monsoon area with two clear-cut seasons: cold season (dry) from September to April, and hot season (rain) from May to October. The coldest month is January and hottest is July.

The climate is also subject to unexpected changes, which is principally attributed to the influences of the two wind seasons and particular climatic phenomena in each season. Winter may arrive in Hanoi early or late; summer may prolong; sometimes the temperature rises to 42.8°C (May 1926), sometime it drops to 2.7°C (January 1955).

The annual average precipitation in Hanoi is 1.676 mm, and mean humidity is 84%. The summer lasts from May to September with temperature ranging from 27-29°C, the maximum average temperature is observed in July. The highest rainfall is recorded in August (318 mm). The winter lasts from November to March with the minimum temperature (16.4°C) and the lowest average rainfall (16.6 mm) being observed in January

**Fig 2.1. Annual Average Temperature in Hanoi**




### *2.1.2.2. Hydrology*

The project is sited in the catchments area of Nhue and To Lich river, which are the drainage river for Hanoi City.

* *Nhue River*

Nhue river takes water from Red river via Liem Mac gate to serve the Dan Hoai irrigation system. Nhue river also serves as drainage river for Hanoi and Ha Dong before merging to Day river in Phu Ly Town. Nhue river has catchments area of 1,070 $km^2$, of which influence area belonging to Hanoi city covers 20 $km^2$, including part of Thanh Tri and Tu Liem district. Water from To Lich river is found debouching into Nhue river with average flow of 5.0-5.5 $m^3/s$, peaking 30 $m^3/s$.

** To Lich river:*

To Lich river originates from Red river in the existing Nguyen Sieu street. It flows in parallel with Quan Thanh and Thuy Khe street, connects to West lake via its branch at the beginning of Ho Village, then flows through Buoi market to the South of Cau Giay, Nga Tu So, Kim Giang and finally merges to Nhue river.

To Lich river is 13.5 km long, with catchments area of 20 $km^2$. The river has now been dredged and improved, with cross section of trapezium shape, average width 20-45m, depth 2-3m, with stone embankment on both sides. There are 16 bridges and roads over the river, maximum flow may reach 30 $m^3/s$.

### *2.1.2.3. Ground Water*

** Volume*

The project site is in Hanoi City which is endowed with abundant water resources. In addition to surface water serving for various purposes likes irrigation, aquaculture, forestry, services, tourism, groundwater is an important source with potentiality of 5,914,000 $m^3$/day. Therefore, groundwater has been exploited more than one decade ago by industrial drilled wells. Currently, it's still one of the main supply sources for Hanoi City.

** Exploitation Status*

Up to now, Hanoi is the only City in the country use groundwater as supply source for industrial and domestic purposes with total extraction volume of 750,000 – 780,000 $m^3$/day, of which in the South of Red river (the inner City and suburban part) account for 450,000-550,000 $m^3$/day. Red river water is the major recharge source for the ground water in the project area. Seasonal fluctuation of Red river water will, therefore, exert direct influences on the groundwater exploitation productivity. In the project area are 02 well fields for concentrated extraction with capacity of 107,336 $m^3$/day.

**Table 2.1 Extraction Productivity of Concentrated Well Fields in the Project Area**

| No | Water Works | Production Capacity ($m^3$/day) |
|---|---|---|

| | | |
|---|---|---|
| 1 | Mai Dich | 56,136 |
| 2 | Ngo Sy Lien | 51,200 |
| | **Total** | **107,336** |

Besides, there existing in the project area numerous small hand-pump household drilled wells (now mostly changed to machine-pump type), capacity of each well being in the range 0.5-3 $m^3$/day.

Due to exceeding concentrated extraction, unreasonable arrangement of well fields, indiscriminate and uncontrollable exploitation, the groundwater source has been suffered from significant changes. Long-lasting observation revealed no recovery signal. The lowest water table in Ngo Si Lien Well field measured in 2004 is -20.72 m, which is 0.70m lower than the level measured in 2003. The estimated lowest drawdown in 2005 is -21.30 m. Mai Dich well field's lowest groundwater level in 2004 is -25.41m, which is 0.63m lower than that of 2003. In 2005, the anticipated drawdown is -26m.

### 2.1.3. Status of Natural Environment

#### *2.1.3.1. Air, Noise and Vibration*

The Scientific and Technological Center for Environmental Protection has carried out monitoring of air, noise, vibration, water (surface and groundwater); soil in the project area in May 2006. The sampling, analysis and evaluation results are presented below:

The methods used for air, noise sampling for the purpose of this report fully comply with Vietnamese Standards:

**FiG 2.1: Location of environmental Monitoring and sampling Points**

***1) Air Environment***

*a. Air Measuring and Sampling Network*

In order to evaluate the air quality in the project site, survey team of the Scientific and Technological Center for Communication and Transport Environmental Protection has measured and analyzed the air environment from 04 May 2006 to 13 May 2006 at typical points within the study area.

*b. Air Measurement Indicators*

Indicators measured and evaluated include indicators in ambient air as follow:

- Ambient air mixtures: $SO_2$, $NO_2$, CO, HC.
- Particles: suspended dust
- climatic indicators: temperature, humidity, wind velocity, air pressure

*c. Air Measurement and Sampling Methods:*

- $SO_2$ in accordance with Vietnamese Standards TCVN 5971-1995. Method applied is Tetracloromercurat (TCM)/Pararosanili.
- CO as per TCVN 5972-1995. Gas chromatograph.
- NO2 in accordance with standard No.406 (Saltzmam method).
- Suspended dust in accordance with Vietnamese standard TCVN-5067-1995

*d. Equipment used for sampling and analysis*

- CO taking and analyzing Carbon Monoxide Analyzer ML9832, MONITOR LAB-USA;
- Dust collector: Dustscan Scout Aerosol Monitor
- Air collector: Air Sampler- DESAGA 212- Germany; and
- Spectrophotometer.

Regulations on limits of contaminants (in accordance with Vietnamese Standard. TCVN 5937-5938, 1995) is presented in2.3 below:

**Table 2.2.** ***Limit of Basic Indicators in Ambient Air***
**TCVN 5937-2005**

*Unit:* $\mu g/m^3$

| *TT* | **Indicators** | **Average 1 hour** | **Average 8 hours** | **Average 24 hours** |
|---|---|---|---|---|
| 1 | CO | 30,000 | 10,000 | - |
| 2 | $NO_2$ | 200 | - | - |
| 3 | $SO_2$ | 350 | - | 125 |
| 4 | Suspended Dust | 300 | - | 200 |

*e. Sampling Location (Ref. Fig 2.1)*

KK01: The area for construction of Depot (in Tay Tuu road)

KK02: Intersection of National Road 70 and National Road 32

KK03: Km 1+750

KK04: Intersection with the National Railway

KK05: Intersection with Le Duc Tho road

KK06: Intersection with Ring Road 3

KK07: Intersection with Duong Quang Ham street

KK08: Intersection between Lieu Giai and Kim Ma road

KK09: Cat Linh-Ton Duc Thang Intersection

KK10: Project end (gate of Hanoi Railway Station in Tran Quy Cap street)

*f. Results and Comments:*

Microclimatic environment:

*Table 2.3. Microclimatic Measurement in the Project Area*

| TT | Samples | ***Microclimatic Parameters*** | | | | |
|---|---|---|---|---|---|---|
| | | $T^o$ ($^0$C) | Pressure (mbar) | Wind Velocity (m/s) | Humidity (%) | Wind Direction |
| 1 | KK01 | 28.1 | 1005 | 0.5 | 81 | SE |
| 2 | KK02 | 26.9 | 1008 | 0.5 | 80 | SE |
| 3 | KK03 | 27.7 | 1006 | 0.5 | 80 | SE |
| 4 | KK04 | 29.0 | 1007 | 0.6 | 82 | SE |
| 5 | KK05 | 29.3 | 1006 | 0.5 | 80 | SE |
| 6 | KK06 | 27.4 | 1009 | 0.6 | 82 | SE |
| 7 | KK07 | 27.7 | 1008 | 0.5 | 82 | SE |
| 8 | KK08 | 26.9 | 1006 | 0.5 | 81 | SE |
| 9 | KK09 | 26.2 | 1004 | 0.6 | 81 | SE |
| 10 | KK10 | 25.5 | 1005 | 0.8 | 82 | SE |

*Source: Measurement results of Center for Environmental Protection in Transport, 2006*

In general, the microclimatic environment in the project area bears the tropical monsoons climate. The temperature amplitude is in the range 25 - 30$^o$C, humidity 80 - 82%, and wind velocity 0.5 - 0.8m/s, the atmospheric pressure 1,004 -1,009 mbar.

- Air quality status

Air measuring results in the project area are shown in table 2.4.

***Table 2.4. Air Measuring Results in the Project area***

| TT | Samples | *Environmental Indicators* | | | | |
|---|---|---|---|---|---|---|
| | | Dust ($\mu g/m^3$) | CO ($\mu g/m^3$) | $SO_2$ ($\mu g/m^3$) | $NO_2$ ($\mu g/m^3$) | HC ($\mu g/m^3$) |
| 1 | KK01 | 111 | 450 | 150 | 070 | 180 |
| 2 | KK02 | 150 | 720 | 220 | 240 | 300 |
| 3 | KK03 | 124 | 660 | 160 | 150 | 260 |
| 4 | KK04 | 159 | 690 | 200 | 120 | 280 |
| 5 | KK05 | 154 | 540 | 200 | 090 | 150 |
| 6 | KK06 | 071 | 600 | 190 | 110 | 270 |
| 7 | KK07 | 215 | 680 | 200 | 120 | 170 |
| 8 | KK08 | 068 | 910 | 270 | 290 | 140 |
| 9 | KK09 | 105 | 270 | 260 | 290 | 220 |
| 10 | KK10 | 075 | 650 | 170 | 140 | 310 |
| **TCVN 5937-2005** | | **300** | **30000** | **350** | **200** | **-** |
| **TCVN 5938-2005** | | **-** | **-** | **-** | **-** | **5000** |

*Source: Measurement results of Center for Environmental Protection in Transport, 2006*

The air measurement results in the project site show that:

Concentration of air pollutants ($NO_2$, $SO_2$, CO, HC) and suspended dust at 10 measuring points are below the standard limits in TCVN 5937 -2005 and TCVN 5938-2005.

***2) Noise***

*a. Evaluation Methods*

Noise is evaluated by measurement at network of previously selected points.

The techniques for noise measuring are pursuant to Vietnamese Standard TCVN-5965-1995. Measurement duration is 16 hours/day, 3 times/1 hour, 10 minutes/time, 3 samples/time.

*b. Location of Noise Measurement*

The noise measurement network is proposed at project's typical locations, representing all project activities. In this project, the noise measurement points are coincisive with air measuring points.

*c. Equipment used*

Noise measuring device RION - Model Na - 24 SOUND Level Meter Japan.

*d. Evaluation Method*

Noise evaluation is conducted by the following method: Comparing collected data with Vietnamese Standard on environment for summing up and assessment.

*e. Evaluation standard:*

Vietnamese environmental standards TCVN 5949-1998 (ref. Table 2.5)

**Table 2.5. Maximum Allowable Noise for Public and Residential Areas.**

*Unit: dBA*

| **No.** | ***Areas*** | **Times** | | |
|---|---|---|---|---|
| | | 6 -18h | 18 - 22h | 22 - 6h |
| 1 | Area need special quiet atmosphere: Hospital, library, sanatorium, baby-sit house, pagoda, school. | 50 | 45 | 40 |
| 2 | Residential area, Hotels, houses, offices | 60 | 55 | 45 |
| 3 | Residential area interpercolating in | 75 | 70 | 50 |

| **No.** | ***Areas*** | **Times** | | |
|---|---|---|---|---|
| | | 6 -18h | 18 - 22h | 22 - 6h |
| | commercial, service and production areas | | | |

Noise measuring results are presented in the table below:

**Table 2.6. Noise Measuring Results**

*Unit: dBA*

| **TT** | **Samples** | **Average Value** | | | | |
|---|---|---|---|---|---|---|
| | | | $L_{eq}$ | $L_{Amax}$ | $L_{50}$ | **TCVN 5949-1998** |
| 1 | N01 | Day time (6 - 18h) | 75,0 | 91,2 | 65,0 | Day time : 60<br>Evening: 55 |
| | | Evening (18 - 22h) | 72,4 | 89,0 | 63,1 | |
| 2 | N02 | Day time | 77,2 | 93,2 | 71,4 | |
| | | Evening | 69,3 | 79,4 | 66,1 | |
| 3 | N03 | Day time | 78,3 | 95,4 | 72,4 | |
| | | Evening | 73,9 | 84,6 | 69,6 | |
| 4 | N04 | Day time | 74,9 | 92,3 | 69,1 | |
| | | Evening | 70,2 | 86,2 | 63,8 | |
| 5 | N05 | Day time | 73,8 | 93,2 | 64,9 | |
| | | Evening | 69,5 | 85,3 | 64,3 | |

| TT | Samples | Average Value | | | | |
|---|---|---|---|---|---|---|
| | | | $L_{eq}$ | $L_{Amax}$ | $L_{50}$ | TCVN 5949-1998 |
| 6 | N06 | Day time | 71,2 | 83,9 | 70,2 | |
| | | Evening | 66,1 | 72,9 | 65,1 | |
| 7 | N07 | Day time | 74,5 | 86,2 | 71,3 | |
| | | Evening | 69,9 | 80,7 | 65,4 | |
| 8 | N08 | Day time | 73,8 | 85,3 | 70,6 | |
| | | Evening | 69,3 | 81,3 | 65,8 | |
| 9 | N09 | Day time | 73,3 | 84,6 | 70,9 | |
| | | Evening | 70,7 | 80,8 | 68,2 | |
| 10 | N10 | Day time | 70,1 | 80,6 | 67,0 | |
| | | Evening | 67,2 | 77,5 | 63,4 | |

*Source: Measurement results of Center for Environmental Protection in Transport, 2006*

*Evaluation of Noise Environment*

Noise measuring points are near residential areas, thus the Center has applied TCVN 5949-1998, Item 2 (Residential area, Hotels, houses, offices) to evaluate the noise environment.

The measurement results reveal that at all 10 measuring points, the equivalent noise value (Leq) all exceed the permissible limits in TCVN 5949-1998. The traffic flow in the route is very high, particularly the operation of trucks.

### *3) Vibration*

*a. Vibration Measuring Points*

The noise measurement network is proposed at project's typical locations, representing all project activities. In this project, the noise measurement points are coincisive with air measuring points (ref. Fig 2.1)

*b. Equipment Used*

VM - 53A - Vibration Level Meter.

*c. Evaluation Methods*

Noise evaluation is conducted by the following method: Comparing collected data with Vietnamese Environmental Standard for summing up, analysis and assessment.

*d. Evaluation standard:*

TCVN 7210: 2002 Vibration and collision - Vibration due to road traffic. The permissible limits applied for public places, residential areas are presented in Table 2.7:

**Table 2.7. Standard Limits of Vibration Acceleration (TCVN 7210: 2002)**

*Unit:dB*

| **Areas** | **Time** | **Limit** | | **Measuring Duration** |
|---|---|---|---|---|
| | | **dB** | **$m/s^2$** | |
| Public places and Residentials areas | 7 h - 19 h | 65 | 0,018 | Measuring in duration of no less than 4 hours |
| | 19 h - 7 h | 60 | 0,010 | |
| Residential area interpercolating in commercial, service and production areas | 6 h - 22 h | 70 | 0,030 | |
| | 22 h - 6 h | 65 | 0,018 | |

The measuring results in the areas relating the project are depicted in the following table:

**Table 2.8. Vibration Measurement Results**

| TT | Samples | Measurement Indicators | | |
|---|---|---|---|---|
| | | $L_{eq}$(dB) | a ($m/s^2$) | TCVN 7210:2002 |
| 1 | V 1 | 53.0 | 0.0120 | **75 dB** |
| 2 | V 2 | 48.3 | 0.0134 | |
| 3 | V 3 | 54.1 | 0.0146 | |
| 4 | V 4 | 41.2 | 0.0052 | |
| 5 | V 5 | 38.8 | 0.0042 | |
| 6 | V 6 | 39.3 | 0.0049 | |
| 7 | V 7 | 46.7 | 0.0056 | |
| 8 | V 8 | 48.8 | 0.0068 | |
| 9 | V 9 | 44.6 | 0.0057 | |
| 10 | V 10 | 38.3 | 0.0042 | |

*Source: Measurement results of Center for Environmental Protection in Transpor, 2006*

*Evaluation of vibration*

Vibration measurement points are near residential areas, thus TCVN 5949-1998, Item 2 (Residential area, Hotels, houses, offices) has been applied to evaluate the vibration status.

According to measurement results, at Point V01, V02, V03 the equivalent level (Leq) sometimes exceed the tolerable limits, but on average it is within the limits. In general, at all monitoring points, the average equivalent level is within the permissible limits in TCVN 6962-2001.

### *2.1.3.2. Surface Water Quality*

*a. Analysis Methods*

Surface water evaluation indicators and analysis methods are presented in Table 2.9.

**Table 2.9. Surface Water Parameters and Analysis Methods**

| **Parameters** | **Analysis Methods/Equipment** |
|---|---|
| **Physical Parameters** | |
| pH | Water meter YSI 650 MDS |
| Turbidity | Water meter YSI 650 MDS |
| Odor | Perception |
| TDS | Water meter YSI 650 MDS |
| Dissolved oxygen | Water meter YSI 650 MDS |
| Conductivity | Water meter YSI 650 MDS |
| **Inorganic components, heavy metals** | |
| Sulfate | |
| Al | AAS method |
| $Cl^-$ | AAS method |
| Pb | AAS method |
| Zn | AAS method |
| Co | AAS method |
| **Organic parameters** | |

| **Parameters** | **Analysis Methods/Equipment** |
|---|---|
| T-N | EPA 2-95 |
| T-P | TCVN 6202 – 1996 |
| Organic Chlorinated Pesticides | APHA 6630 B |
| Oil, grease | Extraction method |
| **Microorganisms** | |
| E. coli and Coliform | Filter membrane |

*b. Sampling Location: (Ref. Fig 2.1)*

Surface water samples are taken from rivers, lakes along the line, specifically:

NM01: Lake in the area of Depot station

NM02: Km1+500, lake in front of Hanoi Electromechanical equipment Manufacturing Company

NM03: Km3+100, Nhue river (Cau Dien)

NM04: Km4+200, lake in Mai Dich cemetary

NM05: Km7+750, To Lich river (Cau Giay)

NM06: Km8+900, Thu Le lake

NM07: Ngoc Khanh lake

NM08: Van lake (opposite Van Mieu-Quoc Tu Giam)

*c. Sample Storage*

The samples collected were kept in an ice cold container with temperature maintained at < 4oC. Depending on the parameters, the samples were properly preserved and analyzed. Parameters like pH, DO, conductivity and TDS were measured on-site. Other parameters were analyzed in the laboratory.

*d. Sampling frequency:* 2 samples / point (01 sample in the morning, 01 in the afternoon).

*e. Reference Standards:*

TCVN 5942 - 1995: The tolerble limits of parameters and concentration of pollutants in surface water, Category B- applied for surface water used for other purposes.

*e. Analysis Results*

The surface water analysis results are as follows:

**Table 2.10a. Surface Water Quality in the Project Area**

| No | Parameters | Unit | Analysis Results (Average) | | | TCVN 5942 - 1995 | |
|---|---|---|---|---|---|---|---|
| | | | NM01 | NM02 | NM03 | Column A | Column B |
| 1 | pH | - | 7.47 | 7.24 | 7.42 | 6 - 8.5 | 5.5 - 9 |
| 2 | Color | Co-Pt | 55 | 36.5 | 40 | - | - |
| 3 | Odor | - | Smell | Offensive | Smell and offensive | - | - |
| 4 | Turbidity | NTU | 13.7 | 11.2 | 19.6 | - | - |
| 5 | Conductivity | MS/cm | 41.12 | 57.25 | 54.85 | - | - |
| 6 | Sulfate | mg/l | 30.3 | 23.2 | 34.4 | - | - |
| 7 | Al | mg/l | 0.03 | 0.04 | 0.06 | - | - |
| 8 | Temperature | $^oC$ | 23.6 | 23.5 | 23.0 | - | - |
| 9 | T-N | mg/l | 2.4 | 1.7 | 3.2 | - | - |
| 10 | T-P | mg/l | 0.16 | 0.23 | 0.28 | - | - |
| 11 | Cl- | mg/l | 1.2 | 1.5 | 1.4 | - | - |
| 12 | Oil, | mg/l | 0.007 | 0.010 | 0.030 | Nil | 0.3 |

| No | Parameters | Unit | Analysis Results (Average) | | | TCVN 5942 - 1995 | |
|---|---|---|---|---|---|---|---|
| | | | NM01 | NM02 | NM03 | Column A | Column B |
| | grease | | | | | | |
| 13 | Organic Chlorinated Pesticides | mg/l | 0.06 | Trace | 0.07 | - | - |
| 14 | Total Coliform | MPN/100 ml | 24000 | 22000 | 29000 | 5000 | 10.000 |
| 15 | Ecoli | MPN/100 ml | 6000 | 1503 | 5000 | - | - |
| 16 | Pb | mg/l | 0.03 | 0.05 | 0.04 | 0.05 | 0.1 |
| 17 | Zn | mg/l | 0.018 | 0.034 | 0.034 | 1 | 2 |
| 18 | Cr(III) | mg/l | 0.076 | 0.058 | 0.057 | 0.1 | 1 |
| 19 | Co | mg/l | 0.02 | 0.05 | 0.04 | - | - |
| 20 | DO | mg/l | 5.89 | 4.50 | 4.20 | $\geq$ 6 | > 2 |
| 21 | TDS | mg/l | 26.7 | 37.2 | 38.37 | - | - |

**Table 2.10b Surface Water Quality in the Project area**

| No | Parameter | Unit | Analysis Results (Average) | | | TCVN 5942 - 1995 | |
|---|---|---|---|---|---|---|---|
| | | | NM04 | NM05 | NM06 | Column A | Column B |
| 1 | pH | - | 8.29 | 7.36 | 7.21 | 6 - 8.5 | 5.5 - 9 |
| 2 | Color | Co-Pt | 15.5 | 61.5 | 31 | - | - |

| No | Parameter | Unit | Analysis Results (Average) | | | TCVN 5942 - 1995 | |
|---|---|---|---|---|---|---|---|
| | | | NM04 | NM05 | NM06 | Column A | Column B |
| 3 | Odor | - | Offensive | Smell | Offensive | - | - |
| 4 | Turbidity | NTU | 21.8 | 63.0 | 32.5 | - | - |
| 5 | Conductivity | MS/cm | 29.86 | 30.50 | 98.36 | - | - |
| 6 | Sulfate | mg/l | 23.6 | 42.1 | 43.2 | - | - |
| 7 | Al | mg/l | 0.03 | 0.11 | 0.05 | - | - |
| 8 | Temperature | $^{o}C$ | 24.4 | 24.1 | 24.4 | - | - |
| 9 | T-N | mg/l | 3.2 | 2.9 | 2.0 | - | - |
| 10 | T-P | mg/l | 0.17 | 0.49 | 0.19 | - | - |
| 11 | Cl- | mg/l | 1.1 | 1.7 | 1.5 | - | - |
| 12 | Oil, grease | mg/l | 0.004 | 1.282 | 710.476 | Nil | 0.3 |
| 13 | Organic Chlorinated Pesticides | mg/l | Trace | 0.07 | Trace | - | - |
| 14 | Total Coliform | MPN/100 ml | 18500 | 31000 | 15500 | 5.000 | 10.000 |
| 15 | Ecoli | MPN/100 ml | 6000 | 5500 | 3000 | - | - |
| 16 | Pb | mg/l | 0.02 | 0.14 | 0.07 | 0.05 | 0.1 |
| 17 | Zn | mg/l | 0.030 | 0.255 | 0.285 | 1 | 2 |
| 18 | Cr(III) | mg/l | 0.031 | 0.101 | 0.049 | 0.1 | 1 |

| No | Parameter | Unit | Analysis Results (Average) | | | TCVN 5942 - 1995 | |
|---|---|---|---|---|---|---|---|
| | | | NM04 | NM05 | NM06 | Column A | Column B |
| 19 | Co | mg/l | 0.30 | 0.64 | 0.30 | - | - |
| 20 | DO | mg/l | 6.74 | 1.05 | 2.35 | $\geq$ 6 | > 2 |
| 21 | TDS | mg/l | 20.48 | 17.74 | 56.78 | - | - |

**Table 2.10c. Surface Water Quality in the Project area**

| No | Parameter | Unit | Analysis Results (Average) | | | TCVN 5942 - 1995 | |
|---|---|---|---|---|---|---|---|
| | | | NM07 | NM08 | NM09 | Column A | Column B |
| 1 | pH | - | 7.47 | 7.60 | - | 6 - 8.5 | 5.5 - 9 |
| 2 | Color | Co-Pt | 60 | 46.5 | - | - | - |
| 3 | Odor | - | Offensive | Offensive | - | - | - |
| 4 | Turbidity | NTU | 21.3 | 23.1 | - | - | - |
| 5 | Conductivity | MS/cm | 67.73 | 54.42 | - | - | - |
| 6 | Sulfate | mg/l | 20.7 | 18.7 | - | - | - |
| 7 | Al | mg/l | 0.07 | 0.03 | - | - | - |
| 8 | Temperature | $^{o}$C | 22.3 | 24.1 | - | - | - |
| 9 | T-N | mg/l | 2.2 | 2.9 | - | - | - |
| 10 | T-P | mg/l | 0.32 | 0.40 | - | - | - |
| 11 | Cl- | mg/l | 1.1 | 0.9 | - | - | - |
| 12 | Oil, | mg/l | 0.850 | 0.250 | - | Nil | 0.3 |

| No | Parameter | Unit | Analysis Results (Average) | | | TCVN 5942 - 1995 | |
|---|---|---|---|---|---|---|---|
| | | | NM07 | NM08 | NM09 | Column A | Column B |
| | grease | | | | | | |
| 13 | Organic Chlorinated Pesticides | mg/l | Trace | Trace | - | - | - |
| 14 | Total Coliform | MPN/100 ml | 23500 | 22000 | - | 5000 | 10.000 |
| 15 | Ecoli | MPN/100 ml | 4500 | 5000 | - | - | - |
| 16 | Pb | mg/l | Trace | 0.08 | - | 0.05 | 0.1 |
| 17 | Zn | mg/l | 0.295 | 0.240 | - | 1 | 2 |
| 18 | Cr(III) | mg/l | 0.061 | 0.040 | - | 0.1 | 1 |
| 19 | Co | mg/l | 0.49 | 0.41 | - | - | - |
| 20 | DO | mg/l | 2.30 | 3.54 | - | $\geq$ 6 | > 2 |
| 21 | TDS | mg/l | 47.91 | 36.82 | - | - | - |

*Assessment of Surface Water Quality*

Surface water analysis results show that:

- Almost all parameters are below the standard limits prescribed in TCVN 5942 - 1995 (Column B). However, parameters in some samples do not satisfy the acceptable limits.

- Total coliform in all samples is 1-1.1 times higher than permissible limits (Column B).

- At Point NM5 (To Lich river water), the concentration of dissolved oxygen fails to satisfy the TCVN 5942-1995

(Column B), the content of lead, oil and grease are also found exceeding the limits from 1.4 - 4 times.

In short, the surface water in the project area is not contaminated by domestic activities and traffic operation, except for water in To Lich river which is seriously polluted.

### *2.1.3.3. Groundwater Quality*

In adition to evaluation of surface water quality, we also carried out sampling and analysis of several groundwater samples taken from the project affected areas. All groundwater samples were taken from potentially affected drilled wells which are now being used for drinking and domestic purposes.

*a. Groundwater Parameters*

Parameters used for analyzing groundwater quality, as well as analysis methods are presented in Table 2.12 .

**Table 2.11. Parameters and Methods for Groundwater Analysis**

| **Parameters** | **Analysis Methods/Equipment** |
|---|---|
| **Physical Parameters** | |
| T°C | pH meter |
| pH | Spectrophotometer |
| Odor | Perception |
| Turbidity | HACH analyzing kit |
| Conductivity | DO meter, with improved Winkler method |
| Hardness | APHA 2340 C |
| **Heavy metals** | |
| Mn | ASS Method |
| Fe | ASS Method |
| Mn | ASS Method |

| **Parameters** | **Analysis Methods/Equipment** |
|---|---|
| **Microorganism** | |
| Ecoli and total Coliform | Filter membrane |

*b. Sampling Location (ref. Fig. 2.1)*

NN01: Depot Station

NN02: Km4+000

NN03: Km6+000

NN04: Ngo Si Lien water work

*c. Sample Storage*

The samples collected were kept in an ice cold container with temperature maintained at < 4oC. Depending on the parameters, the samples were properly preserved and analyzed. Parameters like pH, DO, conductivity and TDS were measured on-site. Other parameters were analyzed in the laboratory.

*d. Sampling Frequency*: 3 samples/point x 4 points

*e. Reference Standards:* TCVN 5944 - 1995: Groundwater Standards

*f. Analysis Results*

**Table 2.12. Analysis Results of Groundwater Samples**

| **No** | **Parameters** | **Unit** | **Average Results** | | | | **TCVN 5942 - 1995** |
|---|---|---|---|---|---|---|---|
| | | | **NN01** | **NN02** | **NN03** | **NN04** | |
| 1 | T$^{o}$C | $^{o}$C | 18.5 | 21.5 | 21.0 | 19.0 | - |
| 2 | pH | - | 6.9 | 6.9 | 6.9 | 7.0 | 6.5 – 8.5 |
| 3 | Color | Co-Pt | 30 | 28 | 24 | 20 | 5-50 |
| 4 | Odor | - | Nil | Nil | Nil | Nil | - |
| 5 | Turbidity | NTU | 8.9 | 6.4 | 9.4 | 6.5 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6 | Conductivity | MS/cm | 27.8 | 33.8 | 34.3 | 42.5 | - |
| 7 | Hardness | mg/l | 69.0 | 74.7 | 77.7 | 63.1 | 300-500 |
| 8 | Mn | mg/l | 0.03 | 0.088 | 0.135 | 0.078 | 0.1-0.5 |
| 9 | Fe | mg/l | 0.46 | 0.65 | 0.11 | 0.47 | 1-5 |
| 10 | Total Coliform | MPN/100ml | 25 | 33 | 38 | 17 | 3 |
| 11 | Ecoli | MPN/100ml | 6 | 5 | 6 | 0 | - |

*Evaluation of Groundwater quality*

Groundwater analysis results reveal that almost all parameters are within the permissible limits in TCVN 5944-1995 except for total coliform which is 4-11 times higher than the standard limits.

### *2.1.3.4. Soil Environment*

In order to evaluate the quality of soil environment in the project site, we have conducted soil sampling and analysis along the line. The methods applied for sampling is in compliance with TCVN 5297-1995.

Soil parameters are shown the below table:

**Table 2.13. Soil Parameters and Analysis Methods**

| **Parameters** | **Analysis Methods** |
|---|---|
| **Heavy Metals** | |
| Cu | Dissolved Von - Ampe |
| Zn | Dissolved Von-Ampe |
| Cd | Dissolved Von- Ampe |
| Pb | Dissolved Von- Ampe |

| **Parameters** | **Analysis Methods** |
|---|---|
| Co | Dissolved Von - Ampe |
| **Organic Parameters** | |
| Total organic substance | Chemical methods |

The analysis results will be compared to TCVN 7209-2002. Heavy metal are shown the table below:

**Table 2.14. TCVN 7209-2002 - Heavy Metal Standards in Soil**

*mg/kg*

| **Parameters** | **Agricultural land** | **Forestry Land** | **Residential, recreational land** | **Commercial and Service land** | **Indus la** |
|---|---|---|---|---|---|
| Cu | 50 | 70 | 70 | 100 | 10 |
| Zn | 200 | 200 | 200 | 300 | 30 |
| Cd | 2 | 2 | 5 | 5 | 1 |
| Pb | 70 | 100 | 120 | 200 | 30 |
| Co | - | - | - | - | - |

*Sampling Location (ref. Fig 2.1)*

§01: Depot Station

§02: Km2+345

§03: Field land opposite Mai Dich cemetery (Km4+800)

§04: Van Mieu-Quoc Tu Giam

The analysis results are presented in the Table below:

**Table 2.15. Soil Analysis Results**

| **No** | **Paramet** | **Unit** | **Analysis Results** | **TCVN 7209-2002** |
|---|---|---|---|---|

| | ers | | §01 | §02 | §03 | §04 | Agricultural land | Residential, recreational land | Commercial and Service land |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Cu | mg/kg | 54.6 | 31.2 | 28.9 | 32.8 | 50 | 70 | 100 |
| 2 | Zn | mg/kg | 205 | 79.1 | 75.1 | 44.0 | 200 | 200 | 300 |
| 3 | Cd | mg/kg | 0.35 | 0.45 | 0.62 | 0.35 | 2 | 5 | 5 |
| 4 | Pb | mg/kg | 26 | 34 | 30 | 18 | 70 | 120 | 200 |
| 5 | Co | mg/kg | 2.3 | 2.8 | 1.8 | 2.3 | - | - | - |
| 6 | Total organic substance | % | 1.50 | 1.59 | 3.36 | 1.29 | - | | - |

*Evaluation of soil analysis results*

Most soil parameters from the analysis results are within the tolerable limits for agricultural, residential, recreational, commerical ad service land as per TCVN 7209-2002 except for soil samples taken from the intended Depot Station location whose CU and Zn content exceed the permissible limits for agricultural land.

### *2.1.3.5. Ecological Environment*

*Flora:*

Depot Station: the terrestrial plants in this area include some dry crops (peas, ground-nut, pumpkin, cabbages, roses, chrysanthemum), some fruit trees (banana, guava, sapodilla, pomelo, apples..) These are trees of high economic value, serving for the demand of Hanoians as well as nearby residents.

Along the route, small and medium shade trees are observed likes arjiun, flamboyant, china tree, baccaureas; margoses, dracontomelum. Besides, in Kim Ma street, there is row of mother-of-pearl with diameter 2-2.5m and height 15-20m.

*Fauna:*

The animals in the project site bear the characteristics of Red river delta, which is clearly shown in all species from terrestrial non-vertebrate animals, insect, to rodent, amphibian, and bird, animal. In the terrestrial vertebrate animal system, no precious and endangered species are found.

*Aquatic species in Nhue and To Lich River*

The river ecosystem is diversified by nature and subject to seasonal changes in term of water velocity and flow. The aquatic plants include principally algae, the zoobenthos groups are larva, insect, worm, shrimps, clams and snails. The Copepoda species present a highest density (75-76% of all species).

*Aquatic species in channels and lakes:*

- Lakes are quite still and the water flow is slow. The aquatic plants include mainly algae, water fern, and spinach. The bottom is soft with much organic micro-organism humus. There are both natural and raised fishes in lakes.

- In Nhue river, which receives wastewater from Hanoi, the aquatic plants includes 105 species belonging to 45 families, 6 phylum, of which the Bacilliariophyta accounts for 42 species, Chlorophyta 37 species, Phalophyta and Cyanophyta 12 species each, Rhodophyta and Pyrophyta 1 each.

- The ecosystem in irrigation channels depend on the quality of recharge source from Red River in serve for agricultural production.

The agricultural and industrial ecosystem in the Delta in general and in the project site in particualr is poor in both diversity and species as compared to other natural oulets.

## 2.2. Social-Economic status

### 2.2.1. Economic Condition

#### *2.2.1.1. Traffic*

From 2002 to now, there have been steady annual increase in newly paved roads. The City has upgraded and enlarged 50km of roads in the plan, particularly important road sections likes Lang Trung-La Thanh-Ngoc Khanh- Lieu Trai-Hoang Hoa Tham, Cau Giay-Kim Ma, Hoang Quoc Viet road, Cau Giay-La Thanh-Dai Co Viet, Kim Ma-Thu Le-Nghia Do, Lang-Ring Road 3, Road 131, Road 35 and Intersections: Ngoc Khanh, Cau Giay, Kim Ma-Lieu Giai, Pham Van Dong-Xuan Thuy.

Currently, the traffic flow in the project site is relatively high as result of increasing traveling needs.

The National Road 32 from Nhon to Cau Dien is now narrow, with the carriageway 9m for both directions while the traffic density is very high. Therefore, traffic jam frequently occurs in this road section in peak hours.

Road section from Cau Dien to Swedish Embassy has dual carriageway, each 10-15m wide. The traffic density in this section is high, but traffic congestion is rare.

Nui Truc street has narrow roadway with width of 5 m for both direction. The intended railway route turns left at Giang Vo treet and follows its right side. Giang Vo street has 2x3 lanes in each side, with width of 12m separated by 4m-wide median. This road intersect Giang Van Minh and Cat Linh street at Horison Hotel. This is the transfer point with Ha Noi-Ha Dong BRT and LRT route

The Railway then turns into 8m-wide Cat Linh street, follows Quoc Tu Giam street to Van Mieu, runs under residential area and Hanoi Railway Station.

**Table 2.16: Main Intersections in Railway Route**

| TT | Sta. | Intersection |
|---|---|---|

| | | |
|---|---|---|
| 1 | Km 02+800 | Intersection with National Railway |
| 2 | Km 05+600 | Intersection with Ring Road 3 |
| 3 | Km 08+000 | Intersection with Ring Road 2 |
| 4 | Km 09+010 | Lieu Giai-Nguyen Chi Thanh Intersection |
| 5 | Km 11+530 | Ton Duc Thang Intersection |

### *2.2.1.2 Economic Development*

*a) Industry*

During the past years, Hanoi City in general and the project area in particular has maintained high industrial growth rate. The industrial growth rate recorded in 2000-2004 period is 13.6%, production value attained 18.35%. Restructuring of product by businesses have resulted in changes. Traditional industrial products have been promoted likes electric fan, machine tools, diesel engine. The ratio of processing, construction sector has also on the rise.

In order to provide space for businesses, many small and medium industrial hubs, clusters have been constructed in the area.

**Table 2.17. Industrial Hubs, Clusters in the Project area**

| No. | Name of industrial hubs, scluster | Location | Year of establishment | Area (ha) | Main product Category |
|---|---|---|---|---|---|
| 1 | Light industry and small scale industry in Cau Giay district | Dich vong ward, Cau Giay district | 2000 | 8,29 | - |

| No. | Name of industrial hubs, scluster | Location | Year of establishment | Area (ha) | Main product Category |
|---|---|---|---|---|---|
| 2 | Small and medium industrial hubs in Tu Liem district | Minh Khai commune, Tu Liem district | 2004 | 62,9562 | Plastics, mechanics, electricity, chemicals, pulp, textiles, glasses, woods, foodstuff |
| 3 | South Thang Long industrial zone | Liem Mac commune, Tu Liem district | 2000 | 30,83 | |

*Source: Hanoi Management Unit of Industrial and Processing Zones, 2005*

*d)Agriculture*

Eventhough facing complicated weather condition, avian-flu apidemic, shrinking agricultural land, the area still achieves incresing agricultural growth rate.

Research and application of scientific and technological advacement in farming has still been promoted. Some high technologies have been applied in propagation likes tissue invitro, plantation in, greenhouse, clean production. There have been concentrated agricultural areas with high productivity.

The abuse or misuse of pesticides has still been reported in vegetable and fruits cultivation in suburban areas, creating adverse impacts on human health, hampering the agricultural ecological balance and reducing the effectiveness of pesticide. However, the most critical influence is on community health as the pesticide

residuals in soil, surface water and agricultural products has many time exceeded the tolerable limits

#### *2.2.1.3. Tourism, Service and Trade*

The tourism sector in the past years has enjoyed relatively high growth rate. Various toursim services have been developed with the introduction of new tours and destinations, which help to promote the entire tourism activities. The infrastructure serving for tourism has been invested, upgraded, and new recreational centers born. The number of hotels, restaurants has increased from 233 in1995 to 378 in 2004, of which 16 hotels are foreign invested. Occupancy rate of hotels in Hanoi averages over 70%. The total number of tourist to Hanoi increase by 11.7%/year in 2001-2005 period, with the increase if foreign visitors by 15.7%. In 2004, domestic tourists are estimated at 3,500,000, and foreign visitor 950,000, an increase of 2 times as compated to that in 2000. Turnover from tourism increases by 16%/year on average.

Together with industrial growth, the services have also been developed and gradually improved. Some services of high intellectual level has experienced positive changes, contributing to push up economic growth and satisfy the economic integration needs. (The productivity of service sector increase by 9.6%/year in 04 year from 2001-2004).

The commercial activities has taken place seethingly in civilized and modern orientation. The total estimated value of goods circulation in 05 years in the market averages 71.000 billion VND/year, total retail value is 27.500 billion VND/year, an average increase of 14%/year. The export turnover increase in the study area is also fair high: 2.164 million USD in 2004, which is 1.6 times higher than that of 2000. The Outlets have been strengthened and expanded. The export mechanism has witnessed positive changes: the agricultural product ratio drop from 31,8% in 2000 to 23% in 2004; the electronical equipment increases from 6.5% to 16.8%, the import

turnover rises 19%/year, of which import by local sector increases 31%/year

### 2.2.2. Social Charactersitics

#### *2.2.2.1. Population*

Hanoi's population as off 31 December 2004 is 3,118,200 people, of which inhabitants in 09 inner districts is 1,950,500, and in 05 suburbant districts 1,167,700 people. The natural population growth rate is 1.224%; of which the inner City: 0.956%, suburban part: 1.155%.

The inner City's average population density is 10,910 people/$km^2$, suburban districts: 1,573 people/$km^2$.

The natural population growth rate of Hanoi City, following the stable period in 2000-2002 at 1.06-1.09%, has increased by 1.25% in 2003, then slightly dropped to 1.22% in 2004 (down 0.03% as compared to 2003). On the contract, the mechanical growth rate (due to inflow of provincial migrant workers) is down from 2.01% in 2000 to 1% in 2003.

**Table 2.18. Population in the Project area**

| No | Wards | Population (person) | Area ($km^2$) | Population Growth (person/$km^2$) |
|---|---|---|---|---|
| 1 | Tran Hung Dao | 10.906 | 0,5 | 21812 |
| 2 | Cua Nam | 12.716 | 0,4 | 31790 |
| 3 | Van Mieu | 11.300 | 0,4 | 28250 |
| 4 | Quoc Tu Giam | 9.795 | 0,2 | 48975 |
| 5 | Cat Linh | 13.486 | 0,4 | 33715 |
| 6 | Van Chuong | 12.319 | 0,4 | 30798 |
| 7 | Giang Vo | 12.216 | 0,7 | 17451 |
| 8 | Kim Ma | 13.000 | 0,5 | 26000 |

| | | | | |
|---|---|---|---|---|
| 9 | Ngoc Khanh | 24.395 | 1,1 | 22177 |
| 10 | Quan Hoa | 13716 | 1,0 | 13716 |
| 11 | Dich Vong | 10.796 | 1,4 | 7711 |
| 12 | Dich Vong Hau | 8641 | 1,5 | 5761 |
| 13 | Mai Dich | 13.087 | 2,1 | 6232 |
| 14 | Cau Dien town | 8.202 | 0,2 | 41010 |
| 15 | Phu Dien commune | 9.929 | 4,1 | 2422 |
| 16 | Minh Khai commune | 8.300 | 5,1 | 1627 |
| 17 | Tay Tuu Commune | 10.663 | 5,3 | 2012 |

#### *2.2.2.2. Community Health*

In recent years, Hanoi has made notable achievement in community healthcare. Medical services have been developed and improved. In some particular medical fields, we have catched up with standards of developed nations, contributing to improve the health of City dwellers. Innitial healthcare has been well conducted in recent years, with many basic healthcare objectives being enhanced and maintained at high levels; such as:

- Average life expectancy: 76 years old;
- Infant mortality: droping from 6.5 in 2001 to 5.3 in 2004;
- Mortality of children under 1 year old: reducing from 9.2 in 2000 to 8.5 in 2004;
- Mortality of children under 5 years old: reducing from 10.3 in 2001 to 9.8 in 2004;
- Rate of infant less than 2,500g of weight: down from 6.5% (in 2001) to 5.3% in 2004;
- Malnutrition rate of children under 5 years old: reducing from 18.7% in 2001 to 14.9% in 2004.

*(Source: 5 Year Plan (2006-2010) of City's Healthcare Sector, Hanoi Department of Helath, 2005)*

Disease prevention

In recent years, the Hanoi's healthcare sector has established a wide surveilance network to prevent potential outbreak of epidemic diseases. This has contributed to the early forecast of plague, facilitating active and timely safeguard and combat of epidemic diseases by higher and central levels. At the same time, the Hanoi's heathcare sector also play a core part in implementing environmental sanitation in communes, wards, and towns level. Thank to the activeness in disease precaution, the Healthcare sector in 2003-2005 has contributed to eliminate some dangerous diseases arisen, notably the sucessful elimination of SARS and timely prevention of pneumonia caused by influenza A (H5N1) virus in Human

Food security is also a matter of great concern by healthcare sector in the current stage. The risk originates from the excessive usage of chemicals, additives in foodstuf processing (for instance the use of Formaldehyde in making noodles (pho), rice vermicelli, borax in making pork pies, dyeing agent); the use of ready-made foods, fresh vegetables, or unsecure dish like fermented pork roll, which is very popular among people.

Diseases relating to living styles, sanitation and environmental pollution

Hanoi is the second biggest City in the country with high population and important traffic linkages, attracting numerous migrant workers, both home and abroad, to Hanoi for living, working and visiting. Epidemic diseases, therefore, occur here as a complicated issue. A number of epidemic diseases are still in high rate (diarrhoea, respiratory infections...). At the same time, some diseases relating to the lifestyle and social development is on the increase (HIV/AIDS, accident, trauma, mentally disorder...). Diseases resulted from social evils is also on the rise, and more and more diseases of developed

countries likes cardiovascular, hypertension, cancer, diabetes, obese are observed.

Population boom and the subsequent increase of urbanization and the exodus of rural workers to urbanities has given rise to increasing demand of energy, fuels as well as the pressure to put on the infrastructures, deterioration of environmental quality and outbreak of occupational and pollution related dieases.

Air pollution is the principal cause of respiratory diseases. Digestion diseases and food poisoning are still popular in the community. Intestinal diseases such as cholera, dysentery, typhoid, hepatitis, diarrhoea caused by virus and bacteria due to the use of contaminated water or unsecured foods has increased rapidly during the past years.

According to statistics of Yearbook, in 2004 Hanoi has 47,151 cases of cholera, diarrhoea, dysentery; 540 cases of petechial fever and 220 cases of hepatitis. These diseases are considered the tracer of clean water supply and sanitation status. These diseases will be reduced or eliminated when the water supply and environmental sanitatin is improved.

#### *2.2.2.3. Structures related to the project*

The proposed Urban Pilot Railway project is located within Hanoi City, which is home to numerous important historical, cultural monuments, relics and urban landscapes.

Following cultural and historical structures are found within the project area:

**Table 2.19. Cultural work and Historical vestige within the project area**

| NO | Location | Structures | Distance to the |
|---|---|---|---|

| | | | **Project site** |
|---|---|---|---|
| 1 | Minh Khai commune | Dong Co Communal house and Temple | 60 m |
| 2 | Mai Dich ward | Mai Dich cemetery | 20 m |
| 3 | Quan Hoa ward | Ha Pagoda | 80 m |
| 4 | Ngoc Khanh ward | Kim Son pagoda<br>Kim Ma Temples | 120 m |
| 5 | Dong Da district | Van Mieu Quoc Tu Giam | 20 m |

Besides, along the Railway route are many universities, colleges and secondary schools.

**Table 2.20. Universities within the Project Site**

| **No** | **Lcoation** | **Schools/Universities** | **Distance to the Project Site** |
|---|---|---|---|
| 1 | Tay Tuu commune | Hanoi Industrial University | 15 m |
| 2 | Minh Khai commune | Communication and Transport Technical College | 30 m |
| | | Meteorological College | 30 m |
| | | Minh Khai Secondary School | 50 m |
| 3 | Mai Dich commune | Trade University | 15 m |
| | | University of Stage and Cinema | 20 m |
| 4 | Quan Hoa commune | Hanoi National University | 15 m |
| | | Teacher Training University | 15 m |
| | | Nguyen Tat Thanh Secondary School | 15 m |
| | | Hanoi Teacher Training College | 150 m |
| 5 | Lang Thuong commune | University of Communication and Transport | 60 m |
| 6 | Cat Linh commune | Cat Linh Secondart School | 15 m |

# Chapter 3

# Environmental Impact Assessment

## 3.1. Sources of impact

### 3.1.1. Source of Impact relating to Waste

***3.1.1.1. Pre-Construction Stage*:** waste related sources primarily originates from demolition of residential houses, public structures, removal of infrastructures likes power, water, commercial activities.

***3.1.1.2. Construction Stage*:** ground leveling, construction underground tracks, flyovers, bridges, transportation of borrow materials to the Sites, waste discharged by workers.

***3.1.1.3. Operation Stage*:** operation of metro trains and Depot.

### 3.1.2. Sources of Impact not relating to Waste

***3.1.2.1. Pre-construction Stage:*** compensation, resettlement.

***3.1.2.2. Construction Stage:*** potential subsidence due to excavation of rail tunnel, drawndown of groundwater table, submerge.

***3.1.2.3. Operation Stage:*** settlement in railway tunnel, commercial activities.

### 3.1.3. Anticipation of Project-related Environmental Risks

***3.1.3.1. Risks during Construction*:** settlement, inundation of tunnel.

***3.1.3.2. Risks during Operation*:** fires and explosion inside the tunnels, traffic accidents.

## 3.2. Affected Groups and scope

In addition to positive influences, the Project can exert adverse impacts on the natural environment, social-

economic environment, commercial activities, cultural structures, residential areas...

❖ *Affected groups and scope of influences due to site clearance and resettlement:* Resettlement might have impacts on 'Project-affected People- PAPs' due to relocation, influencing their livelihood accordingly. Population displacement may cause impacts on accessibility to necessary basic infrastructures likes power, water, healthcare clinics, market. There occurring also altered livelihood. Small businesses likes streetside shop owners must adapts to the new resettlement where no favorable business condition is available.

The influenced structures are surveyed and evaluated with details as follows:

- Area for construction Depot and approach road to Depot: 162.510 $m^2$ of agricultural land, 560$m^2$ of public land, 7.100$m^2$ residential land (53 households must be removed)
- Power Station in the Line: 1,500 $m^2$ (removal of 30 households)
- Elevated Station : 6, 600$m^2$ (removal of 110 households)
- Land for road construction: 38.400$m^2$.

❖ *Affected groups and scope of influences due to changes of groundwater level:*: area for underground tube excavation from Swedish Ambassy to Hanoi Railway Station is 2.9 km long. The affected people are residential clusters in Dong Da and Hoan Kiem district.

❖ *Affected groups and scope of influences due to surface water pollution:* lakes in Depot station, Nhue river, To Lich river, Thu Le lake will bear the influences during project construction and operation period.

❖ *Affected groups and scope of influences due to Particles, Noise and Vibration*

Public structures, residential houses alongside the Lines, which is 50m away from the edge line will bear direct and indirect impacts during construction and operation Stage

**Table 3.1. Identification of Project Affected Groups, Scope and Duration**

| Source of Impact | Affected Group | Influenced Scope | Period |
|---|---|---|---|
| Particles and exhaust gases | Busy residential areas, schools and public places | The area of Depot and alongside the railway Line, 100m away from centerline | During construction stage (1/2007-10/2010) |
| Noise and vibration | Busy residential areas, schools and public places | The area of Depot and alongside the railway Line, 100m away from centerline | During project construction and operation period (from 1/2007) |
| Surface water and ground water contamination | Agricultural production (fields, gardens), domestic water sources | The area of Depot station and underground sections (from Swedish Ambassy to Hanoi Railway Station) | During construction and operation stage (from 1/2007) |
| Solid and hazardous wastes | Agricultural production (fields, gardens), domestic water sources | Residential areas, schools and farming land around the Depot | During construction and operation stage (from 1/2007) |

| Source of Impact | Affected Group | Influenced Scope | Period |
|---|---|---|---|
| Land clearing anda resettlement | 320.900$m^2$ of forming land, 560$m^2$ of public land | The area of Depot and approach road to Depot | During pre-constructio n stage (2007) |

The levels of impact by Project's major activities are depicted in Table 3.2 below.

**Table 3.2. Checklist of Project Environmental Impacts**

| Environmental Issues | | Pre-construction | Construction | Operation |
|---|---|---|---|---|
| 1 | Land acquisition and Resettlement | Δ | Δ | + |
| 2 | Trade activities | Δ | Δ | + |
| 3 | Traffic congestion | + | Δ | ° |
| 4 | Traffic accident | + | Δ | ° |
| 5 | Solid Wastes | + | Δ | Δ |
| 6 | Groundwater | + | Δ | + |
| 7 | Hydrology (inundation) | Δ | Δ | ° |
| 8 | Landcapes | + | Δ | ° |
| 9 | Air contamination | Δ | Δ | + |
| 10 | Water pollution | Δ | Δ | ° |
| 11 | Noise and vibration | Δ | Δ | Δ |
| 12 | Land subsidence | + | Δ | Δ |
| 13 | Social | + | + | ° |

| Environmental Issues | | Pre-construction | Construction | Operation |
|---|---|---|---|---|
| | environment | | | |
| 14 | Spiritual life | + | + | + |

***Note:***

Δ : Negative impacts to be mitigated

° : Positive impact

\+ : No impact

**Table 3.3. Environmental Impact Matrix**

| Project Activities / Environmental components | Site clearanceand | Materials Hauling | Quarries | Drilling, Excavation | Use machines and Equipment | Concrete Mixing and Placing | Waste Transportation | Worker's domestic | Metro Operation |
|---|---|---|---|---|---|---|---|---|---|
| ***1. Natural Environment*** | | | | | | | | | |
| Air quality | * | * | * | * | * | * | * | * | |
| Surface water quality | | * | * | | * | * | * | * | |
| Groundwater quality | | | * | * | | | | | |
| Hydrology | | | * | * | | | | | |
| Noise and Vibration | | * | * | | * | * | * | | * |
| Soil | | * | | * | | * | * | * | |
| Inundation | | | | * | | | | | |
| Ecology | * | | | | | | | | |
| ***2.SocialEnvironment*** | | | | | | | | | |
| Housing | * | | | | | | | | |
| Occupation | * | | | | | | | | |
| Social diseases | | | | | | | | * | |
| Mass organization | * | | | | | | | | |
| Traffic accident | | | | | | | * | | |

| **Project Activities** / **Environmental components** | Site clearanceand | Materials Hauling | Quarries | Drilling, Excavation | Use machines and Equipment | Concrete Mixing and Placing | Waste Transportation | Worker's domestic | Metro Operation |
|---|---|---|---|---|---|---|---|---|---|
| Trade activities | * | | | | | | | | |

**Table 3.4. Checklist of Project Environmental Impacts**

| | Items | Impact Level | | | | Explanation | Mitigative Measures |
|---|---|---|---|---|---|---|---|
| | | M | I | Mi | No | | |
| **Pollution** | 1. Air pollution due to project activities | | V | | | 1. Impacts by exhaust gases on air quality | 1. Need Mitigation measures |
| | 2. Impacts on underground ecosystem and water sources | | V | | | 2. Bridge construction might affect aquatic ecosystem. River water becomes dirty during pier construction | 2. Technical option selected, tunnel excavation and pier construction plans shall be approved by functional agencies |
| | 3. Water pollution and soil contamination due to wastewater from machines and construction Sites | | V | | | 3. The disposal sites may cause groundwater and soil contamination if the disposed waste has high content of heavy metals | 3. Excavated soil samples shall be analyzed to evaluate the contamination potentiality. The disposal sites shall be informed to competent bodies |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 4. Influences of noise and vibration during operation of elevated Railways | | V | | | 4. Noise and vibration generated during operation time will exert influences on local dwellers and the areas needing special tranquility likes schools and hospitals | 4. The operational techniques shall take into account mitigation measures to prevent nuisance to local peoples |
| | 5. Impacts by noise and Vibration generated by construction equipment | | | | | 5. Noise and vibration caused by construction equipment and machines will influences local peoples and areas needing special tranquility | 5. The construction techniques for elevated railway shall take into account mitigation measures to prevent nuisance to local peoples |
| | 6. Risk of land subsidence and collapse of tunnel during construction | | V | | | 6. Land subsidence caused by drawdown of groundwater table. | 6. Groundwater monitoring shall be conducted during the entire construction periods. |
| | 7. Pollution of waste and wastewater discharged by local residents and workers | | | | | 7. A Large number of workers mobilized on Sites create water and waste pollution. | 7. Cooperation with Urban Environmental Company to appropriately collect wastes and effluent |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Natural environment** | 8. Impacts on ecosystem during construction and operation | | | V | | 8. Construction of the Railway may influence the ecosystem in the area. Construction of bridge can impact aquatic ecosystem in rivers, lakes in the project site. | 8. The construction technologies shall be appropriately selected to minimize pollution in river |
| | 9. Impact on lanscapes | | V | | | 9. Construction of tunnels and bridges will influence general urban landscapes. | 9. Layout and color of the tunnels, bridge shall be properly designed to avoid breaking the local general landscape |
| **Social environment** | 10. Impacts during construction stage and impacts by operation of equipment on cultural historical structures and relics | | V | | | 10. Van Mieu Quoc Tu Giam is above the railway tube<br>Possible underground relics during excavation | 10. Proper mitigation methods shall be selected for careful protection of the structure during the entire costruction time<br>Cultural heritages shall be protected, coordinating with Ministry of Culture and Information to have removal options if needed. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 11. Impact on existing structures and houses (underground section) | V | | | | 11. Construction activities in City's inner shall influences road traffic and in-ground structures | 11. Construction time and technologies shall be considered carefully |
| | 12. Removal, Resettelement | V | | | | 12. Construction of Depot station shall encroach a portion of residential and farming land. | 12. Resettlement for local PAPs shall be carefully conducted by competent agencies in prior to construction. If required, alternative employment shall also be created for those loosing the income. |
| **Others** | 13. Impacts on the environment during the entire construction time. | V | | | | 13. Noise generated during the entire construction time may create nuisance for residents living in vicinities. Hauling of materials, dredged sludge will also influence nearby areas | 13. Fences shall be erected to minimize visual nuisances, particles dispersion on road. Water shall be sprinkled on the Sites, and hauling vehicles covered carefully |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 14. environmental monitoring | V | | | | 14. Monitoring of water, air, noise, vibration shall be conducted during the whole construction period | 14. Monitoring equipment and environmental experts shall be facilitated to perform professional tasks, Monitoring findings shall be reported to functional organs |
| | 15. Exploiring bomb and mine residuals | V | | | | 15. There shall be plans to investigate residues of bombs and mines. | 15. Exploration shall be conducted during the entire construction time |

Notes:

M: Major

I: Moderate

Mi: Minor

No: Unclear

### 3.2.1. Major Impacts during Construction Stage

Potential impacts during this perod comprise the followings:

- Temporary traffic congestion on the Line due to transport and unload of materials, operation of machines and vehicles.
- Atmospheric pollution, particularly particle matters from the Sites, concrete batching station and transportation of materials, ending up in bad effect on human health as well as cultural and historical vestige.
- Increase of noise, vibration by construction equipment, influencing adverse impacts on community health and historical, cultural relics.
- Soil contamination due to transportation and disposal of generated waste volume.
- Possible outbreak of equidemic diseases (when pandemic occurs) from local residents to workers and vice versa.
- Waste pollution due to generated domestic refuses by workers.
- Occupational accidents.

### 3.2.2. Impacts during Operation Stage

- Increase of noise and vibration along the Line due to operation of the Metro trains, influencing adversely the health of alsongside dwellers and cultural, historical structures.
- Contaminated waste and wastewater discharge from Station if not being collected and treated suitably.
- Pollution of water sources and soil at Depot area due to refuses and effluent from Depot operation.

## 3.3. Accessment of Impact

### 3.3.1. Impacts during Pre-contruction Stage

***Impacts of site clearance and resettlement***

During land clearing stage, the most notable impacts is land accquisition and resettlement. These are not minor problems, necessitating great effort for settlement.

Resettlement causes the folowing issues: pernament and temporary impacts on affected households in term of livelihood, employment, schooling... impacts on operation of offices, businesses, schools, relating infrastructure (power system, in-ground cable...). These impacts are direct, and proper compensation shall be made.

Land accquisition and resettlement may create disturbance to the removed households and offices. Removal will make them worried, causing troubles, worries and possibly hamper the relationship between migrating and staying ones. This is a great impact during project implementation, but creating temporary influence for some households and longtem one for others, particularly in stabilization of employment for those households loosing farming land.

Public consultation has been conducted to 100 households, the finding eing presented in Table 3.5.

**Table 3.5. Results of Social Survey**

| | | | |
|---|---|---|---|
| Household monthlt average income | < 3 mil VND | 3 to 7 mil VND | > 7 mil VND |
| | 25% | 38% | 27% |
| Opinion on resettlement | Concentrated resettlement | Free resettlement | Temporary resettlement |
| | 29% | 1% | 60% |
| Opion on the Projet implementation | Support | Do not Support | No opinion |
| | 97% | 2% | 1% |

Survey results reveal high level of public support for the project, provided that proper compensation shall be made to PAPs as per prescribed State policies, and

employment assistance provided. Within the cleared area, a large number of wholly farming households with fairly high income are found. Acquisition of their farming land makes them landless, while the City has no agricultural land reserved for compensation. Affected households shall, therefore, be compensated for their lost properties and be given assistance for economic recovery or at least maintain their living standards and income as before. The policies and entitlements shall be mentioned in Mitigation Chapter.

Negative transaction possibly arisen during measurement and examination of compensation may lead to long lasting grievance, creating delay in project progress, waste of money and effort of people and authorities. Therefore, sound policies, transparency and intervention of competent Authorities (People's Committee of ward, commune, district and city) and relevant bodies is needed to ensure equality and stability during removal and land acquisition

Resettlement also raises numerous concerns on the capability to adapt to the new environment, lifestyle, relationships …

Employment alternation and job creation shall also be considered for PAPs

A number of cultural vestiges, public works also suffer from project activities although not locating in influence area, being removed or demolished.

### 3.3.2. Impacts during Construction Stage

The impacts created in this stage is considered to be major, but locally occurred in short period of time depending on mode of construction.

#### *3.3.2.1. Impact on the Air Environment*

During construction stage, the air pollution is caused from the followings: particles, hazardous gases ($SO_2$, $NO_x$, CO, volatile organic compound and lead) emitted from construction equipment and excavation activity.

During construction of road work, the equipment and machines generate air pollutants include: steam hammer, drillers, generators, concrete batching station, and transportation vehicles. Since almost all machines fueled by oil or petroleum, their exhaust gases emitted to the air environment contains (TSP), $SO_2$, NOx, hydrocarbon.

As the result, air pollution caused by construction equipment and construction activities is fairly serious. However, they are local and temporary (occurring in the construction time only). Particles, scattering soil, grit, sands during earthwork, drilling, excavation…lead to the increase in suspended dust. In addition, operation of machines which generate large volume of air pollutants, and traveling of traffic means has constituted significant sources of pollution to the ambient air environment, both inside the project site and its vicinities. Coarse dust shall fall near the construction Site, fine particles disperse extensively. Hauling of materials create pollution not only in the Site but also in the area along the transportation route (from quarry to the Site). The pollution source depends on the quantity of construction equipment, machines and selected methods.

Dust scattered from materials shed is dispersed in the air following the wind, polluting the ambient air environment. There is a fact that particles generated from transportation routes and materials shed is popular. The dust pollution coefficient during materials transportation and storage is calculated using the following formula:

$$L = 1{,}7k \left[\frac{s}{12}\right] x \left[\frac{S}{48}\right] x \left[\frac{W}{2{,}7}\right]^{0{,}7} x \left[\frac{w}{4}\right]^{0{,}5} x \left[\frac{365-p}{365}\right]$$

where: L: dust pollution coefficient (kg/km/trip/year).

k: grain size; 0,2µm
s: soil volume on road surface; 8,9%
S: average vehicle speed; 20 km/h
W: vehicles weight (with load); 10 tons
w: number of wheels; 6 wheels
p: number of working day per year

We can calculate the dust pollution coefficient of 0.15 kg/km/trip/year.

Normally, the value of suspended dust measured on the construction site fluctuates in the range 300-2700 µg/$m^3$, which is 3-9 times higher than the permissible limit in TCVN 5937-2005 of 300 µg/$m^3$). Preliminary calculation has put the number of hauling vehicles serving the project at 20,000 trips. Given the average travelling distance of 10km for each vehicle, the estimated dust load as per above coefficifent is calculated at 30 tons.

Air pollution is principally caused by waste exhaust emitted from construction machines and equipment. Given the aditionally mobilized equiment, the actual traffic flow increase considerably. On the other hand, the roadway is narrowed giving place to construction activities, even when traffic distribution is properly applied. Consequently, there are still problems such as: reduction of average speed, increase of traffic congestion in rush hours. This worsens the problem of hazardous exhaust emission from engines. Even though this source of air pollution is not serious since dispersion in large project area, it do have considerable impacts on the health of people living alongside the transportation route, particularly those residing in the immediate vicinity of construction site. If obsolete machines are used, the amount of waste exhaust will be quite great. This makes the contents of some air pollutants exceeding the tolerable standards for ambient air.

Historical, cultural, religious relics (Dong Co Communal House and Temple, Voi Phuc Temple, Van Mieu Quoc Tu Giam… ) locating near the project site may suffer from

$SO_2$, $NO_x$. With high concentration, these air pollutants can cause adverse impact on human health, plant and structure.

### *3.3.2.2. Impact of Noise and Vibration during Construction Period*

**1) Impact of Noise**

According to monitoring data, the current noise level along the line is higher than the permissible limits applied for residential areas, especially in the area along the main line in City's inner, the noise level is very high as compared with the Standards. Construction activities will, therefore, likely lead to the increase of noise in the area. During construction time, noise is generated form the following sources:

- Construction equipments,
- Concrete mixing station,
- Pile driving for construction of column in tunnel
- Transportation of borrow materials,
- Generators
- Vibrating compactor,

Data of the US Highway Management Committee specifies the Type A noise variance of construction machines as follow:

- *Concrete batch plant*

The maximum noise level at 15m distance is 90 dB and the level in longer distance can be defined using the following rule: each 6dB is reduced to a double distance; this means the noise level will be 84dB in distance of 30m, 78 dB in 60m and 72dB in 120m. If the concrete batching plant operates most of the time during the day, it shall be placed far away from affected places (e.g. residential area). For other sensitive areas, the noise level can be calculated similarly or 240m at least to reduce the noise to 68dB.

Since the calculated noise form the above sources is the maximum value as guided in documents, in case the Contractors utilize modern eqipment, the above mentioned

distance can be shorter. For instance, concrete batching machines as per GSA standards (Geology Societ of America) create noise level of 75 dBA at 15m distance, so it generate 63 dBA noise level at distance of 60 m.

- *Excavation area:*

Earthwork will be conducted in the area for construction of tunnel. The noise level of excavators may reach 98 dBA at distance of 15m. According to survey results, sentivitive groups (residential areas, tourism, schools...) are found in the area for construction of tunnel.

- *Transportation of borrow materials*

A number of equipment to be used for this work likes backhoe, bulldozers, tractors, graders and trucks. Each equipment might generate noise up to 90 dBA at distance of 15m (GSA allows 75 - 80 dBA). If these equipments operate simultaneously, the resonant noise may total 97 - 98 dBA.

Therefore, fences shall be erected to protect the sensitive groups from noise impact. The operating time shall also match to the receptors.

- *Generators:*

The noise created by generators normally do not exceed 82 dBA at distance of 15m (GSA requires under 75 dBA). This means that the maximum noise at distance of 60m will be around 70 dBA. There shall be necessary isolating structures if the affected locates nearer.

On the construction Sites, equipment generating great noise shall exert bad influences on the workers' health. These influences are evaluated as negative, but local and temporary since great noise normally attenuate through the distance from Sites to worker camps.

It can be concluded from the above analysis, that residential clusters alongside the railway lines and nearby pagoda, schools, offices, banks within 100-200m radius from the noise source might be affected by the noise, particularly the area from Intersections in Pham Van Dong street to Hanoi Railway Station. Therefore, noise insulators are necessary.

**2) Impact of Vibration**

During construction time, an significant source of impact is vibration from excavators and heavy trucks transporting borrow materials. Excavation and transportation generate great vibration affecting residential area shall be conducted during the daytime to minize the impacts.

In order to protect cultural places (pagodas, hospitals, schools, historical relics...) from the influence of vibration, the maximum vibration in these areas shall be restricted to under 2 mm/s.

#### *3.3.2.3. Impact of Subsidence*

The Hanoi's geological setting consists of various layers, including alluvial sediments so it's quite weak. It's mainly composed of sand, cobbles, clay or mixture of these components with proportion differed to each layer.

Construction of shallow and deep underground tunnels will influence adjacent structures, particularly in case the deep tunnels are constructed under the foundation of these structures, but data relating building and its foundation structures is insufficient.

Land subsidence occurs in a large area normally due to the impact of groundwater extraction. It's not the case in this project, but excavation of tunnels in weak foundation will likely create settlement in nearby areas. With only some centimeters of settlement, nearby structures might be destroyed.

Land settlement occurring in adjoining locations might be attributed to tube excavation, which might distort the buildings' wall and temporarily influence groundwater exploitation. In other words, recommended precaution of land subsidence is limited since tunnel construction will put pressure to ground level due to operation of drillers. In practice, it's difficult to evaluate land subsidence. Monitoring is, therefore, proposed to identify level of impact.

Geologically, as the railway Line passes through the weak soil foundation with presence of unstable peat and organic sediments, the risk of tunnel collapse is very high. This also poses serious threats to ground-level structures. However, as the selected excavation method is

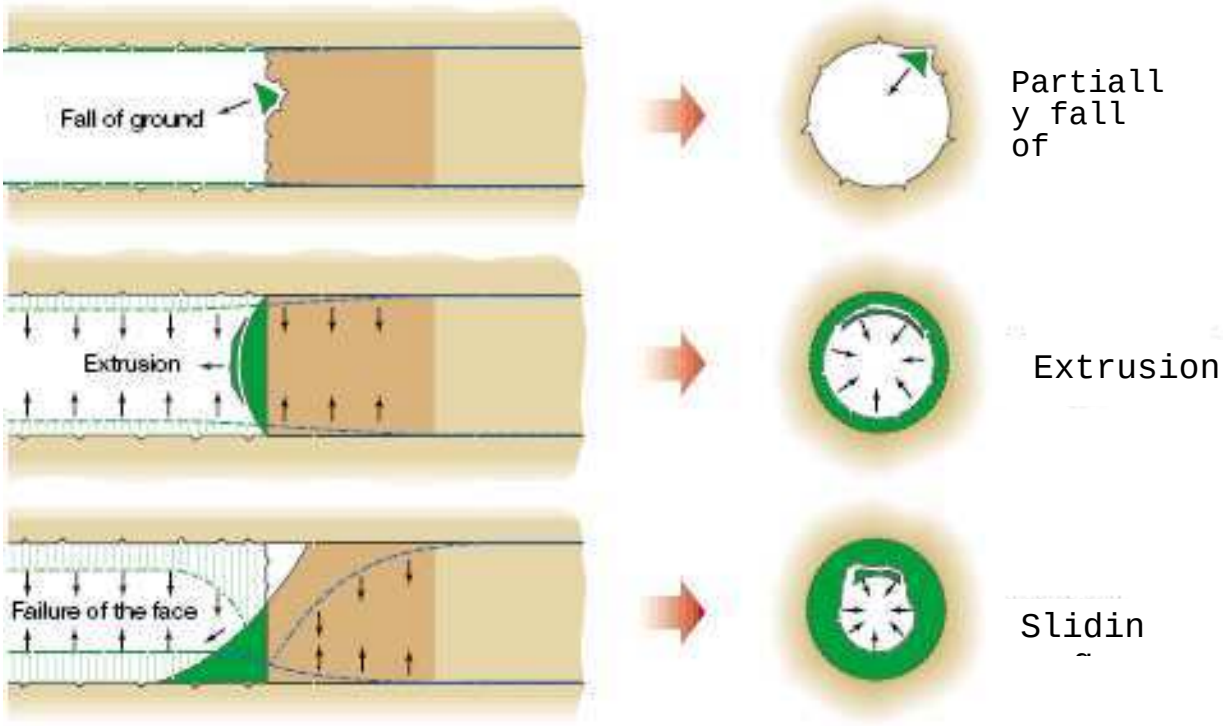
tunneling shield, the risks in excavation is minimized thanks to the followings:

- During excavation time, workers work in close chamber,

- Right after completion of each segment, the hole is immediately supported by pre-fabricated RC vault. These structures have sufficient strength to bear the load, and restrict percolation of water into the tunnel.

- Quick construction time.

The pictures under described the potential subsidence during excavation of deep tunnels:




### *3.3.2.4. Impact of water run-off (inundation)*

Inundation may exert adverse impacts on the urban railway project. According to statistics of Hanoi Meteorological Station, the annual rainfall in Hanoi is 1585,3 mm, which is relatively high as compared to the adjoining areas. The highest precipitation is 2247 mm (in 2001), the lowest precipitation is 1278 mm (in 2000). The water run-off has caused numerous adverse impact on the environment such as overloading the drainage system, flooding in some areas, particularly in low-lying areas likes Hanoi Railway Station, Ngo Sy Lien street where

serious floods occurs frequently in heavy rain. During contruction period, removal of drainage system may create partial flooding in the area when there is heavy rain, badly influencing travelling and activities of local people. Flooding, however, can be mitigated by providing pumping stations to pump water run-off into the City's combined sewer system.

#### *3.3.2.5. Impact of ground levelling, construction of yards, storages, worker camps*

- Obtruction of river flow will lead to the changes of water quality, risk of flooding in rain season, increase of suspended solid.

- Scattered earth materials swept by water into water bodies, increasing water turbidity in rivers, lakes along the Line.

- Vehicles transporting chemicals, petroleum passing through water courses may contaminate the water in case of incidents likes leakage, fire, explosion. v.v...

- The volume of chemicals, fuel contained in depot is the potential cause of water pollution due to accidential leaks, infiltration to the shallow groundwater table.

Water run-off may also sweep oil and grease leakage, and contaminate surface water courses around the depot.

#### *3.3.2.6. Impact of Waste Transportation*

Given the estimated project's waste amount of 33,650 tons (or 500.000 $m^3$ of earth materials with d = 0,673 $m^3$/tons), waste transportation and disposal will create bad impact in the environment. This waste amount is planned to be transported by 10 tons truck and disposed at Lam Du dump site, the number of truck trips is calculated at 3.365.

Currently, in Vietnam there is absence of standard data on air pollutants from traffic vehicles, thus the WHO's standards are proposed for quick identification of pollutant sources as per "air pollution coefficient". Load

of air pollutants due to transportation of materials and waste is presented in Table 3.6

**Table 3.6. Air Pollution Coefficient with diesel propelled trucks (3.5-6 tons)**

| **Unit(U)** | TSP (kg/U) | $SO_2$ (kg/U) | $NO_x$ (kg/U) | CO (kg/U) | VOC (kg/U) |
|---|---|---|---|---|---|
| 1000 km | 0,9 | 4,29S | 11,8 | 6,0 | 2,6 |
| *Sources: WHO* *Note: S – Concentration of sulphur in petroleum* | | | | | |

Given the truck's average travelling distance of 20km, the concentration of sulphur in petroleum is 3%. The air pollutant load by waste transport is calculated as follows:

| **Air Pollutants** | **TSP** | **$SO_2$** | **$NO_x$** | **CO** | **VOC** |
|---|---|---|---|---|---|
| Pollution load (kg) | 121,14 | 17,32 | 1588,28 | 807,6 | 349,96 |

### *3.3.2.7. Impact on Traffic*

As the traffic density in the project area is fairly high while roadway is narrow, construction activities will likely cause traffic congestion in roads crossing the rails and near project sites. In order to transport earth materials from tunnel excavation as well as construction materials needed, a large number of trucks shall be mobilized and concentrated in some road sections.

Operation of transportation vehicles and construction machines will impact significantly other means of transport likes buses, cars, motorbikes… during construction time especially in downtown routes.

Traffic operation shall also be affected by materials yards likes sand, stone, irons and other materials used for construction of tunnels.

These impacts are evaluated as major (during construction period). However, they are temporary, not serious and can be mitigated by appropriate organization

of traffic likes: transporting at the night time, traffic distribution during construction.

Tunnel excavation shall also generate other environmental impacts likes drains, sewers, pipes, in-ground power cables, disturbance to traffic, air pollution and noise by traffic means

#### *3.3.2.8. Impact on Ecosystem*

The project is sited in urban area, thus the ecosystem alongside line railway line is very poor, no precious species is found. Therefore, impacts on ecosystem is very minor.

#### *3.3.2.9. Impact by Workers Routines*

The project shall attract large number of migrant workers from other provinces. As they have no shelter in Hanoi, they will live in temporary camps provided by Contractors. In inflow of workers will affect the surroundings due to increased waste, domestic water. The average daily waste volume of 100 workers is estimated as follow::

*1. Daily domestic water of workers*

Domestic wastewater and solid waste generated by workers on Sites is the major cause of impact on the surrounding water quality. Domestic wastewater normally contains residuals, suspended solids, organic compound (BOD/COD), nutrients (N, P) and microorganism.

Most engineers and workers work on the construction sites only in the day time. At night, they return to shelters or camps in the City or in residential areas far away from the Sites. Only a few of them is assigned to stay for protecting the properties on sites. Night shifts (in any) are only in crucial period. As the results, daily water usage is reduced substantially, and the volume of domestic wastewater generated daily and its impacts on the surface water quality is minor accordingly.

According to statistical data, the volume of pollutants discharged daily per person in developing country is introduced in Table 3.7 below:

**Tabl 3.7. Pollutants in daily per head domestic wastewater**

| No. | Pollutants | Volume (g/person. day) |
|---|---|---|
| 1 | $BOD_5$ | 45-54 |
| 2 | COD (Dicromate) | 72-102 |
| 3 | Suspended solid (SS) | 70-145 |
| 4 | Oil and grease | 10-30 |
| 5 | Total N | 6-12 |
| 6 | Ammonia | 2,4-4,8 |
| 7 | Total P | 0,8 - 4,0 |
| 8 | Total Coliform (MPN/100ml) | $10^6$ – $10^9$ |

*Source: WHO - 1993*

If one worker use 100 litres of water per day, the total discharge volume by 100 workers will be 8 $m^3$ (about 80% of used water). The concentration of pollutants in domestic wastewater is introduced in Table 3.8.

**Table 3.8. Concentration of Pollutants in Domestic Water**

| **No** | **Pollutants** | **Pollutants Concentration (mg/l)** | | |
|---|---|---|---|---|
| | | No treatment | With septic tanks | TCVN 6772-2000 (Level IV) |
| 1 | $BOD_5$ | 450 – 540 | 150-200 | 50 |
| 2 | COD | 720 – 1020 | 275-400 | 100 |
| 3 | SS | 700 – 1450 | 250-525 | 100 |
| 4 | Oil, grease | 100 – 300 | 40-150 | 20 |
| 5 | Total P | 8 – 40 | 3,6-19,8 | 10 |
| 6 | Total (MPN/100ml) | $10^6$ – $10^8$ | $10^4$ | - |

*Source: Center for Environmental Protection in Transportation- 2006*

*Note*: TCVN 6772-2000: Quality of water-domestic wastewater. Permissible Limits

Comparing the contents of major pollutants in septic-tank treated wastewater with wastewater standards TCVN 6772-2000, Level IV) show that: domestic wastewater in prior to treatment has $BOD_5$ content exceeding the tolerable limits from 9 - 11 times, COD exceeds 7.2 - 10 times, SS exceeds 7 – 14.5 times. After being treated, pollutants in wastewater has reduced significantly.

Besides, untreated wastewater can be sources of epidemic diseases to local residents through the use of oil-contaminated aquatic products, contaminated water.

*2. Solid waste from daily activities*

Estimation has it that each worker on the Sites discharges 0.5 – 0.7 kg dometic waste per day. An amount of 50 - 70 kg/day contains 60 - 70% of organic matters, 30 - 40% of other substanes. This domestic waste in general contains much organic substances, easy to be decomposed (except for nylon bags, packages).

Waste accumulation creates environment and facilitate development of organims and vectors of diseases (mice, fly, mosquito, cockroach..), which pose the riks of pandemic for local communities.

Gases generated during decomposition of domestic waste creates bad smell ($H_2S$, $NH_4$) affecting daily routines of neaby communities.

Domestic collection and treatment system intergrated in worker camps normally fails to satisfy sanitation standards. This lead to indiscriminate littering part of the waste on roads, which ends up in surface water courses, soil, causing environmenta pollution around the camps and bad landcape, particualrly when the camps are sited in inner City, or near historical monuments or residential areas. Therefore, suitable waste bins shall be supplied to camps, and daily collection is needed.

A large number of rural workers migrating from vicinities to the City to work for the project might compete for the job on Sites, creating social disorder. In adition, unhealth services may be developed, which may lead to the increase of social evils in the area.

*3. Transmission of epidemic diseases from residential to workers and vice versa*

On construction sites, water-born diseases (diarrhoe, dysentery, cholera, typhoid..) migh occur. Therefore, badly hygienic condition in worker camps and frequent contacts between workers and local residents may facilitate transmission of epidemic dieases form workers to local residents or vice versa in cases pandemic happens. This is quite popular in developing countries. Precausion of pandemic is of greate importance on the constructino sites.

### *3.3.2.10. Impacts to groundwater environment during construction periods*

Bridge construction techniques includes bored piling, which likely create percolation of surface water into groundwater table during bored pile driving process.

Bored pile: Bored pilling technique is more complicated and there is possibility of surface water infiltration into groundwater table through water spring in bored piles.

The most important step in bored pile construction is to create the hole position by drilling holes to attain greater diameter than that of piles. In weak soil foundation, fluid and admixtures shall be supplied for sealing and surfacing, this also help to reduce infiltration of surface water into groundwater table. Another method is to place the steel pipes during drilling. When concrete has not been placed for pile, surface water and groundwater almost circulates and infiltration occurs. The next step is sealing of pile bottom, puting reinforced, stone and concrete placing. At this stage, some groundwater springs will be sealed by conceret grout or get contaminated by plastic admixture in cement grout when concrete has not become hard.

For the underground section (from Kim Ma to Hanoi Railway Station), excavation at designed depth of 20m will affected the area's shallow groundwater table at 8-10m.

The impacts on shallow groundwater is most significant. This impact is indispensable during construction of bored pile for foundation and pier construction. However, the supply groundwater source for Hanoi is extract at dept 5-70m so excavatin activity has no influence on this groundwater table.

#### *3.3.2.11. Impact on urban landscapes*

Construction of the elevated urban railway line might badly influence the urban landscapes. Since the line start from Nhon to Hanoi Railway Station with total length of 12.5 km, the project site also stretches from highly urbanized area (inner City) to less urbanized zones (suburban area). The elevated railway is about 9.6km and underground 2.9 km. Thus, design of the railway line shall match to the current urban landscaping. Upon completion, however, the general landscape will be much improved.

#### *3.3.2.12. Impact on Businesses*

During construction period, shops alongside the line as well as in affected areas might be influenced due to reduction of customers and turnover eventually. This influence is, however, just minor. Upon construction and operation of the line, the businesses at Stations and along the entire lines will likely be better thank to the increased passengers.

### 3.3.3. Impact during Operation

#### *3.3.3.1. Impact on Air Quality*

The Metro trains are mostly electric propelled, thus minor impact on the air environment is anticipated. The principaly source of air pollutants is from activities at passenger stations. Transport means shall still generate a significant volume of exhaust composed of particles, SOx,

NOx, HC... The pollutant load depends on flow, technical status of vehicles and road condition.

The Vietnam's ambient air quality standards: TCVN 5937 - 2005 will be referred for projection of air quality and pollution level. Pollution coefficients of cars, heavy-good trucks, motorbikes will be used for calculation.

In general, when the railway line is put into operation, the air quality along the line in particular and in the City in general will be improved.

#### *3.3.3.2. Impact on Noise, Vibration*

Fairly high noise and vibration will be created from train operation, particularly at night. During opertion time, noise from engine and friction of Metro wheels and tracks is rather high in elevated tracks. Regarding the underground from Swedish Ambassy to Hanoi Station, noise is minor, but vibration is considerable as the Metro runs. Residental areas, some recreational places, structures (schools, hospitals..) from Nhon ti Swedish Ambassy will be affected by noise. Residential houses, hotels and offices along the line from Swedish to Hanoi gas Station might suffer from vibrtion.

**Table 3.9. Sensitive Places affected by Noise and Vibration**

| No | Affected Groups | Major Impact |
|---|---|---|
| 1 | Cau Dien residential area, along Cau Giay, Kim Ma, National Road 32 | Noise |
| 2 | University of Commerce, National University, University of Communication and Transport Teacher Training University, Hanoi Industrial College | Noise |
| 3 | Diplomatic Corps | Noise |
| 4 | Residential houses and offices | Vibration |

| | | |
|---|---|---|
| | along Nui Truc, Cat Linh, Ngo Sy Lien | |
| 5 | Van Mieu Quoc Tu Giam | Vibration |

Noise and vibration shall be restricted to a level that is lower than TCVN

#### *3.3.3.3. Impact by Operation of Transformer Station*

In the whole line are 10 transformer stations and 1 power station at Depot. Operation of these power structures shall create noise and magnetic field affecting local communinity health.

#### *3.3.3.4. Movement of Groundwater springs*

The changes of groundwater springs may affect the surroundings due to groundwater depletion, destruction of vulnerable ecosystem, and increased risk of land settlement. The underground parts of the project is limited, but may still obstruct the movement of groundwater course. However, as the tunnel area's vicinities are highly urbanized, no vulnerable ecosystem of national or regional significance is found.

Mitigative measures shall includes:

- Considering protective measures for groundwater courses during designing period,
- Use of methods to prevent land settlement as introduced in " land subsidence " part
- Monitoring of groundwater talble.

#### *3.3.3.5. Impact by Waste and Wastewater discharged from Stations*

A large number of passengers are anticipated to use the elevated Railway in the near future. This will create huge volume of refuses and wastewater from Stations which may contaminate the surrounding environment if no appropriate treatment measures are taken.

**Table 3.10. Waste and Wastewater discharge by Passengers**

| NO | Year | Number of passengers (person/day) | Projected wastewater volume ($m^3$) | Projected waste volume (kg) |
|---|---|---|---|---|
| 1 | 2010 | 92.000 | 690 | 27.600 |
| 2 | 2020 | 202.000 | 1.515 | 60.600 |
| 3 | 2030 | 268.000 | 2.010 | 80.400 |

*Notes:*

* Base for waste calculation: 75% of passengers uses toilet, with 0.01$m^3$ of excrement per head.

** Estimated waste: 0.3kg/1ng-êi

At Depot Station, industrial wastes and effluent containing oil, grease comes from following sources: washing of coaches's outer part, washing of inside accessories, wastewater from dining room, administrative building, training center.. The volume of industrial effluent is estimated at 72$m^3$/day, domestic wastewater is 65.66$m^3$/day. However, if this amount of waste and wastewater is collected for treatment, potential risks can be avoided.

## 3.4. Assessment of EIA methods

### 3.4.1. Statistical Method

This method is aimed at collecting and screening of data relating to project implementation in order to provide initial evaluation of project's potential impacts on the environment. This is a traditional method, with high reliability as the evaluators must have field survey and research of associated documents to produce the preliminary evaluation, facilitating the later assessment of impacts.

### 3.4.2. Environmental Matrix Method

Based on the initial assessment, the evaluators will summarize all issues pertaining to the project and possible environmental impacts to produce a simple matrix. Normally, the horizontal axis lists all project activities; the vertical axis presents environmental components. The activity causing environmental impact will be marked in corresponding square. The matrix will show all environmental factors that is affected by specific project activities to make the assessment logic and sufficient. However, this method does not highlight the impact level, whether they are negative or positive.

### 3.4.3. Checklist Method

The method allows for identification of project's different impact levels on the natural, social environment. The checklist method is clear, easy to understand, a reliable basis for making decision.

However, this method also contains subjective assessment of the evaluators. Thus, when using this method, evaluators has consulted environmental specialists to produce the most objective evaluations to make it more reliable.

### 3.4.4. Modeling Method

This method is used to evaluate the movement of contaminants, level of pollution, and then make quantitative assessment of parameter value. Currently, this method is used commonly in EIA. The quantitative calculation results are very necessary for assessment. However, in order to produce high accuracy, numerous input data is needed, which can not be met in the current Vietnam's condition. As the results, an average coefficient must be used for all traffic vehicles, so accuracy of the output is very high. Therefore, in order to make reliable assessment, the evaluators have combined various methods.

### 3.4.5. Public Consultation Method

With this method, the evaluators have collected numerous field data from various levels such as: project affected people, project beneficiaries and local authorities. This method is effective, highly feasible, but time consuming, costly and may slow down the project progress.

# Chapter 4
# Mitigation measures for adverse impacts
# Precaution and response to environmental mishap

## 4.1. Mitigation of Adverse environmental impacts

### 4.1.1. Pre-construction Stage

#### 4.1.1.1. Disemination of Information to the Public

Information pertaining to the project shall be announced to administrative units to miminize the negative environmental impacts and raise the public awareness on environmental protection. This shall be done by the Project Management Unit (PMU) in cooperation with other agencies likes nearby schools, universities, office staff, mass media, Women Association, Youth Union, NGOs. Particularly, this shall be assisted by traffic police departments in rush hours at locations near the project sites.

In addition, awareness raising programs on the project environmental impacts shall be conducted for site engineers and workers to ensure sanitation and labour safety. Leaders of nearby districts, wards shall be introduced about the project and its impacts on the environment to enhace awareness.

#### 4.1.1.2. Mitigation Measures during Site Clearance and Resettlement

The project progress depends much on the progress of site clearance. If site clearance is quick, the project will be started early. Delay in site cleance will prolong the project implementation time. However, site clearance relates directly to compensation of land, houses and crops for affected households alongside the railway line, and stabilize the life of those removed. The experience in conducting appraisal and compensation show that this is a very difficult and complicated task which may create social problems. Therefore, following measures are

proposed for implemenattion to keep the site clearance on progress and start construction of the project early.

- Inform the project scope, specifications, construction progress, site clearance and resettlement to relevant agencies and levels.
- Announce the Decrees and compensation policies to removed households.
- Establish Site Clearance Committee in districts, towns. Training on the procedures for compensation listings and appraisal.
- Give priority, means and financial support for the poor, policy families, families with war-martyrs,
- Meet with leaders of local authorities, residential groups, project affected people, and disseminate necessary information relating to the project, compensation policies, guiding procedures….
- Survey the current living environment (impacts on the social infrastructures), activities to create income for the project affected people, then propose of new resettlement area.
- Design assistance programs to affected peoples such as vocation training and issue of business silences for operation in the new resettlement areas.
- Local authorities and project investor shall agree on the resettlement an option which is suitable to the wishes of people. Allowance, resettlement land, shelters shall be provided to stabilize the lives of displaced people in prior to construction.

Site clearance and compensation will be implemented in compliance with current regulations of State and City. Resettlement will be of two types: concentrated and dispersed.

The project-affected households includes: small-sized businesses, farming households and state officials.

Compensated households will be classified according to Decree 197/2004/ND-CP dated 3/12/2004.

**1) *Compensation Options***

*a) Land compensation:*

- **Farming land**

According to Article 4 of Decree 197/2004/ND-CP dated 3/12/2004, as the free agricultural land reserve is unavailable, agricultural land in Hanoi reclaimed by the State will be compensated in money at rate prescribed by the People's Committee.

As per Decision 26/2005/Q§-UB dated 18/02/2005 of the Hanoi People's Committee promugating on "Regulations on compensation, allowance and resettlement" to implement the Decree 197/2004 /N§-CP dated 3/12/2004 of the Prime Minister for land acquisition in Hanoi by the State.

- **Non-farming land**

According to Article 3 Decree 197/2004/N§-CP dated 3/12/2004 of the Government and Item 5 Circular 116/2004/TT-BTC dated 7/12/2004 of the Ministry of Finance, residential land will be compensated in money according to the land value at each area, location announced annually by the Hanoi People's Committee.

*b) House Compensation*

According to Article 19 of Decree 197/2004/N§-CP dated 3/12/2004 of the Government and Item 02 of Circular 116/2004/TT-BTC dated 7/12/2004 of the Ministry of Finance.

The basis for house compensation is house grade and construction unit price promulgated by the Hanoi People's Committee.

Regarding the legal houses, Grade IV and temporary houses will be compensated as per construction unit price.

Illegal houses are not compensated but considered for subsidy only.

Regarding other legal structures: compensated as per current structure status and unit price prescribed by the People' Committee.

*c) Allowance for Dismantle and Removal*

According to article 19 of Decree 197/2004/N§-CP dated 3/12/2004 of the Government and Item 2 of Circular 116/2004/TT-BTC dated 7/12/2004 of the Ministry of Finance.

Land, house owner will be given an allowance of 3,000,000 VND each time when removing within Hanoi City.

In case of removal to provinces other than to a prescribed resettlement area in the City, the land/house owner will receive relocation allowance of 5,000,000 VND/ household.

For resettled households having not yet received houses/land, or households which do not have to removed, but have house partially or wholly encroached by the project, affecting the structure and necessitating house demolishing or temporary removing, the temporary rent allowance provided will be 250,000 VND/roster/month; 500,000 VND/single roster/months, but not exceeding 1,500,000 VND/household/month.

*d) Compensation of plant and croas*

Based on the actual number of plant and crops listed, the Hanoi Tram and Public Transport Development Management Unit will make compensation plan for plant and crops of specific types according to Document 2144/UB-NN§C dated 27/2/2005 of the Hanoi People’s Commmittee regarding the compensation policy for plants and crops during land accquisition by the State; and Notice No. 1931/TB-STC dated 10/6/2005 of the Department Finance notifying the compensation rate of plant and crops in serve for site clearance.

At the area intended for construction of Depot, the principal plants are perenial fruit trees and flower, which will be compensated based on expense for initial investment expense, care taking to the land accquisition time; and the current status of the trees.

In the areas along the line, vegetation cover comprises mainly of shade trees on street sides and median. Compensation will be made according to Notice No. 1931/TB-STC dated 10/6/2005 of the department Finance.

*e) Other allowance:*

- Subsistence allowance for stabilizing lives and production: based on Article 20 of Decree 197/2004/N§-CP dated 3/12/2004 of the Government, households directly involving in agricultural production is to receive subsistence alllowance of 35,000 VND/$m^3$ for reclaimed land.

- Allowance for employment alternation and creation: based on Article 20 of Decree 197/2004/N§-CP dated 3/12/2004 of the Government, when removing, households and individuals directly involving in agricultural production in suburban areas and new wards established after 1997 will be entitled to employment alternation allowance of 25.000®/$m^2$

- Allowance for removal of power, water, telephone will be prescribed by competent agencies belonging to Hanoi People's Committee

- Removal of power, telephone system and in-ground structures: specific removal plans shall be made for each componets in prior to removal.

*f) Bonus for site handover:*

Bonus for handover of site: based on Article 23 Decree 197/2004/N§-CP dated 3/12/2004 of the Government.

Regarding owner of agricultural land: if the reclaimed land is timely handed over to the Compensation Committee, the land owner will enjoy bonus of 3,000 VND/$m^2$.

For households whose land is reclaimed and house destroyed, if the owner actively comply with the removal plan prescribed by Compensation Committee, the bonus for timely site hand-over and relocation will be 3,000,000 VND/owner; if site hand-over of 15 days in prior, bonus

will be 4,000,000 VND/owner, if site hand-over of 16 days in prior; bonus will be 5,000,000 VND VND/owner.

*g) Resettlement*

*** Land Resettlement:**

Applicable for households within the area of Depot and along the railway line in Tu Liem district, the relocation of entire affected households is proposed to the resettlement area in Minh Khai and Phu Dien commune, which belongs to the National Road 32 Expansion project (as per Official Letter No. 564/UB-§CN§&§T dated 11/8/2004 of Tu Liem People's Committee).

*** House resettlement:**

Applicable for affected households alongside the Line in City inner districts. Based on the current house area, the Hanoi Tram and Public Transport Development Mangement Unit, in cooperation with Land Reserve Development Center, People's Committee of districts to arrange resettlement houses using Housing fund of the districts as per Decision 80/2005/Q§-UB dated 03/6/2005 of Hanoi People Committee promulgating on the unit price of flats in living quarter used for resettlement in case of State accquisition of land for defense, national security, public benefits in Hanoi City.

**2) Compensation and Resettlement Plan**

- Survey, measurement and data synthesis.
- Project investor report to the Municipal People's Committee to make decision on population arrangement and land accquisition after the Chief Achirtecture Office agree on the construction location.
- Establishment of Compensation Committee,
- Planning and got approval of compensation policy applicable for various target groups.
- Make and approve compensation expense.
- Announcement of land acquisition.
- Consultation with households.
- Compensation payment for land owners.

- Procedures for purchase of resettlement houses.

The impact of resettlement is inevitable. Considering the new living environment facing those removed, priority in selecting resettlement area shall be given to project affected households.

However, the impacts shall be brought to the minimum by the following methods:

- Minimize the number of affected households by selecting the line with least site clearance.

- Informing the local Compensation Committees at resettlement area on project stages by providing information relating to the project, organizing meeting with consultants and reach consensus on resettlement areas.

**3) Estimated compensation: 187.897.200.000§**

**Table 4.1. Site Clearance Expense**

| No | Site Clearance Areas | Unit | Amount |
|---|---|---|---|
| **I** | **Depot and approach road** | VND | **63,000,000,000** |
| 1 | Depot + planned approach road, South of Depot | VND | 46,593,633,640 |
| 2 | Approach road to Depot | VND | 16,397,707,680 |
| **II** | **Site Clearance along the railway line** | VND | **124,897,200,000** |
| **1** | **Power Stations along the line (10 stations)** | VND | **30,252,000,000** |
| | Tu Liem district (4 station)<br>Station 2,3: 2 x3.750.000vnd/$m^2$x150$m^2$<br>Station 5: 4.500.000vnd/$m^2$ x 150$m^2$<br>Station 6: 11.000.000vnd/$m^2$x | VND | 1,125,000,000<br>675,000,000<br>1,650,000,000 |

| | | | |
|---|---|---|---|
| | 150m$^2$ | | |
| | Cau Giay district (2 stations)<br>Station 8,10: 22.000.000vnd/m$^2$ x 150m$^2$ | VND | 3,300,000,000 |
| | Ba Dinh district (1station)<br>Station 11: 35.000.000vnd/m$^2$ x 150m$^2$ | VND | 5,250,000,000 |
| | Dong Da district (2 stations)<br>Station 13,14:<br>2x35.000.000vnd/m$^2$ x 150m$^2$ | VND | 10,500,000,000 |
| | Hoan Kiem district (1 station)<br>Ga 15: 45.000.000vnd/m$^2$ x 150m$^2$ | VND | 7,750,000,000 |
| **2** | **Stations** | VND | **92,100,000,000** |
| | Tu Liem district (6 Stations)<br>Station 1-4: 4 x3.750.000®/m$^2$x600m$^2$<br>Station 5: 4.500.000vnd/m$^2$ x 600m$^2$<br>Station 6: 11.000.000vnd/m$^2$x 600m$^2$ | VND | 9,000,000,000<br>2,700,000,000<br>6,600,000,000 |
| | Cau Giay district (4 Station)<br>Station 7-10:<br>4x22.000.000vnd/m$^2$ x 600m$^2$ | VND | 52,800,000,000 |
| | Ba Dinh district (2 Stations)<br>Station 11: 35. 000.000vnd/m$^2$ x 600m$^2$ | VND | 21,000,000,000 |
| **C** | **Removal of households along the line (140 households)**<br>Removal allowance:<br>3,000,000vnd/household x 140<br>Hand-over Bonus:<br>5,000,000vnd/households x 140 | VND | **2,545,200,000**<br>420,000,000<br>700,000,000<br>1,260,000,000<br>165,200,000 |

| | | | |
|---|---|---|---|
| | Allowance for temporary rent:<br>6x 1,500,000vnd/household x140<br>Removal of power, telephone, water structures<br>1.180.000®/hé x 140 | | |

*** Removal of Ground-level and In-ground structures**

Any affected public structures shall be recovered or rebuilt.

*Regarding in-ground structures*:

- The power, communication, water supply, drainage system along the railway line will be removed to utility tunnels along the roads. The PMU will coordinate with line agency to make removal plans.

- The power, communication, water supply, drianage system intersecting the railway line: at each specific intersecting point, there shall be specific removal option. The PMU will operate with line agency to make proper removal plan.

*Regarding ground-level structures*:

- For vegetation cover, power, lights, communication, structures alongside the line and crossing the line, the PMU will coordinate with line agencies to design temporary removal options during construction period and recover upon completion.

**Table 4.2. Estimation of Removal Cost: 126.823.230.000 ®**

| No | Items | Unit | Amount |
|---|---|---|---|
| 1 | In-ground structures (tentative) | VND | 80,000,000,000 |
| 2 | Ground-level structures (tentative) | VND | 40,000,000,000 |

| | | | |
|---|---|---|---|
| 3 | Relevant structure | VND | 6,823,230,000 |
| | Toseccco Stair: 30m$^2$ x 694,000®/m$^2$ | VND | 20,820,000 |
| | - Ministry of Health<br>Construction of building<br>Bulding B4: 80 x 4x 2,130,000 ®/m$^2$<br>Building B3 : 670 x 3 x 1,735,000 ®/m$^2$<br>Building B1: 250 x 990,000 ®/m$^2$<br>Yard, Garden: 2000 m$^2$ x 72,000 ®/m$^2$<br>Fence: 100m x 435,000m$^2$<br>Rental subsidy<br>6 month x 2500m$^2$x100.000 vnd/m$^2$-month | VND | 681,600,000<br>3,487,350,000<br>247,500,000<br>72,000,000<br>144,000,000<br>43,500,000<br>1,500,000,000 |
| | - Corner of Giang Vo-Cat Linh<br>House compensation: 2x 160m$^2$ x 1,735,000®/m$^2$<br>Rent subsidy: 6t x 7 x 1,500,000 ®/h<br>Allowance for installation of power, telephone, water | VND | 555,200,000<br>63,000,000<br>8,260,000 |

### 4.1.2. Mitigation Measures during Construction Stage

#### 4.1.2.1. Construction Options and Arrangement of Worker Camps

- Construction and transportation will be by sequential method, which facilitate recovery of the scape

for traffic upon completion of each packages, components, sections.

- Large stockpiles of materials are not allowed in roadway.

- Make full use of local workforces for construction.

- Provide mobile toilets along the construction sites.

- Coordinate with URENCO in domestic wastes collection and street cleaning, daily sprinkle in routes where extensive truck traveling is observed.

- Cooperate tightly with traffic police force of districts, wards along the railway line to properly direct the traffic, reduce traffic jam.

- Announce the selected traffic distribution scheme in mass media.

- In order to minimize refuses and wastewater generated from worker camps, the project investor shall cooperate with a sanitation company to place mobile sanitation works, to collect discharged waste and wastewater from worker camps for treatment in prescribed site.

#### *4.1.2.2. Mitigation of Air, Noise and Vibration Pollution*

Air pollutants and particles constitutes the major source of pollution during the construction time. The principal cause of air pollution is vehicles transporting materials, particularly large volume of surplus earth materials from tunnel excavation. The following methods shall be applied:

- Reduction of particles during construction: dust shall be minimized by sprinkle (average 4-5 times per day) in dry days, or days with low humidity and strong wind, adopt sequential construction method with full completion of each component, section for immediate site clearing and cleaning; erect 3m- high peripheral fences by plywood or corrugated iron around the construction site to minimize dispersion of dust to the surroundings; construction

activities shall be properly managed and supervised. Transportation vehicles shall be carefully covered.

- Daily cleaning of the construction site, particularly at the entrance to minimize solid waste and construction materials to be scattered and blown by wind to create particles. Sanitation teams shall be set up at construction sites.

- Excavation and transportation scheme shall be well designed, transportation routes and vehicles selected properly.

- Regarding construction of sewers, sludge dredging: tank trucks shall be used for transportation of dredged sludge to avoid seepages of sludge into road, obstructing the traffic. On the routes for transportation of dredged sludge, sediments; spraying shall be applied, and road cleaned regularly or as per transportation schedule. Dredging and transportation during rush hours shall not be allowed.

- Sepration of routes for transporting earth materials, specify the hours for transportation of sand and soil, minimize the particles in these routes by water spraying every 02 hours for dust minimization.

- The project investor shall cooperate with Hanoi URENCO to conduct water spraying on contruction sites, and routes used for transportation of earth materials.

- Install temporary noise and dust barrier around the construction sites to protect vulnerable areas like schools, historical relics, residential areas.

- Machines creating great noise and vibration likes drillers, rollers, excavators shall be permitted to operate in the daytime only, operation from midnight to 5h00 am shall be restricted. If night working is needed to keep the project schedule, there must be acceptance of district or ward authorities.

- Do not used obsolete machines since they create great noise.

-Regularly maintain noise insulators of machines like drillers, excavators, roller, bulldozer.

-Pile driving for construction of bridge overpass which create great noise shall be allowed in the daytime. Working from 10h00 pm to 5h00 am is not allowed.

Locations which necessitate application of noise minimization methods includes Hanoi Industrial University, Trade University, Hanoi National University, Univeristy of Communication and Transport, Van Mieu, residential areas along Xuan Thuy, Kim Ma, Nui Truc, Hanoi Railway Station (deep tunnel- Km 12+000 - Km 12+500)

#### *4.1.2.3. Mitigation of Wastewater Impact*

-Construct temporary drains to take wastewater out of the construction sites, or excavate water sumps and settling tanks.

-Use of mobile sanitation work for collection and treatment of domestic wastewater on site.

-Keep the households surrounding the project sites be infomed of temporary drains to prevent discharge of domestic wastewater into demolished sewers.

- During construction time, surface water bodies (rivers, lakes near the construction site) shall face risk of pollution due to activities likes excavation, filling, bridge construction.. The major source of pollution including materials, oil and grease released from construction machines might follow water run-off and pollute surface water course. The main mitigation measures is to promote sanitation practices on site, covering material stockpiles, dump sites, chemical storages, depot to prevent run-off overflow.

#### 4.1.2.4. Measures for Landfilling and Treatment of Domestic and Construction Waste

Solid waste generated during construction period comprises mainly of debris, cements, waste equipment packages, domestic waste by workers. This solid waste amount shall be collected, transported to prscribed place as agreed with local authorities.

Solid wastes generated may badly influenced surface water, groundwater, soil and air environment, landuse and urban landscapes. The proposed mitigative measures comprises: collection of worker's domestic wastes, well management of wastewater to prevent indiscriminate discharge to the surroundings; management and collection of construction waste for disposal at prescribed places, removing temporary camps, equipment, waste woods, surplus materials, fence to prescribed sites upon completion.

The PMU shall coordinate with puclic environmental serive company to collect for landfilling of all wastes generted from the project.

#### *4.1.2.5. Measures for Traffic jam Minimization*

Prepare the traffic mitigation plan for construction sites, roads that is encroached or closed for construction, such as calculating the number of vehicles mobilized for construction activities.

Comply with the time specified for vehicles joining construction activities.

Install signals to guide the traffic and alert normal vehicles from entering the construction sites. Arrange of favorable by-pass roads for pedestrians

Make a good construction plan to minimize the area, duration of road blocking, as well as density of construction machines on Sites.

Announce the construction schedule in mass media to keep the general public informed of construction time and location.

In tunnel section constructed by cut & cover methods, pre-cast concrete slabs shall be used to allow for traffic circulation on the surface.

Informing road blocking by signals and media announcement.

Identifying the roads to be blocked for construction to avoid access of normal traffic to the construction sites.

Arrange personnel for traffic distribution direction.

#### *4.1.2.6. Mitigation of Flooding*

- Construct reinforced concrete retaining wall (underground) in the area of Stations. The retaining wall serves for obstructing soil during excavation. The retaining wall shall be of sufficient strength to resist the ground pressure, water-proofing and prevent subsidence of nearby structures

- For Station applying cut & cover construction methods, in order to prevent subsidence of the station, the bearing capacity of soil foundation shall be checked in prior to installation of the concrete cover. The soil bearing capacity shall be sufficient to resist total load of the Station.

- *Water Supply for the Tunnel:*

- Shallow underground Station: connect to the City's water supply system at the point near the underground station. Water pipes run along the stairs (installation shall be during stair construction), or utility box to distribute to different areas of the Station: air conditioning, toilets, fire extingusher.

- Deep underground Stationconnect to the City's water supply system at the point near the underground station. Water pipes run along the stairs (installation shall be during stair construction), or utility box to distribute to different areas of the Station: air conditioning, toilets, fire extingusher.

- *Drainage for the tunnel:*

- During tunnel operation, water can be generated from possible leakage, tunnel wash water, water run-off from entrance. Therefore, there shall be gutters along the tunnels with the same gradient as tunnels. Water sumps shall be provided at 200m interval. Pumps shall be placed in these sumps.

- At the connecting point of the tunnel portal to the elevated Railway, in rainy season, great volume of water run-off (200 mm/day) will flow into the tunnel. In order

to minimize this, roof structure is proposed to cover the tunnel portal, the roof height is 0.5m from the ground level. Besides, manholes are arranged at the lowest point inside the tunnel with great capacity pumps (100$m^3$/h). At underground Stations, pumps are also placed at lowest points, the number of pumps are 02 for each station with capacity of 60$m^3$/hour for timely pumping water ouside.

#### *4.1.2.7. Measures for prevention of penetration in underground structures*

Prevention of tunnel infiltration shall be conducted during contruction of tunnel shield to ensure that surface and groundwater can not seep into the tunnel.

Infiltration prevention can be applied for underground structures as follow:

+ Between the two tunnel membranes: impermeable liners (Hydroswelling Sealing Strip), double membrane, 01 layer of systhetic plastics and 01 layer of geotechnical textile.

+ Pre-fabricated panels: precast panels produced in compliant to a strict technical process from materials, structuring, curing (soaking). Super plastic admixtures are also used in shortconcrete grouting for water-proofing of underground work

+ At the joints of shield: use of rubber bands or special use plastics to seal the gaps between slabs (the slabs shall be calculated in the design stage to ensure minimum gaps and tightness).

Specific infiltration prevention measures will be detailed in technical design stage.

### 4.1.3. Mitigation during Operation Stage

#### *4.1.3.1. Mitigation of Noise Pollution*

-Well maintenance of locomotives, metro and tracks system will be an effective method to reduce air contaminants and vibration of the metro train during operation.

-In concrete or steel bridges, noise and vibration

insulation measures shall be applied by installing concrete noise barrier along the bridge, use of madacam courses (1x2cm) under the concrete ties, at the same time welding of tracks to reduce vibration caused by joints

- Construction of noise barriers on bridge shall be based on noise monitoring results conducted during operation stage, or projection in sensitive areas (residential areas, hospitals, schools)

- Recover the destroyed vegetation cover. In residential area, trees shall be planted along the streets for reducing noise and filtering particles, trees interval being 6 - 8 m.

- Regularly examine dust and noise, carry out sufficiently the environmental monitoring program as stated in the EIA-study.

**Table 4.3: Locations for Installing Noise Barrier**

| Location | Length of wall |
|---|---|
| Hanoi Industrial University | 20m |
| Trade Univeristy | 20m |
| Hanoi National University | 50m |
| University of Communication adn Transport | 20m |
| Diplomatic Corps | 400m |

### *4.1.3.2. Mitigation of Wastewater and Refuses fro Station*

When the project is put into operation, there will be large volume of waste, wastewater discharged by passengers from metro and at Station. Thus, the following measures shall be applied:

- Waste, wastewater collection and treatment, public awareness raising on environmental protection, installation of waste bins in metro trains and stations.

- Detail survey of the waste and wastewater discharged in Stations in different condition during

design period.

-At each Station, public toilets and waste bins shall be installed.

-Design of the wastewater pipes at lower position than water supply pipes

-Work with local workers on the possibility on waste collection for proper treatment.

## 4.2. Mitigation of environmental mishap

The following risks are anticipated during project construction and operation stage:

-Risks during construction: settlement, flooding

-Risks during operation: fire, explosion inside the tunnels, traffic accidents.

### 4.2.1. Mitigation Measures for Subsidence

-After completion of each segment, tunnel shield shall be intalled immediately. Shield is RC slabs, installed immediately after completion of each segment by boring machine to prevent collape of tunnel roof and wall. Groupting is then thorugh holes in shield in high pressures to fill slurry into the gaps between shield and soil. The inner shide of shield is linned by a 20cm thick linning layers.

-Land subsidence depend on the geological characteristics of the area. Thus the proposed measures is as follows:

- Use of impermeable retaining wall.
- Temporary support structures installed at proper time.
- Select and restrict injection of materials during bottom strengthening and take into account the impact on groundwater.

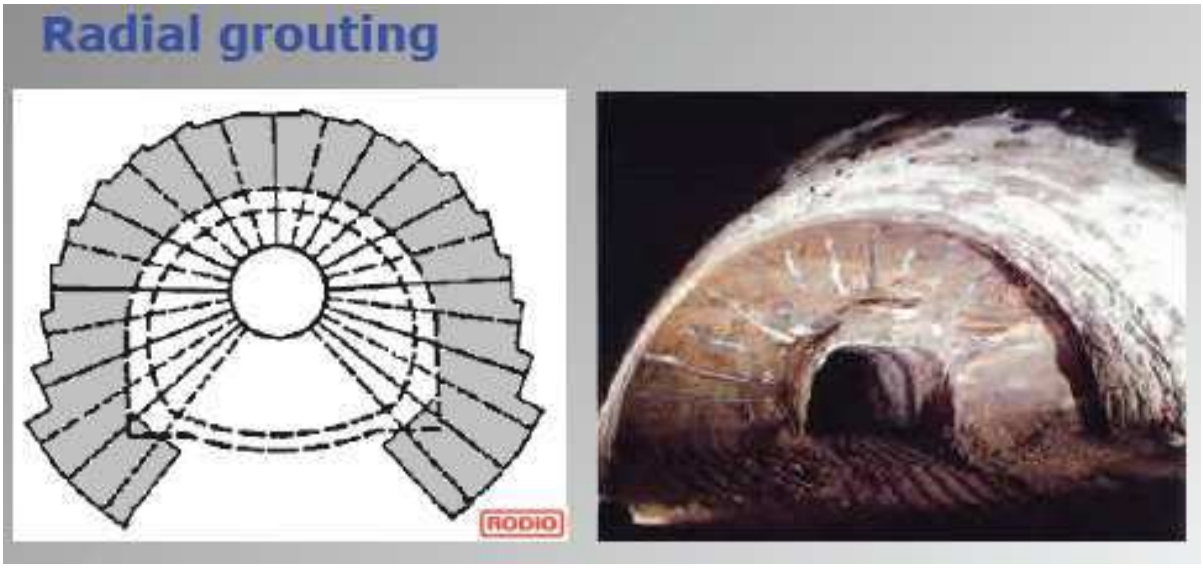
**Mitigation Measures due to settlement of tunnel construction area**

The settlement scope is normally different depending on the area geological setting. Therefore, mitigation measures shall include monitoring to identify level of impact.

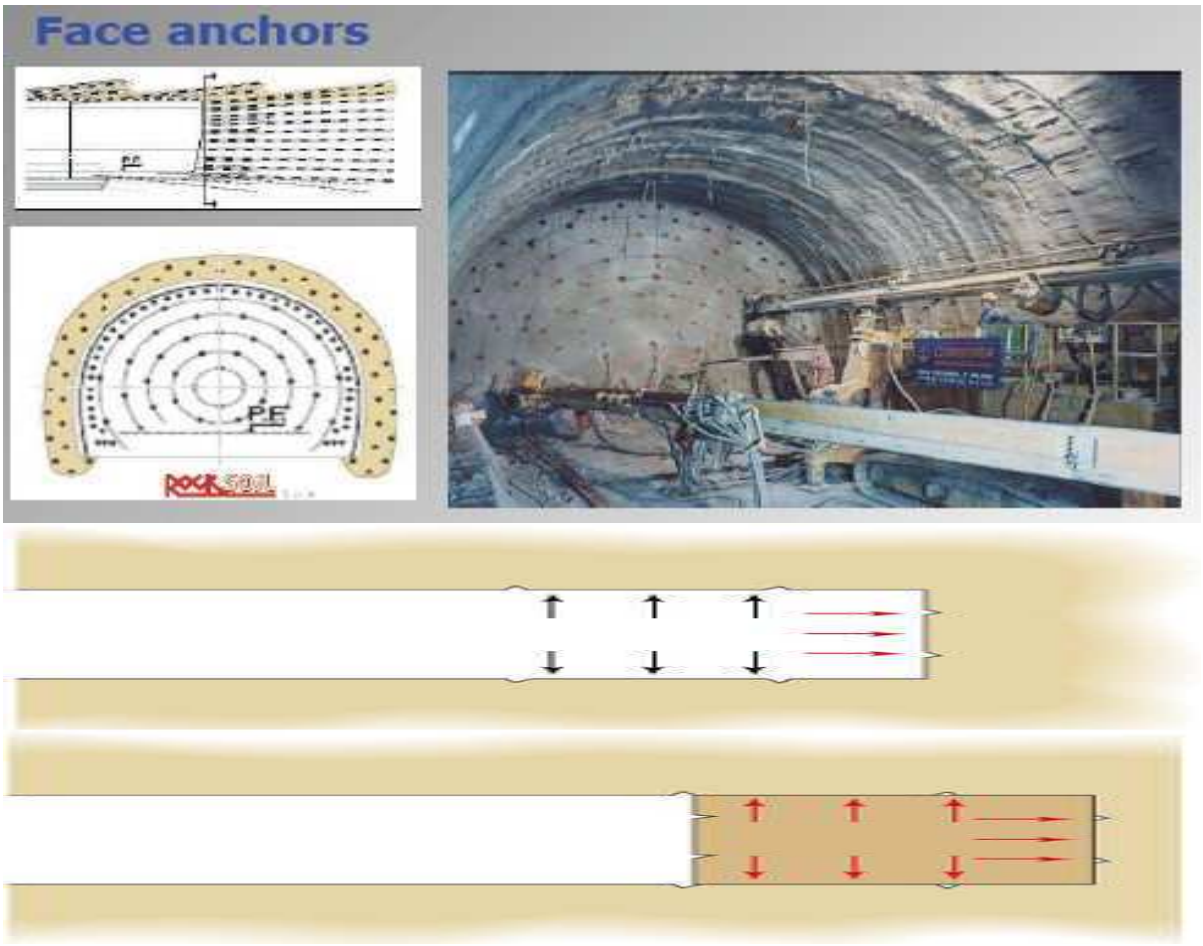
- Use of impermeable canvas to cover the wall (likes diaphragm wall).
- Use of temporary support beams at proper time.
- Select and restrict the use of admixtures for sealing the surrounding, recommending its impact on groundwater quality.

Below are methods for handling land subsidence during tunnel contruction:

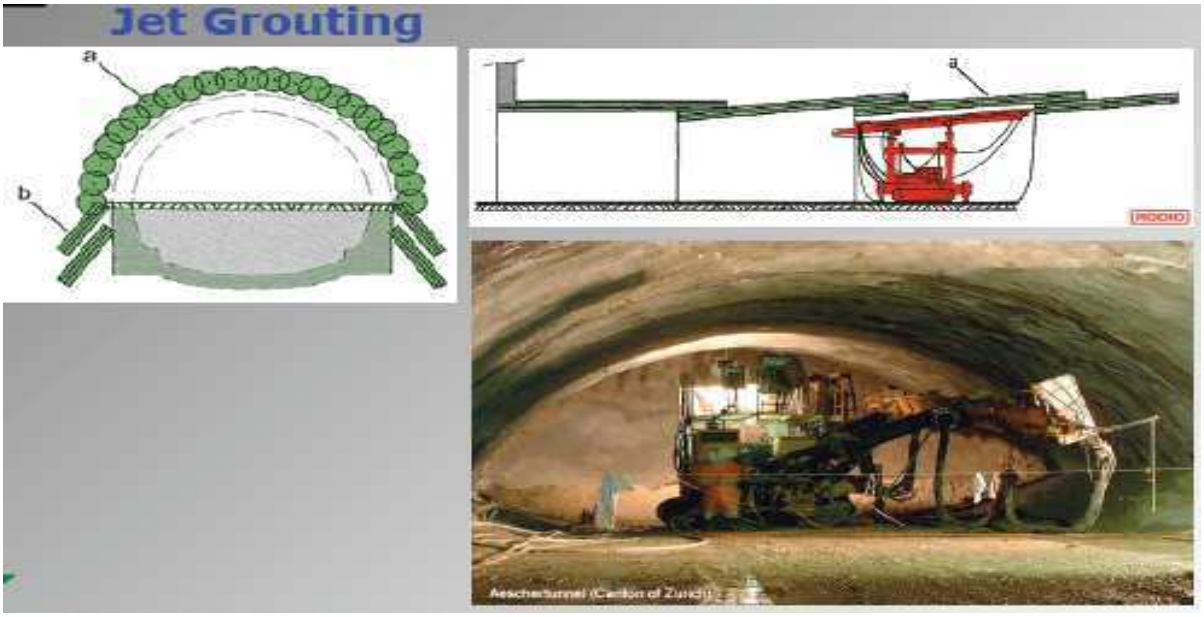
**Radial Grouting**



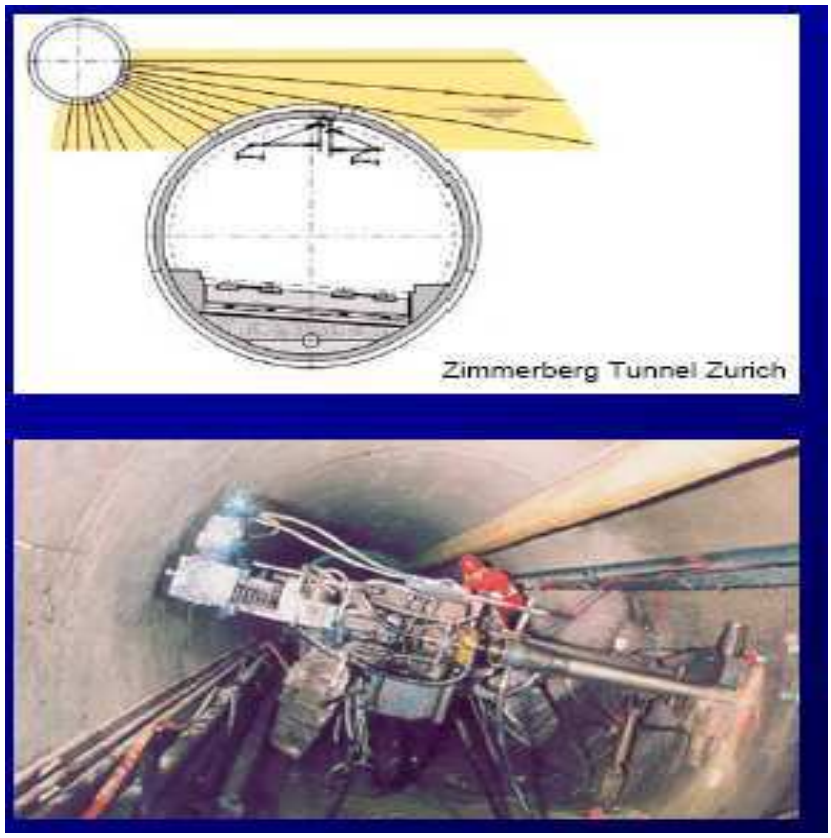

**Face Anchors:** use of gun to place anchors for soil consolidation



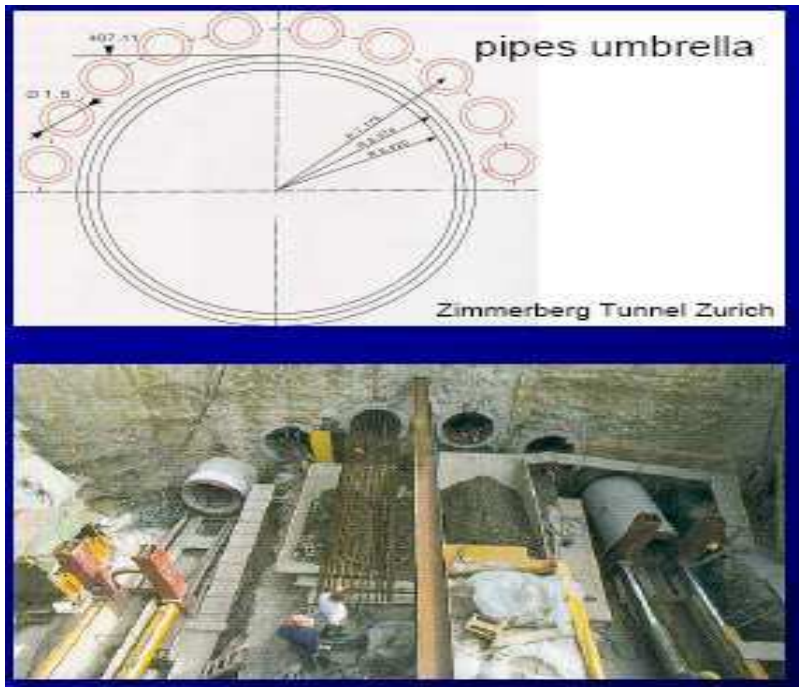

**Jet Grouting:** use of special machines spray admixtures in parallel with excavation direction for strengthening of soil.




**Grouting from a small tunnel**




**Pipes Umbrella:**




Soil strengthening and prevention of settlement needs specific circumstance. Therefore, application of prevention method for specific locations will be mentioned in later design.

### 4.2.2. Mitigation of fire and explosion in the tunnel

-Install of vents at underground stations and tunnel to reduce accumulated toxic gases, which may cause fires, explosion

-Fully obey the regulations on fire and explosion precausion.

-Arrange common fire extinguishers as well as modern firefighting equipment in each tunnel segment.

-Disseminate regulations on fire and explosion prevention inside the tunnels among operating staff and passenges

-In case of fire in underground station, toxic gases and smokes can affect a lot of people. Therefore, protective equipment shall be installed in compliance to Japan;s standards as follows:

- Use of non-flammable materials and structure: all the structures installed inside the tunnel shall be non-flammable
- Automatic fire alarming devices shall be installed at Station and signals shall be transmitted to Emergency Controlling Center
- Smoke saperating device
- Double layer door.

-Install fire alarming system at underground station. Warning signals shall be transmitted to PCC through the GTC.

- Fire extingushers: water, foam, gas.
- In tunnel with access roads for firefighters, the access roads shall includes stairs to ground-level, pressure rooms, ventilation fans to create suprlus pressure.

### 4.2.3. Methods for prevention of general incidents and mishaps

General rules:

- Establish Emergency Control Center: provide in a selected Station one Emergency Control Center with on-duty staff to collect, screen the information and give command, make announcement to passengers, control and prevent fires, as well as to manage other equipment.
- Information exchanges and writte messages annouced to the public
- Emergency exits

### 4.2.4. Traffic Incidents in the Railway Line (technical problems, derailment)

Depot and the maintenance workshops shall comply with the specribed specifications. The standards applicable here is the Urban Railway Standards; Asia-SRTASYA. During operation, regular checking and examining of trains and tracks is very important to ensure favourable and safe operation.

In order for the Metro trains to keep prescribed speed, turns quickly, it’s necessary to provide the maintenance chains in scientific way, and to adopt proper maintenance procedures. This process shall be well organized to be cost-effective, save time and labour. The repairing, overhauling schedule shall be in proper and specific period to better serve transportation and business tasks.

Equip modern system of railway communication, signals, control and stop according to the Urban Railway Standards; Asia-SRTASYA, ensuring safety in train operation.

### 4.2.5. Measures to Ensure Security in Tunnel

One police guard shall be provided for the railway line. At each Station, security team supervised by the police shall also be organized to keep the general security at the Station.

The camera system shall be installed to monitor activities at the underground Station. The signals shall be controlled from the PCC.

# Chapter 5

# Commitment for implementation of Environmetnal protection measures

The project Investor and Contractors commit to carry out the following environmental protection measures:

The Investor will fully comply with the Law on Environmental Protection, National Action Plans and Strategies, Vietnamese standards on environmental protection in transportation, particualarly regulations on environmental management; precaution, control, treatment; abatement of environmental pollution, degradation, mishaps; improvement of environmental quality and ensure urban sanitation.

The project Investor shall control Contractors' environmental protection activities in adherent to the Law on Environmental Protection, Vietnamese Standards (TCVN) as well as other environmental guidelines, rules and principles.

Adopt comprehensive environmental plan and fully follow guidance of environmental consultants. Besides, the contractors shall execute environmental management together with sub-contractors as specified in the Contract.

We also pledge to continue improve and apply proper measures to minimize environmental impacts during the entire construction period.

Responsible for managing and supervising environmental monitoring activities during the 3 project stages as mentioned in the approved EIA report.

The contractors shall be kept responsible for carrying out measures to combat or mitigate the adverse environmental impacts caused by contruction or activities relating to construction.

Execute mitigation measures, construct mitigation facilities as mentioned in EIA report.

Upon project completion, the Investor shall request Contractors to recover the environmental landscape.

Awareness raising for on-site worker and engineers on the importance of environmental protection. Effort will be made to better manage and improve site working condition to minimize adverse environmental impacts.

**Table 5.1. Commitment on Environmental Protection Measures**

| No | Project Implementation stage | Commitment on Environmental Protection |
|---|---|---|
| 1 | Pre-construction stage | - Apply the current State's regulation on compensation rates<br>- Coordinate with local authorities in organizing public hearing to inform compensation policies and methods, at the same time obtaining public feedbacks and desires.<br>- Agree with the local authorities on appropriate and equal compensation rates and methods in prior to construction |

| No | Project Implementation stage | Commitment on Environmental Protection |
|---|---|---|
| 2 | Construction Stage | - Covering the materials at stockpiles and in transportation routes<br>- Sprinkling to minimize particles at least twice a day<br>- Do not allow oil, grease leakage during tranportation<br>- Organize construction activities in business hours, strict restriction on the use of obsolete construction machines, equipment and vehicles by Contractors, whch ends up in exceeding noise level.<br>- Construct reinforced concrete retaining wall (underground) in the area of Stations. The retaining wall serves for obstruct soil during excavation. The retaining wall shall be of sufficient strength to resist the ground pressure, water-proofing and prevent subsidence of nearby structures.<br>- Install temporary noise barriers and fences for particls preventtion in crowed residential areas and Universities (Hanoi Industrial university, Commercial University, Hanoi Naional University, University of Communicatino and Transport, Van Mieu, residential cluster along Xuan Thuy, Kim Ma, Nui Truc, residential area near Hanoi Railway Station (the underground section between Km 12+000 - Km 12+500).<br>- Install mobile toilets to collect and treat domestic wastes, wastewater from worker camps.<br>- Improve site sanitation, covering of material stockpiles, waste dumps, chemical storages, depot to prevent overflow of water run-off. |

| | | |
|---|---|---|
| | Construction period | - Educate and awareness raising on disease precausion measures.<br>- Periodical health checking for worker and treatment provided if necessary.<br><br>- Install warning signals and traffic instruction boards alongside the constructed railway lines |
| 3 | Operation stage | - Maintain the metro trains, locomotives, tracks to reduce noise and vibration.<br>- Use of noise and vibration reducing methods likes installing nose barriers, use of madacam courses (1x2cm) under the concrete ties, at the same time welding of tracks to reduce vibration caused by joints.<br>- Noise barriers shall be installed at the following locations: Hanoi Industrial university, Commercial University, Hanoi Naional University, University of Communicatino and Transport, Van Mieu, residential cluster in Cau Giay, Cau Dien, Dplomatic Corps.<br>- Organize collection of refuses and wastewater discharged by passengers by awareness raising on environmental protection and placing waste bins on the Metro and at the Station.<br>- Install wastewater treatment tanks, including primary treatment at Stations with proper capacity. Cooperate with URENCO to collect wastes for proper treatment. |

| | | |
|---|---|---|
| | | - Inside the tunnels, provide water sumps at the lowest points and install high capacity pump (100$m^3$/h). At underground Station, the pumps are also placed at lower points. For each Station, install 02 pumps with capacity of 60$m^3$/hour for water pumping to the outsides.<br>- Vents shall be provided at underground Station and tunnels to disperse hazardous gases which entail risk of fire and explosion.<br>- Fully comply with fire, explosion prevention and fire abatment regulations inside the tunnels<br>- Arrange common fire extinguishers, and modern firefighting equipment in each tunnel segment.<br>- Disseminate regulations on fire and explosion prevention inside the tunnels among operating staff and passenges. |
| | Operation Stage | - Use of non-flammable materials and structure: all the structures installed inside the tube shall be non-flammable<br>- Automatic fire alarming devices shall be installed at Station and signals shall be transmitted to Emergency Controlling Center |

# chapter 6

# environmental treatment works
# environmental management and monitoring programs

## 6.1. List of environmental treatment works

-A wastewater tank and a septic tank are built at each station to serve passengers at the station.

-During the execution process, temporary noise and dust flaps are installed at sites experiencing construction of high bridge piers and stations, and along the route from Nhon to the Hanoi Railway Station.

-On-site bentonite solution-collecting pits are made at sites having pile bores.

-Canvas is used at construction material gatherings, and automobiles used to spray water on materials, streets and roads serving vehicles which transport materials needed for the Project.

-Mobile toilets and public dustbins are installed at tents and construction sites to collect rubbish and wastes.

-Drainage and wastewater treatment systems are constructed at stations and depots.

-Rubbish bins are placed at stations and depots.

**Table 6.1. Execution progress of environmental treatment works**

| No. | Treatment works | Duration |
|---|---|---|
| 2 | A wastewater tank and a sceptic tank are built at each station to serve passengers at the station. | 10/2008-10/2009 |
| 3 | During the execution process, temporary noise and dust flaps are installed at sites experiencing construction of high bridge buttresses and stations, and along | 12/2007-10/2010 |

| No. | Treatment works | Duration |
|---|---|---|
| | the route. | |
| 4 | Bentonite solution-collecting pits are made at sites having pile bores. | 12/2007-8/2009 |
| 5 | Canvas is used at construction material gatherings, and automobiles used to spray water on materials, streets and roads serving vehicles which transport materials needed for the Project. | 10/2007-10/2010 |
| 6 | Mobile toilets and public dustbins are installed at tents and construction sites to collect rubbish and wastes. | 10/2007-10/2010 |

## 6.2. Environmental management and monitoring programs

The environmental management and monitoring along the route are conducted by the Management board and the authorized agency in charge of environmental protection. The state of environmental quality will be frequently monitored, and observation data will be stored, analyzed and compared on a yearly basis.

Environmental management and monitoring is compulsory in every phase of the Project. They include not only managing and monitoring environmental factors of the urban railway project but also reverting the environment of surrounding areas to the original state when the construction is complete.

To ensure that the operation of the Project will not have considerable negative impacts on environmental quality and to assess the efficiency of pollution settlement measures, the proposed environmental management and environmental quality monitoring programs should be

applied during the execution period and the Project's operation.

The environmental observation and monitoring program will be implemented right after the State approves and licenses the Project. Observation and monitoring data will be stored and act as documents with legal meaning in the realization of the Environment Law of Vietnam.

The purpose of environmental management and monitoring programs is to control impacts arising during the construction process and the implementation of the Project as stated in the chapter 3 of this report.

Supervise and monitor the implementation of environmental protection solutions during the execution process based on the approved environmental impact assessment report.

Recommend additional minimization measures when impacts arise or unforeseen impacts are identified.

Recommend the Project's investor to coordinate with environment organizations at central and local levels in dealing with unsolved issues relating to environmental protection for which the Project is responsible.

### 6.2.1. Environmental management program

Before execution, the contractor should map out environmental management plans to manage environmental protection issues during the execution process and the Project's operation.

***Assignment:***

Environment engineer : Engineer of the contractor

Consultant : Environmental consultant (sub-contractor)

Contractor : Construction companies which win the bid

#### *6.2.1.1. Responsibility of the contractor in environmental management*

Environmental management is part of on-site quality management. Under the environmental management plan, the contractor will propose measures to minimize environmental impacts during the execution process, and submit them to the consultant for consideration.

In case of environmental impacts, the contractor will timely report them to the environmental engineer to get instructions and then take next steps. Arisen problems can be acts of violating laws or recommendations of a certain party on such issues as environment-related damages caused to properties and natural resources, underground water tie-up, and surface and underground water pollution.

The environmental management plan will be submitted. It will be reviewed if there are changes in a legal aspect or adjustments to suit specific cases on the scene.

#### *6.2.1.2. Organization, personnel and assignment in environmental management*

The Project’s Director will decide and offer environmental management guidelines, and put forth specific environmental protection plans. The environmental engineer will be responsible for works on the scene.

All problems arising on the scene will be reported to the on-site engineer by the sub-contractor, workers and staff. Reports on the problems will be submitted to the Project’s Director by the construction manager. All environment-related issues will also be reported to the consultant.

The environmental consultant (sub-contractor) is to coordinate with the construction contractor in supervising the implementation of environmental protection at the construction site.

#### *6.2.1.3. Environmental management methods, and contents*

***a) Measures to raise awareness of environment***

To raise the awareness of environment of on-site workers and people living around the Project's area, the contractor will take following actions:

-Frequently train on-site staff about the meaning and the importance of environmental protection.

- Manage and improve conditions at the construction site to minimize negative impacts.

- Make residents understand consequences of environment destruction.

***b) Specific process to meet environmental requirements***

To meet legal requirements, the contractor will take the following steps:

- Comply with the Environment Law of the Socialist Republic of Vietnam and other legal frameworks.

- Shoulder responsibility for ensuring that no waste materials and rubbish are left on roads as consequences of transport during the execution process.

- Collect and move all wastewater created during the execution process at the construction site out of the site using the temporary drainage system designed and arranged at proper locations so as not to cause environmental pollution.

- Build, maintain, relocate or restore necessary drainage systems and make plans on preventing destruction of floods as well as obstruction caused by materials spilling over during the execution process. The contractor is also to have all preventive schemes to limit the discharge of wastes, debris and other substances produced during the execution process at the construction site.

- Timely clean and move waste materials and debris generated during the land and mud execution process at the construction site and surrounding areas to revert their environment to the original state.

Specific measures to monitor air pollution during the operation of mixing stations include:

- Periodically cleaning and watering mixing stations and related areas to monitor the production of dust.

- Conducting pollution monitoring by the environmental engineer whenever mixing stations operate.

- Enclosing with three-sided walls all sites holding sand and materials within the location of mixing stations with volume of more than 50 m3.

- Taking dust-minimizing measures as proposed in the environmental impact assessment report. Periodically watering the construction site should also be implemented.

- The environment engineer will monitor activities which result in dust on the scene, and join hands with the sub-contractor in minimizing air pollution.

- It is necessary to prevent unsuitable or careless acts which have negative impacts on environment. Dust-generating works should be done in a tidy and orderly way.

***- Water quality management:***

- To prevent water pollution, the joint venture will take management and monitoring measures to minimize damaging effects of causing water pollution.

- The environment engineer is in charge of frequently monitoring water sources to prevent them from being polluted. The contractor and the sub-contractor will supervise the work.

- The environment engineer is to propose schemes on arranging the construction site to limit water pollution. The contractor and sub-contractors are to ensure that the schemes will not cause pollution.

- Liquid waste management: Wastewater should be treated before being discharged into water sources (Permissible values are stated in TCVN 5945-2005).

***- Refuse management:***

The investor instructs the contractor to ensure that no soil, stone or brick debris scatter on roads during the execution process. The refuse include wastes falling down during the transport process.

It is necessary to cover and wrapping wastes containing chemicals when discharging them to prevent dangerous effects on environment and humans. It is also necessary to conform to relevant criteria when handling chemical wastes.

Classifying refuse and strictly following commitments about the location of dumping grounds made with local authorities affected by the Project.

Some construction wastes at the construction site should be collected to be reused. Accordingly, wastes said to be unsuitable to agriculture or cultivated land by the consulting engineer will not be reused. The contractor will allocate areas for specific kinds of wastes at the construction site. However, wood, steel, iron, plastic materials and raw materials necessary to the construction site and not affected by weather will be used to prevent storage overload at the site and material squandering.

***- Hazardous substance management:***

The contractor will comply with conditions stated in the contract and the environmental protection law (NL 13P) and some relevant regulations.

*a) Storage and preservation*

The contractor will ensure that all hazardous wastes are stored and preserved in accordance with chemical properties of each substance such as burning, melting and boiling points. To prevent substances from being interact with one another, each kind of hazardous wastes should be isolated in suitable containers. Specifically, when storing and preserving inflammable substances and agents prone to explosion, the contractor should install fire and explosion prevention systems at the preservation area

using thick concrete blocks, mortar or other fire-proof materials. The contractor is also to supply and install other fire prevention equipment at preservation sites.

Training personnel and assigning responsibility of each individual for managing and monitoring hazardous wastes and materials. The hazardous substance-storing and preserving area should be protected strictly.

Closely monitoring the discharge of liquid wastes which act as solvents of the process of drilling foundations and bridge buttresses (the location for storing these wastes should be approved by local authorities.)

***- Chemical management:***

*a) Chemical inventory*

The contractor will make an inventory about ingredients of chemicals in construction materials, and a sheet about safety criteria of such materials as oil solvents. In case of major changes arising during the execution process, the inventory will be updated on a monthly basis.

*b) Handling steps*

Training personnel and assigning responsibility of each individuals for managing and monitoring chemicals. The chemical storing and preserving area should be protected strictly.

*c) Storage and preservation*

***- Managing the ecosystem, and protecting the scenery of historical and archeological sites at the Project's area:***

The investor will forewarn the contractor against implicit effects on the ecosystem and the scenery of historical and archeological sites at the Project's area.

During the execution process, the contractor will take measures to minimize impacts on the agricultural ecosystem, fauna, flora, scenery of the area, and economic activities of local people. These measure can include:

- The contract will comply with conditions stated in the contract and the Environmental Protection Law as well as some relevant regulations.

- The contractor will comply with and strictly follow environmental protection plans stated in the above-mentioned sections like plans on monitoring noise, air and water pollution, in a move to minimize impacts on agriculture, fauna and flora in the Project's project.

- The contractor will take necessary measures to ensure that its execution and that of sub-contractors within and outside the construction site will not affect local people.

- The contractor will strictly observe regulations and laws regarding conserving cultural and historical sites.

***- Public hygiene management:***

*a) On-site inspection*

The contractor will conduct on-site inspection to ensure that good public hygiene is strictly made. It not only inspect the discharge of wastes but also supervise conditions for storing and preserving chemicals and hazardous substances.

*b) Waste discharge*

Waste matters and redundant materials should be transported out of the construction site. Hazardous wastes should be placed in suitable containers, not normal ones.

Materials and matters generated during the digging and shoveling process should be placed in bags. Then, they will be piled up in an orderly manner, and moved to

dumping grounds according to the decision of local authorities.

*c) Construction site cleaning*

Taking the proposed steps, the contractor can ensure that the construction site cleaning will be implemented during the Project's construction period.

### *6.2.2. Environmental monitoring and observation program*

The program on monitoring the surrounding environment is implemented in three phases: pre-execution (foundation environment), during the execution process (expected to last 3 years) and the project's exploitation (the first year).

The program on observing air, noise and vibration environments is conducted at six locations along the route as follows:

- Location A1 Depot station
- Location A2 Intersection with the national railway
- Location A4 Intersection with the belt road No. 3
- Location A5 Intersection between Lieu Giai Road and Kim Ma Road
- Location A6 Opposite to Van Mieu-Quoc Tu Giam (The Temple of Literature and the ancient National University)

The surface and underground water monitoring program is conducted at 4 locations along the route as follows:

- Location N1 Northeastern of the Depot station
- Location N2 Southwestern of the Depot station
- Location N3 Cau Dien
- Location N4 Van Mieu-Quoc Tu Giam area

Environmental observation works

**Table 6.1. Environmental Monitoring**

| No. | Monitoring | Pre-construction phase | Construction phase | Operation phase |
|---|---|---|---|---|
| **I** | **Noise monitoring** | | | |
| | 1. Monitoring parameter | Leq, Lmax, L50 | Leq, Lmax, L50 | Leq, Lmax, L50 |
| | 2. Monitoring frequency | Measuring for 3 consecutive days, 16 hours/day, measuring 3 times/hour | Measuring 1 time/month, 16 hours/day, measuring 3 times/hour | Measuring 1 time/quarter in the first 12 months, 16 hours/day, measuring 3 times/hour |
| | 3. Monitoring location | At 6 locations | At 6 locations | At 6 locations |
| | 4. Comparative standard: | TCVN 5949-1998 | TCVN 5949-1998 | TCVN 5949-1998 |
| **II** | Vibration Monitoring | | | |
| | 1. Monitoring parameter | La (dB), acceleration ($m/s^2$) | La (dB), acceleration ($m/s^2$) | La (dB), Acceleration ($m/s^2$) |
| | 2. Monitoring frequency | Measuring for 3 consecutive days, 16 hours/day, measuring 3 times/hour | Measuring 1 time/month, 16 hours/day, measuring 3 times/hour | Measuring 1 time/quarter in the first 12 months, 16 hours/day, measuring 3 times/hour |
| | 3. Monitoring | At 6 locations | At 6 locations | At 6 locations |

| | | | | | |
|---|---|---|---|---|---|
| | 4. Comparative standard: | | TCVN 5126-90 TCVN 7210-2002 | TCVN 5126-90 TCVN 7210-2002 | TCVN 5126-90 TCVN 7210-2002 |
| **III** | Air quality monitoring | | | | |
| | 1. Monitoring parameter | | HC, CO, $SO_2$, $NO_x$, dust and microclimate parameters | HC, CO, $SO_2$, $NO_x$, dust and microclimate parameters | HC, CO, $SO_2$, $NO_x$, dust and microclimate parameters |
| | 2. Monitoring frequency | | Measuring for 3 consecutive days, 8 samples at 1 location | Measuring once a month, 8 samples at 1 location | Measuring once a quarter, 8 samples at 1 location |
| | 3. Monitoring location | | At 6 locations | At 6 locations | At 6 locations |
| | 4. Comparative standard: | | TCVN 5937-2005 TCVN 5938-2005 | TCVN 5937-2005 TCVN 5938-2005 | TCVN 5937-2005 TCVN 5938-2005 |
| **IV** | Water quality monitoring | | | | |
| | 1. Monitoring parameter | Surface water | pH, SS, opacity, BOD, COD, DO, oil, grease, Coliform, heavy metals | pH, SS, opacity, BOD, COD, DO, oil, grease, Coliform, heavy metals | pH, SS, opacity, BOD, COD, DO, oil, grease, Coliform, heavy metals |
| | | Underground water | pH, conductivity, hardness, oil, grease, Fe, Coliform | pH, conductivity, hardness, oil, grease, Fe, Coliform | pH, conductivity, hardness, oil, grease, Fe, Coliform |

| | | | | |
|---|---|---|---|---|
| | 2. Monitoring frequency | Measuring for 3 consecutive days, 2 samples at 1 location | Measuring once a month, 2 samples at 1 location | Measuring once a month, 2 samples at 1 location |
| | 3. Monitoring location | At 4 locations | At 4 locations | At 4 locations |
| | 4. Comparative standard: | TCVN 5942-1995 TCVN 5944-1995 | TCVN 5942-1995 TCVN 5944-1995 | TCVN 5942-1995 TCVN 5944-1995 |

Diagram 6.1. Locations of environmental observation and

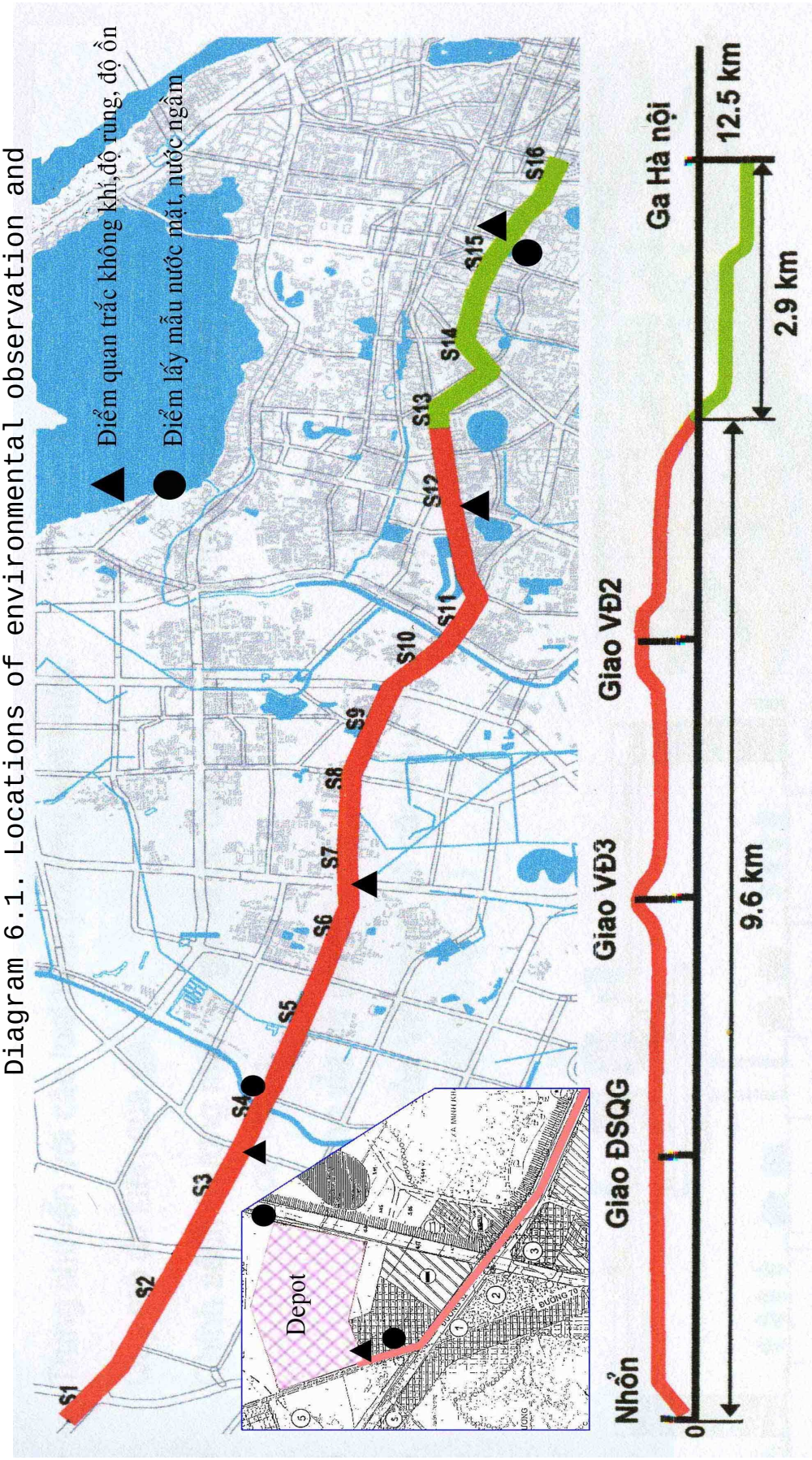


**Table 6.2. Estimated expenses for Environmental Monitoring**

| No. | Phase | Monitoring Items | Estimated expenses (million VND) |
|---|---|---|---|
| I | Pre-construction | Air quality | 66 |
| | | Noise | 77 |
| | | Vibration | 86 |
| | | Water quality | 30 |
| II | Construction | Air quality | 795 |
| | | Noise | 900 |
| | | Vibration | 1,000 |
| | | Water quality | 100 |
| III | Operation | Air quality | 88 |
| | | Noise | 100 |
| | | Vibration | 38 |
| | | Water quality | 50 |
| **Total:** | | | **3,330** |

*Note:* Contents and expenses for the Project's environmental observation and monitoring in details will be in agreement with the investor or the contractor after the contractor makes the Project's Environmental Management and Protection plan for each bidding package of the Project in the execution process. Environmental observation expenses are part of the Project's investment.

### 6.2.3. Organization and responsibility in environmental management and monitoring

The Project's investor is an organization representing the investor in charge of realizing the Environmental Protection Law with regard to the Project. Specifically, it is responsible for:

Setting up the environmental protection plan in the process of implementing the Project before its execution.

Signing with environmental consultancy agencies contracts on conducting environmental observation and

monitoring in accordance with the content of minimization measures stated in the environmental impact assessment report.

In each phase of implementing the Project (between 1 and 2 months), making a report on the results of environmental observation and monitoring, and submit it to the environmental management agency of the locality in which the Project is implemented.

Making additional recommendations, and strengthening minimization measures when impacts have not been forecast or arisen, which are proposed by environmental inspectors during the execution process.

Coordinating with the local environmental agency in solving outstanding issues relating to environmental protection for which the Project is responsible.

Receiving and answering the community’s complaints and claims about the Project’s environmental issues.

Taking responsibility for reporting the Hanoi Department of Natural Resources and Environment on the Project’s environmental protection works.

Directing contractors to make environmental management plans for each bidding package and insert them into tender documents. The Project is responsible for supervising and monitoring environmental protection activities of the contractor via the environmental consultant.

### 6.2.4. Public Awareness-raising Program

The program on raising public awareness of environmental protection will be carried out by the Project Management Board in coordination with organizations near the Project’s area like schools, office clerks working around the area, mass media, women unions, and youth unions. Notably, the program should receive assistance of traffic police bureaus of wards in rush hour near the construction area of the urban rail route.

Besides, the program on raising public awareness of environmental protection should be implemented among employees within the construction area to guarantee their safety. Leaders of the Hanoi People's Committee, and People's Committees of wards and communes near the construction area of the urban rail route should introduce the program to other people.

Main training contents include:

- Training for operation and management of the urban railway project's management, safety and security systems.
- Using and managing fire and explosion prevention systems and railway operation safety systems in the underground rail sections.
- Environmental observation and management programs.
- Programs on calling upon passengers and residents around the route for to protect environment in underground rail sections and at stations by printing and distributing such publications as attractive leaflets.
- Programs on maintaining and supervising the operation of equipment used to run trains, ensure security and treat environment. They will be frequently implemented according to design standards of the Vietnam Railway Department.

Training programs can be implemented in Vietnam and abroad. Training expenses will be added to the Project's total expenses.

# CHAPter 7

## Cost estmation for environmental managemetn Facilities

Estimation of expense for environmental treatment, mitigation and management work during construction and operation as follow:

**Table 7.1. Estimation of Environmental Protection Expense**

| No | **Components** | **Estimated Cost (mil VN§)** |
|---|---|---|
| 1 | Provide wastewater tank and septic tank at each Station to facilitate passengers activities at Station | 12.600 |
| 2 | Install sound barrier and fences on the Site for construction of Pier, Stations, open tunnel excavation and alsongside the railway Line during the entire construction time. | 100 |
| 3 | At bored piles, sumps shall be provided to collect bentonite on site. | 500 |
| 4 | Use canvas to cover the materials stockpiles, sprinkle at the material yards and transportation route. | 100 |
| 5 | Provide mobile sanitation work, waste bins on the construction sites and at worker camps to collect wastes and excrement. | 200 |
| 6 | Install instruction signals during construction period | 50 |
| 7 | Organize training cources on environmental management and protection. | 500 |

| | | |
|---|---|---|
| 8 | Daily sprinkle and street clean during construction. | 300 |
| 9 | Construct drainage system in tunnels and underground Stations | 50.500 |
| 10 | Contruct drainage system for Depot | 2.500 |
| 11 | Install noise barrier at sensitive points | 2.000 |
| | **Total expense** | **69.350** |

Total expense for construction of envrionmental treatment, management, protection, mitigation facilities during construction and operation period is **69.350.000.000 VND**

# ChaptER 8
# Public Consultation

## 8.1. Necessity of commmunity consultation

Community consultation is one part of the Environmental Impact Assessment (EIA) of the Project. Consulation is carried out under the coordination among the Investor, Design Consultant, Environmental Consultant, local authority and residential community. The consultation results shall be used to propose the measures to mitigate environmental impact and also serve as means to show the public support during the Project implementation.

## 8.2.main objectives of community consulation

- In order to understand idea and attention of the community about the Project, especially those from directly affected people. This will serve as the basis to solve any disputes arised during Project preparation.

- To listen to the community about their needs and care to the Project, especially listening to their voice on direct effects on their life.

- To solve any disputes among community on environmental issues as well as any delays during project implementation.

- To determine the soundness and legality of decisions of authorities which satisfy the people’s wishes, to consider recomendations of the publics and authorites.

- To understand the difficulties of the local authority and residential people of the Project site.

## 8.3. methods

First time: During feasibility study period, the investigation will be carried out for households among the route in order to understand their needs and ideas

about the Project. This will be implemented by distributing the Questionnaires.

Second time: The Hanoi Tram and Public Transport Development Management Unit send an official letter to Peoples' Committee and Fatherland Fronts Committee of communal levels informing them about main activities of the Project, the potential effects on environment, and proposed mitigation measures applied during Project implementation period.

## 8.4. Community consultation results

### 8.4.1. Questionnaire Survey Results

EIA Group carried out investigation to each potentially affected households. This create a chance to conduct a close survey to individual potentially affected households as well as exchange and listen to community's ideas about the Project by filling in the distributed Questionnaires.

100 out of 193 households to be removed, have been selected for interview. These households are representative from different groups:

- Group 1: Farmer households (rice, flower, etc.)

- Group 2: Trading households along the study site

- Group 3: Households within estimated site for power station and metro station...

***a) Investigation period:*** From 8 June 2006 to 12 June 2006

***b) The content of the Questionnaires***

The Questionnaires mainly focus on asking the community to provide information on daily life, income and living conditions of the households, transportation status, area environmental uses and their ideas about the Project (the Questionnaires is attached to the Appendix).

***c) Investigation results***

- General descriptions of the investigated households: The total households are 100 and total investigated

people are 475 persons of which 258 (accounts for 54,3%) are in working age and 217 are dependent (45,7%).

- Current House status: please see Table 8.1 below.

**Table 8.1. House category**

| Total | House category | | | |
|---|---|---|---|---|
| | Grade 1 | Grade 2 | Grade 3 | Grade 4 |
| 100 | 2 | 1 | 11 | 86 |
| 100% | 2% | 1% | 11% | 86% |

***d) Summary of the investigation results***

*- Average monthly income of households is summarized as follows:*

+ Income less than 3 million VND/month: 35 households (accounts for 35% of the total investigated)

+ From 3 to 7 million/month: 38 households accounts for 38% of the total investigated)

+ Higher than 7 million/month: 27 households (accounts for 27% of the total investigated))

*- Community ideas on resettlement:*

+ Central resettlement: 39 households (39% of the total)

+ Fee resettlement: 1 household (1% of the total)

+ Temporary resettlement: 60 households (60% of the total)

*- Community ideas on Project implementation:*

+ Agree: 97 households ( 97% of the total)

+ Disagree: 2 households (2% of the total)

+ No idea: 1 household (1% of the total)

The investigation results have shown that most of the affected people agree with Project. However, the compensation must be done in satisfactory manner and in line with Government regulations as well as support to provide jobs for affected peoples.

Most of surveyed peoples think that environmental impacts due to particles, air pollutants, noise and vibration are unavoidable. The project investor shall, therefore, take serious measures to mitigate potential pollution of air, dust, noise, vibration and wastewater... Numerous problems might arise during the project implementation period, so preventive measures shall be designed so that the project can be executed in an active way, minimizing significant impacts on the communities and environment

The community also proposed to the Investor to define the project's specific boundary and the time for land acquisition so prevent uncertainties and worries among the publics.

### 8.4.2. Consultation results with local Peoples Committee and Fatherland Front Committee

During the preparation period of Construction Investment Report, the PMU has cooperated with environmental consultants to carry out public consultation. The purpose of these sessions is to introduce information pertaining to the project, environmental impact and mitigation methods so that the community within the project area can understand about the project.

***a) Time of the meetings with local authorities***

From 21 November 2006 to 18 December 2006

***b) Participants from local authority***

1. Mr. Vu Thanh Thinh – Chairman of Hoan Kiem District Peoples' Committee

2. Mr. Vu Tuan Trung – Chairman of Tran Hung Dao Ward Peoples' Committee

3. Mr. Tran Hong Quan – Chairman of Fartherland Front Commitee of Tran Hung Dao Ward

4. Mr. Le Hong Phu – Chairman of People's Committee of Cua Nam Ward

5. Mr. Pham Nga – Chairman of Fartherland Front Commitee of Cua Nam Ward

6. Mr. Nguyen Van Mao – Vice Chairman of Fartherland Front Commitee of Dong Da district

7. Mr. Tran Quan Bao - Chairman of People's Committee of Van Mieu Ward

8. Mr. Phan Van Duc - Vice Chairman of Fartherland Front Commitee of Van Mieu Ward

9. Mr. Hoang Minh Do - Chairman of People's Committee of Quoc Tu Giam Ward

10. Mr Truong Van Trung - Chairman of Fartherland Front Commitee of Quoc Tu Giam Ward

11. Mr. Nguyen Sy Lap - Chairman of People's Committee of Cat Linh Ward

12. Mr Du Van Trai - Chairman of Fartherland Front Commitee of Cat Linh Ward

13. Mr. Ngo Tien Ngoc - Vice Chairman of People's Committee of Van Chuong Ward

14. Mr Tran Duc Von - Chairman of Fartherland Front Commitee of Van Chuong Ward

15. Mr Le Lan Anh – Vice Head of Natural Resource and Environment Department of Ba Dinh District

16. Mr Nguyen Thi Nga - Vice Chairman of Fartherland Front Commitee of Ba Dinh District

17. Mr Nguyen Van Bao - Chairman of People’s Committee of Giang Vo

18. Mr. Nguyen Quoc Ky - Chairman of Fartherland Front Commitee of Giang Vo Ward

19. Mr Ta Thanh Duong - Chairman of People’s Committee of Kim Ma Ward

20. Mr. Le Minh Trang - Chairman of Fartherland Front Commitee Kim Ma Ward

21. Mr. Nguyen Mai Bao - Chairman of People’s Committee of Ngoc Khanh Ward

22. Mr. Nguyen Van Thanh - Chairman of Fartherland Front Commitee of Ngoc Khanh Ward

23. Mr. Nguyen Le - Vice Chairman of People’s Committee of Cau Giay District

24. Mr. Nguyen Minh Xuan - Chairman of Fartherland Front Commitee of Cau Giay District

25. Mr. Nguyen Van Thu - Chairman of People’s Committee of Quan Hoa Ward

26. Mr. Vu Duc Khuong - Chairman of Fartherland Front Commitee of Quan Hoa Ward

27. Mr. Hoang Trung Kien - Chairman of People’s Committee of Dich Vong Ward

28. Mr. Nguyen Quang  Chat - Chairman of Fartherland Front Commitee of Dich Vong

29. Mr. Dao Trung Dung - Chairman of Fartherland Front Commitee of Dich Vong Hau

30. Mr. Tran Nhat Tuong - Chairman of Fartherland Front Commitee of Hau Dich Vong Ward

31. Mr. Duong Cao Thanh - Chairman of People’s Committee of Mai Dich Ward

32. Mr. Vu Xuan Mien - Chairman of Fartherland Front Commitee of Mai Dich Ward

33. Mr. Nguyen Tat Tuan - Chairman of Fartherland Front Commitee of Tu Liem District

34. Mr. Tran Manh Hung - Chairman of People’s Committee of Cau Dien Town

35. Mr. Lam Duc Long - Chairman of Fartherland Front Commitee of Cau Giay Town

36. ¤ng Phi Le Binh – Chairman of People’s Committee of Phu Dien Municipal

37. Ms Nguyen Thi Thuy - Chairman of Fartherland Front Commitee of Phu Dien Municipal

38. Mr. Vu Dinh Than – Vice Chairman of People’s Committee of Minh Khai Minucipal

39. Mr. Tran Van Khom - Chairman of Fartherland Front Commitee of Minh Khai Municipal

40. Mr. Le Van Viet – Vice Chairman of People’s Committee of Tay Tuu

41. Mr. Nguyen Xuan Tac - Chairman of Fartherland Front Commitee of Tay Tuu Municipal.

***c) Main contents of community consultation***

Environmental expert presented to representatives from People’s Committee and Fatherland Front Committee within the affected site the Summary Report on the followings:

- Summary description of the Project: routes, directions, scope for rehalibitation and surrounding works of the Projects.
- Assessment and Prediction of potential impacts from the Project.
- Mitigation measures on natural and social environment.

These reports have been sent to municipal authority before the actual meeting allowing the representative enough time to read and study thoroughly.

During the meetings with the relevant municipal authorities, Environmental expert questioned and listened

to recommendations from the authotities to the Investor, all recomendations and ideas are summaried in the items below.

***d) Summary of the ideas from local authority and local union***

100% of the people asked agreed with the constructions of the pilot railway line from Nhon to Hanoi Railway Station as this is urgent and necessary for improving the transportation status and reduce accidents, traffic jam in the said route and for whole Hanoi city in general.

People asked also agreed on main environmental issues incurred during Project implementation period are air pollution, exhaust fumes, dust, noise, shuck, wastewater ...It is necessary to pay most attention to reduce pollution on air, noise and shuck.

The main ideas from local authorities are summaried in the table 8.

**Table 8.2. Summary of ideas from local authorities on the Project.**

| Local authority | Contributed ideas |
|---|---|
| Hoan Kiem district | - Construction and supervision methods shall ensure technical specifications, safety, avoiding waste and corruption during project implementation |
| PC of Tran Hung Dao ward | - The Project should be commenced soon in order to improve current transportation status of the city. |
| Fatherland Front Commitee of Tran Hung Dao ward | - Agree with the main content of the Project<br>- Agree with estimated environmental impacts. The Project should detail these impacts and pay more attention to implementation.<br>- Fully consent with proposed environmental control and management<br>- This is a big project of the city, it is |

| Local authority | Contributed ideas |
|---|---|
| | requested to pay attention to urban landcape, aesthetic of the structures for future generation. |
| PC of Cua Nam ward | - Safety measures shall be taken to prevent impacts on nearby structures (houses, offices) along the railway line |
| Fatherland Front Commitee of Cua Nam ward | - Expect that all the mitigation methods mentioned in EIA-study will be complied sufficiently. |
| Fatherland Front Commitee of Van Mieu ward | - More research is needed for changing the bends between Station 12 and 13, then the railway line will be straight and more beautiful.<br>- Take all available measures to protect the environment, the project has mentioned sufficiently, but not abundantly.<br>- Public propaganda and awareness raising shall be promoted, particularly in direct affected areas.<br>- Dwellers in nearby areas do worry about the risk of land subsidence which may influenced existing structures. It is proposed that more investigation shall be conducted, specific measures designed and accountability in the event of land settlement. |
| Fatherland Front Commitee of Cat Linh ward | - The Railway line from Hanoi Station to Nhon is reasonable.<br>- The number and distance of Station is suitable with the traveling demand in selected station areas.<br>- The tunnels under Cat Linh street is suitable, however, this area is has low topography, which suffers from flood when heavy rain occur, drainage is poor also. The |

| Local authority | Contributed ideas |
|---|---|
| | proposed cut & cover construction methods shall be carefully considered |
| Fatherland Front Commitee of Van Chuong ward | - The project investor shall keep the committment |
| Fatherland Front Commitee of Ba Dinh ward | - The project is feasible,<br>- The project progress shall be ensured to avoid prolonged construction time. Construction method shal be sequential, with full completion of Station. Good propoganda to attain public support.<br>- Cau Giay is a gate of Hanoi City. Do the flyover across To Lich river affect the Cau giay? |
| Fatherland Front Commitee of Giang Vo ward | - The metro trains shall be carefully selected so that they do not become obsolete after long-time usage (dozens of year). The possibility for line expansion to other routes in Hanoi City.<br>- The Hanoi's geological setting shall be carefully studied to produce appropriate construction method, avoiding incidents during operation period. The existing structures and relating projects shall be kept free influences.<br>- Ensure safety for workers during construction time, and passengers during operation period.<br>- The project is necessary given the increasing number of private means of transport which overload the traffic infrastructure. It's proposed to hasten the project and shorten the railway line. |

| Local authority | Contributed ideas |
|---|---|
| Fatherland Front Commitee of Kim Ma ward | - Welcome the project |
| PC of Kim Ma ward | - Agree with the pilot railway project, the project should be hastened to minimize traffic accidents. |
| PC of Ngoc Khanh ward | - Attention shall be paid to the underground drainage system.<br>- Pay attention to compensation and resettlement policy during site clearance, traffic circulation during construction time, noise, vibration, wastes which pollute the environment.<br>- More research shall be made on the economic efficiency of the project, considering the high project investment and low efficiency due to the specific charateristics of Hanoi transport system |
| PC of Cau Giay ward | - This Project will help to reduce number of vehicles transporting on the current streets. However, the operation of new train system will cause negative effects on the environment. Therefore, there shall be specific management and institutional measures to settle environmental issues during project implementation period. Also, the project shall match with modern urban lanscapes.<br>- When the project is put into operation, like the situation in other mean of transport, passengers may discharge wastes on the metro trains or at the station, which badly influence the environment and uban landscape. The project investor shall take measures and coordinate with local urban |

| Local authority | Contributed ideas |
|---|---|
| | management acencies in waste and wastewater collection and treatment in adherent to currently City's regulations on safety and sanitation. |
| Fatherland Front Commitee of Cau Giay ward | - Please consider the options to construct a underground metro so as to avoid site clearance<br>- The Railway line shall be undergroud to ensure safety, medernity and effectiveness. |
| PC of Quan Hoa ward | - The Project should have imtigation mesures in order to minimize the environmental impacts as well as to meet the rquirements fro sustainable urban development.<br>- It is necessary to complete the paper procedures and commence the Project |
| PC of Dich Vong ward | - Futher evaluate the impacts on business and life of the households facing frontage road after the project is pu into operation, impact on social security and problems caused by worker. |
| Fatherland Front Commitee of Dich Vong ward | - Information should be public to the community. |
| PC of Dich Vong ward | - The Project should commence as soon as possible and come into operation. |
| Fatherland Front Commitee of Dich Vong Hau ward | - Consent with the content of the Project<br>- The impact on environment is unavoidable; hence it needs to have a good construction organization.<br>- The construction should be implemented in sequential method to minimize impacts on the local environment |

| Local authority | Contributed ideas |
|---|---|
| PC of Mai Dich word | - Reconsider the station No 5 and 6 as they are too close to each other.<br>- In order to have a smooth Project implementation, there should be a good policy for site clearance |
| Fatherland Front Commitee of Mai Dich ward | - All the regulations on traffic safety and environment shall be ensured, noise shall be minimized |
| Fatherland Front Commitee of Tu Liem ward | - All information should be public and available for access in order to make the community aware of the project. Resettlement and compensation should be carried out in right progress.<br>- Consent with the Project. |
| Fatherland Front Commitee of Cau Dien town | - The community is afraid of the noise caused by the train during operation. |
| Fatherland Front Commitee of Phu Dien commune | - Should have a noise mitigation measure. |
| PC of Minh Khai commune | - When the Project is under implementation, it is essential to ensure the drainage and sanitation of the surrounding area. |
| Fatherland Front Commitee of Minh Khai commune | - During the transportation of the materials, there shall occur noise, dust, scatter, vibration which shall certainly cause impact on the environment.<br>- Resettlement and compensation must be done in satisfactory manner. |

***Notes**: Official letters and Questionnaires are included in the Appendix of the Report*

# Chapter 9

# References of data and Assessment methods

## 9.1. References of Data

### 9.1.1. References

1. Ministry of Science, Technology and Environment. *Regulations (temporary) on environmental analysis, monitoring and data management,* 1999.
2. Vietnamese Environmental Standards from 1995 to date
3. The project: Strengthening the Enforcement of Environmental and Social Safeguard Measures in Vietnam - TF 051032. *General Guideline on Environmental Safeguard Policy, June 2004*. *Technical Guideline on implementation of safeguard measures on T§C for transportation sector, April* 2004 (WB)
4. Le Van Khoa, and others. *Measures for soil, water, fertilizer, plant analysis*. Education Publishing House, Hanoi 2000.
5. *Law on Environmental Protection and Implementation Guildelines*. National Political Publisher, 2005.
6. Pham Ngoc Ho, Hoang Xuan Co. *Environmental Impact Assessment*. National University Publisher, Hanoi 2001.
7. Hanoi Department of Natural Resources and Environment. *Environmental Status Report 2005.*
8. General Department of Statistics: *Socio-economic Data of 64 provinces and Cities in Vietnam.* Statistical Publishing House, 2005.
9. Center for Environmental Engineering of Town and Industrial Area - CEETIA. *Environmental Impact Assessment Report for Hanoi Urban Traffic Development Project*, 10/2005.

***Assessment***: The references used for EIA preparation are sufficient, reliable, updated and practical.

### 9.1.2. Documents compiled by Project Investor

1. Investment and Construction Consultation Company, Vietnam Railway Corporation. *Pre-feasibility Study for Urban Pilot Railway Line: Nhon-Hanoi Railway Station Section,* 2005.
2. Investment and construction Consultant JSC. *Inception Report of Hanoi Urban Pilot Railway Line: Nhon-Hanoi Railway Station Section,* 8/2006.
3. Transportation Investment and Construction Consultant JSC:. *Feasibility Study Report for Technical component of Depot, under the Hanoi Urban Pilot Railway Line: Nhon-Hanoi Railway Station Section*, August 2006.
4. Investment and construction Consultant JSC. *Feasibility Study for the Hanoi Urban Pilot Railway Line: Nhon-Hanoi Railway Station Section,* November /2006.

Assessment: The references used for EIA preparation are sufficient, reliable, updated and practical.

## 9.2. EIA methods

The EIA is prepared using the following methods:

- Statistical methods: this method is for collecting and screening of meteorological, hydrological, socio-economic data in the project site.

- Sampling and Laboratory Analysis: to identify the parameters on air, water, noise, vibration in the project site.

- Comparison method: for assessment of project impacts based on Vietnamese Standards.

- Social interview: obtaining feedbacks from local authorities, communities, project affected people in the project site.

## 9.3. Evaluation on the EIA details and reliability

The methods used for EIA preparation are traditional and reliable. On-site sampling and analysis results reflect exactly the environmental quality. However, the methods and tools used for some contents are still limited

Public consultation shall be conducted during the entire project implementation.

Monitoring to evaluate the drawdown of groundwater, tunnel subsidence is difficult in term of method and tools.

Air pollution in the tunnel is minor since the source is few and the tunnels are equipped with modern ventilation system. However, assessment is till limited as the pollution load has not been identified.

# Conclusion and recommendation

## 1. Conclusion

Based on the impacts assessment of the project: "Ha Noi Pilot Metro Line Project, Nhon-Hanoi Railway Station Section" on the natural, socio-economic environment, the following conclusions can be made:

The Project "Ha Noi Pilot Metro Line Project, Nhon-Hanoi Railway Station Section" is a feasible one, suitable to the City's socio-economic development plan. This is the City's ever-first railway project, contributing significantly to improving its traffic condition.

The project will help to promote socio-economic development of Hanoi and its vicinities, meeting the need for urban traffic and transportation development, curbing the traffic jam and accidents, encouraging development of other sectors.

The project construction stage might cause a number of negative impacts on the natural and social environment, which are summarized as follows:

- Site clearance, resettlement will exert direct impact on the communities alongside the railway line;
- Air pollution due to particles, gas fume, oils, hazardous gases, noise during construction and operation in residential areas bodering the railway line;
- Water pollution due to wastewater from construction process, which deteriorate the environment, affecting daily routines of communities in the project areas;
- Traffic congestion during construction time.

## 2. Recommendation

In order to protect the environment and minimize adverse impacts during construction period, proper coordination shall be made among relevant agencies as follows:

- Cooperate with Traffic Police Bureau of districts, wards (commune) along the railway line.
- Local authorities coordinate with project investor to carry out timely site clearance, resettlement to facilitate project progress.

The EIA-study for the project: Ha Noi Pilot Metro Line Project Line (Nhon-Hanoi Railway Station Section) has been completed. We would propose the Ministry of Natural Resources and Environment consider and approve the EIA-study so that the project can be implemented soon.