SECTION - 3
DESCRIPTION OF THE PROJECT

3.1 Rationale of the Project

Lahore is the 2nd largest city of Pakistan with respect to population. The existing population of the city is estimated to be 9 Million. The population forecast for 2025 is 16.2Million, which is estimated on the basis of current population growth rate identified as 3%. The area of Lahore city is 2,300 km^2 and the length of the road network is greater than 2,000 kilometres. The rapid growth of traffic in the city has put great pressure on the road network and the traffic volume on roads and intersections has reached a saturation point.

The Orange Line connects many important locations like Thokar Niaz Baig, Canal View, Wahdat Road, Awan Town, Samanabad, Gulshane Ravi, Chouburji, Lakshmi Chowk, UET, Railway Station, Salamatpura, Baghabanpura, Bund Road and Shalamar Gardens. Presently, due to lack of quality public transport, people prefer using private vehicles to travel. This leads to traffic jams and people have to face traffic delays resulting in nuisance and waste of time.

Over the past years the rapid growth in population and vehicle ownership in Lahore has steadily worsened traffic congestion. Studies conducted in 1990s identified the need for some form of mass transit to meet future public transport demands and recommended LRMTS network of four lines in the following order of priority **(Figure 3.1):**

Green Line:	Ferozepur Road/Mall Road/Ravi Road/Shahdara
Orange Line:	Raiwind Road/Multan Road/ McLeod Road/ Railway Station/GT Road
Blue Line:	Township/Gulberg Boulevard/Jail Road
Purple Line:	Bhatti Gate/Allama Iqbal Road/Airport

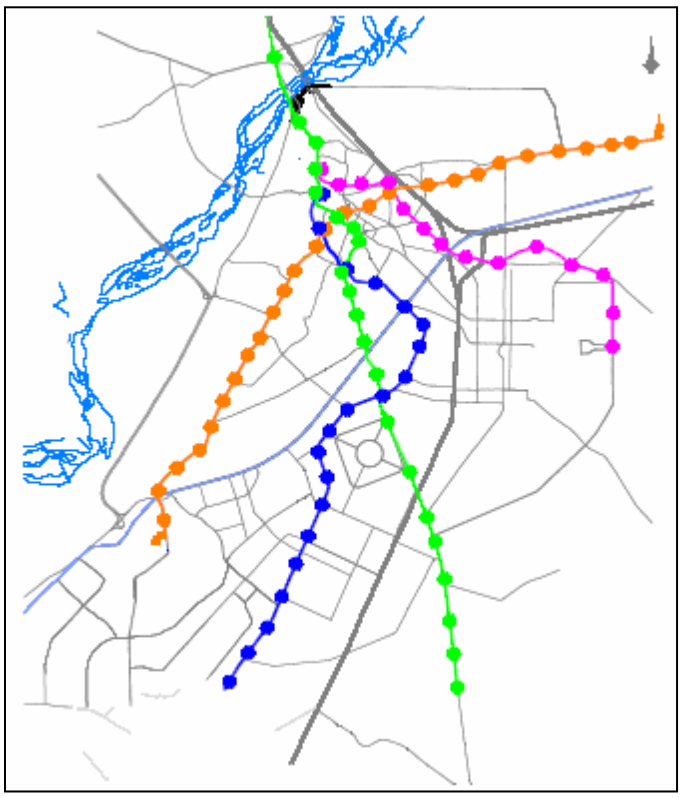

Figure 3.1: The City-wide LRMTS Long Term Network

Thus, the government of Punjab has planned development of LRMTS Orange Line passing through Raiwind Road, Multan Road, McLeod Road, Railway Station, and GT Road

3.2 Objectives of the Proposed Project

The overall objective of the proposed project is to provide a safe, efficient, comfortable and reliable transport facility to the commuters of the project area. The proposed project will greatly benefit the commuters by providing better quality and environmentally friendly public transport, reducing the number of vehicles on the road, reducing fuel consumption and consequently air emissions from vehicular exhaust especially in case of traffic congestion. The following objectives have been considered in the implementation of the project:

- To transfer large number of passengers quickly over short distance with little land use;
- To provide the public with environmentally friendly and quality public transport;
- To provide transport safety, transport productivity, travel reliability, travel choices, and social equity;

- To reduce accidents caused by traffic congestions;
- To help save travelling time;
- To reduce the fuel consumption by reducing the demand of private vehicles;
- To create job opportunities for laborers and semi-skilled staff

3.3 Location of the Project Area

The Orange Line commences in the east of Lahore from the main depot in Dera Gujran, along GT Road to the Main Railway Station, across the city centre via Lakshami Chowk, McLoed Road and Lake Road to Chauburji before heading south-west via Multan Road and Raiwind Road, to a stabling yard and terminus at Ali Town. **Figures 3.2 (a) and (b)** below show the alignment of the system.

3.4 Project Administrative Jurisdiction

The proposed project lies in the city of Lahore in Punjab Province. The project site falls in Administrative jurisdictions of the following towns of City District Government, Lahore:

- Data Gunj Bakhsh Town
- Shalamar Town
- Samanabad Town
- Iqbal Town

3.5 Project Implementation Schedule

The project is expected to be completed within Twenty Seven (27) months.

3.6 Cost of the Project

The estimated capital cost of the proposed project is US $ 1.6 Billion.

3.7 Land Acquisition

The total area of land to be acquired for various components of orange line such as, stations, depot/stabling yard and other locations is approximately 966 kanal. The proposed alignment of the orange line is tentative and has to be approved by the Chinese EPC Contractor CR-NORINCO based on the geometric design criteria given in Chinese codes. The drawings for the land acquisition plan prepared based on the proposed alignment show the areas in the right of the way that need to be acquired and then cleared for orange line. These drawings are attached as Annex XIII (a).

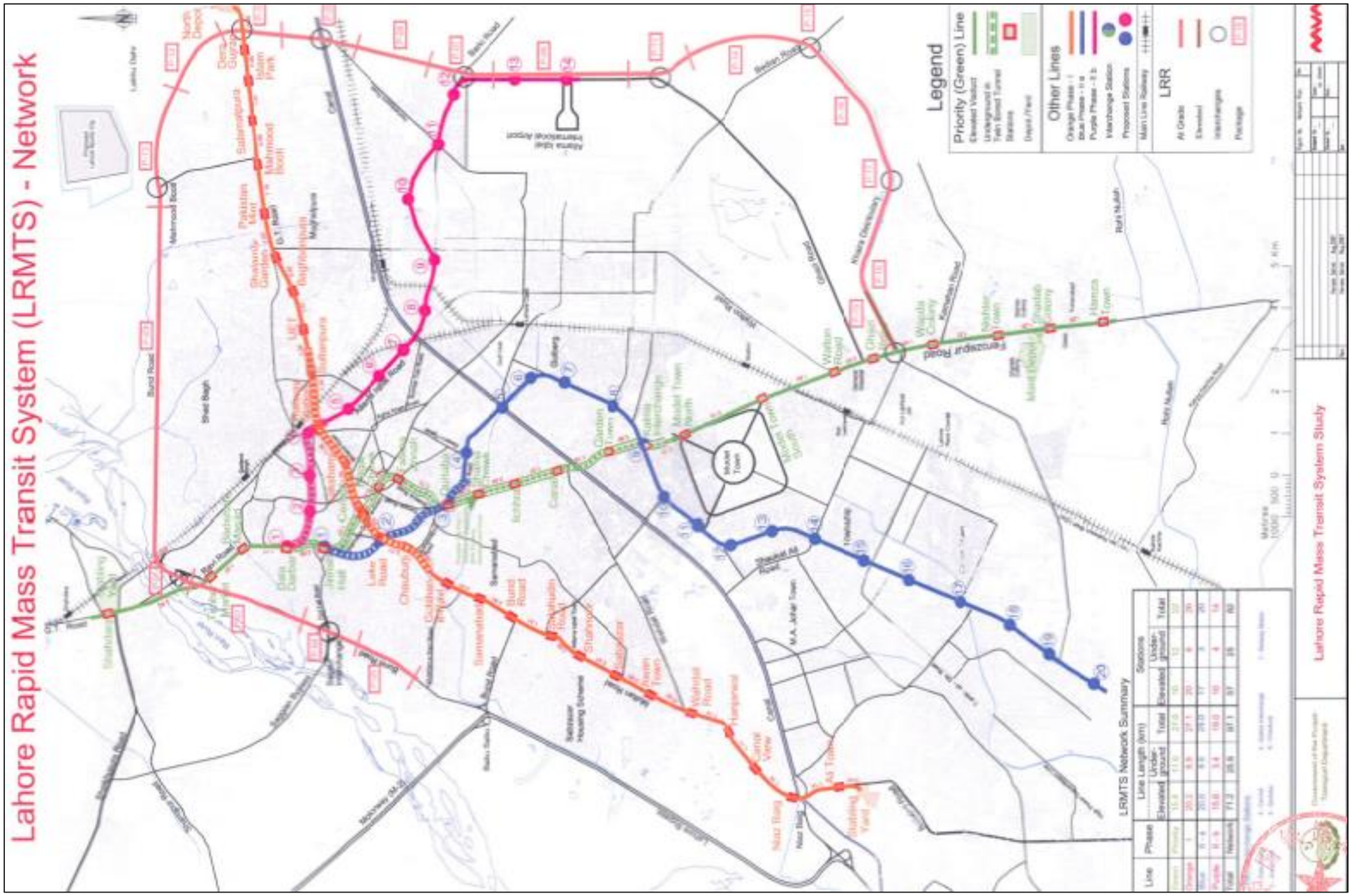

Figure 3.2 (a): Lahore Rapid Mass Transit System (LRMTS) - Network

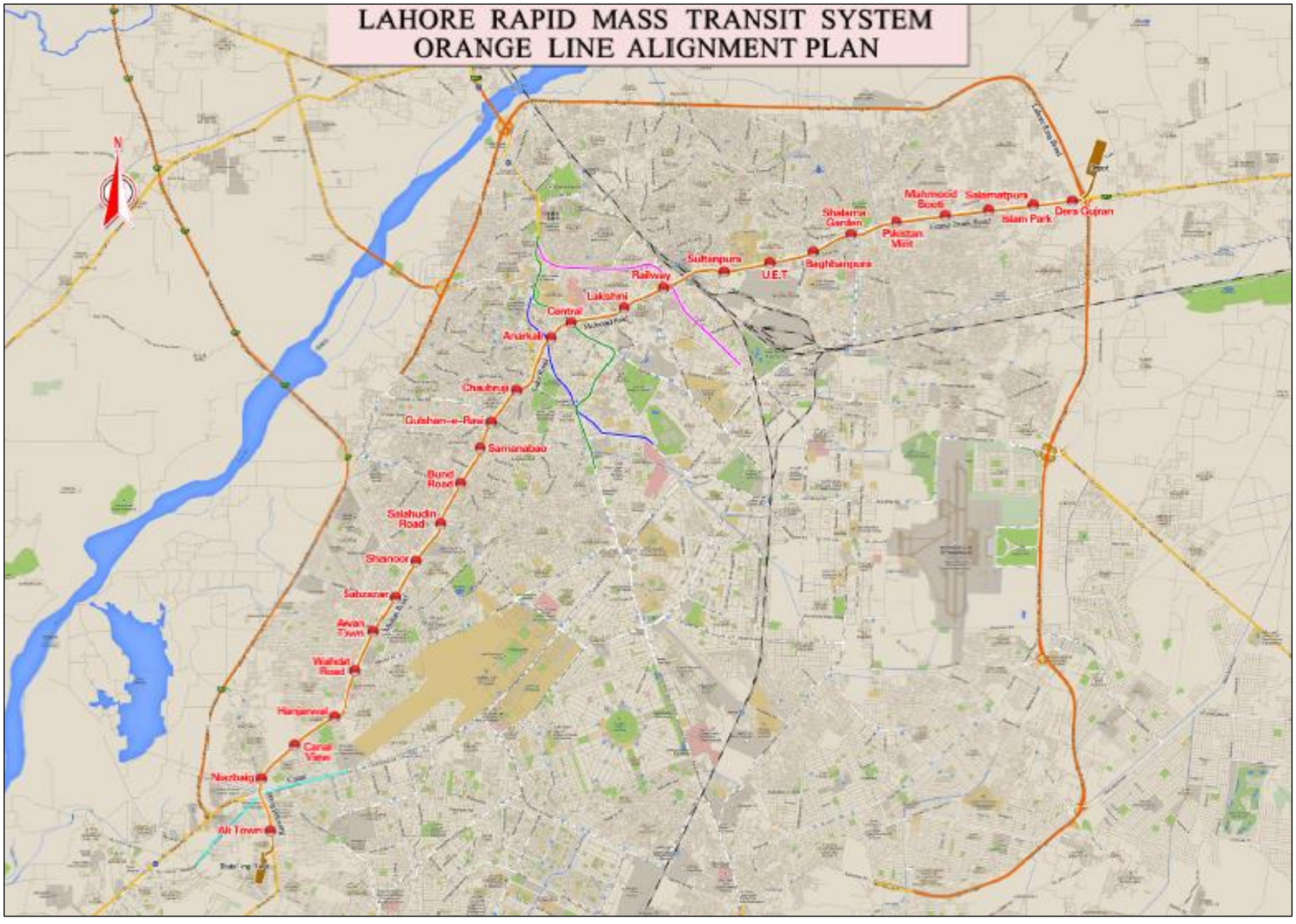

Figure 3.2 (b): LRMTS Orange Line Alignment Plan

3.8 Components of the Project

After optimization, the main line of OL is about 26.23 km long in total, including 1.15 km of underground section, 0.70 km of transition section between underground and elevated sections, and 24.38 km of elevated sections.

At the north end of the line, a rolling stock depot (the depot) covering 19 hectares is designed in the east side of Lahore Ring Road, while in the south end, a stabling yard covering 6.33 hectares is designed to the south of Ali Town. The length of access track in the depot is about 0.56 km and that in the stabling yard is about 0.49 km. The whole line is designed with 2 high voltage substations. A control center and a safety center are set in the depot and share one building.

There are 27 train sets each consisting of 5 cars are being acquired at this stage to meet the ridership demand.

3.8.1 Stations

Total 26 stations are designed along the whole line, including 24 elevated and 2 underground stations (one is one-story and the other is two-storey station with concourse on the ground). The average distance between stations is 1.02 km, while the maximum is 1.54km (from Sultanpura to Railway) and the minimum 0.59 km (from Central to Anarkali). The tentative dimensions of underground stations are 6.7m x 15.4m x 139.5m. Typical plan and sections are attached as Annex XIII (b).

Table 3.1: Station Information

Station Name	Station Type	Station Form	Laying Mode	Station Length	Width of Standard Section	Total Building Area
Dera Gujran	Median three-floor	Side type	Elevated station	102	22.5	4945
Islampura	Median three-floor	Side type	Elevated station	102	22.5	4956
Salamat pura	Median three-floor	Side type	Elevated station	102	22.5	4967
Mahmood Booti	Median three-floor	Side type	Elevated station	102	22.5	4952
Pakistan Mint	Median three-floor	Side type	Elevated station	102	22.5	5029
Shalamar Garden	Median three-floor	Side type	Elevated station	102	22.5	5005
Baghbanpura	Median three-floor	Side type	Elevated station	102	22.5	4948
U.E.T	Median three-floor	Side type	Elevated station	102	22.5	4969

Station Name	Station Type	Station Form	Laying Mode	Station Length	Width of Standard Section	Total Building Area
Sultanpura	Median three-floor	Side type	Elevated station	102	22.5	4988
Railway	Median three-floor	Side type	Elevated station	102	22.5	6075
Lakshmi	Median three-floor	Side type	Elevated station	102	22.5	6060
Central	Underground one-floor station	Side type	Underground station	161.6	49.5	8370
Anarkali	Underground one-floor station	Side type	Underground station	121.5	16	5639
Chauburji	Median three-floor	Sidetype	Elevated station	102	22.5	4935
Gulshan-E-Ravi	Median three-floor	Side type	Elevated station	102	22.5	4935
Samanabad	Median three-floor	Side type	Elevated station	102	22.5	4935
Bund Road	Median three-floor	Side type	Elevated station	102	22.5	4935
Salahudin Road	Median three-floor	Side type	Elevated station	102	22.5	4935
Shahnoor	Median three-floor	Side type	Elevated station	102	22.5	4935
Sabzazar	Road-side three-floor	Side type	Elevated station	102	22.5	4935
Awan Town	Road-side three-floor	Side type	Elevated station	102	22.5	4935
Wahdat Road	Median three-floor	Side type	Elevated station	102	22.5	4935
Hanjarwal	Median three-floor	Side type	Elevated station	102	22.5	4935
Canal View	Median three-floor	Side type	Elevated station	102	22.5	4935
Niazbaig	Median three-floor	Side type	Elevated station	102	22.5	6056
Ali Town	Median three-floor	Side type	Elevated station	102	22.5	4935

3.8.2 Passenger flow analysis

The model was established based on the traffic survey made in 2005 and 2006, and the forecast years are:

- 2015
- 2021
- 2025

This part makes a forecast on the full-day passenger flow, passenger flow section at peak hours, etc. in each forecast year, and the major forecast results are shown below:

Table 3.2: Results of Passenger Flow Forecast on Orange Line

Orange Line	Initial Term (2015)	Short Term (2021)	Long Term (2025)
Length (km)	26.2	26.2	26.2
Passenger Traffic Volume (10,000 person-time/day)	24.52	38.62	49.55
Average Travel Distance (km/person-time)	8.1	——	8.3
Sectional Passenger Flow at Peak Hours (10,000 person-time)	1.01	1.54	2.05

3.8.3 Technical standard and design transport capacity

- The line is designed with double tracks.
- The maximum design speed: 80km/h.
- The minimum headway shall satisfy the demands of passenger flow volume. For this line, the minimum head way is 2minutes, the design capacity of the system is 30 pairs/h and design transport capacity is 30,000 persons/h.
- The design service life of the major structures of station, bridge and tunnel in sections under normal service and maintenance is 100 years.
- The whole line is designed with 2 high voltage substations. A control center and a safety center are set in the depot.
- Operation time of the train is 5:30a.m.to 23:30p.m. (18 hours daily).

3.8.4 Type selection of rolling stock (vehicle)

Chinese standard Type B train of 5-car formation will be used. Main technical parameters of rolling stock are given in **Table 3.4.**

Table 3.3: Technical Parameters of Rolling Stock

Sr. No.	Item	Parameter
1	Number of axle per car	4
2	Axle load	≤14
3	Length of car (mm)	19000□21000
4	Width of car(mm)	2800
5	Max. height of car(mm)	≤3800
6	Distance between bogie centers (mm)	12600
7	Fixed wheel base (mm)	2200 ~ 2300
8	Number of doors on each side	4

9	Maximum running speed of rolling stock (km/h)	80

3.8.5 Depot and Comprehensive Base

- One depot and one stabling yard are set for the whole line and located in the north and south respectively.
- Rolling stock base consists of depot (including stabling yard), comprehensive maintenance center, store house, training center and necessary office and living facilities. It is an important base for maintenance of equipment and facilities of rail transit system, as well as for management of material and equipment and technical training for the staff.
- Layout of the depot is designed according to the demands of application and maintenance of 54 trains in the long term, and the construction in this project can meet demands of 27 trains in the short term.

3.8.6 Track

The tracks, fastenings, turnouts and other track devices shall be the series of products meeting Chinese national standard.

- Rail: 60kg/m rail on the main line and 50kg/m rail in the Depot and Stabling Yard.
- Fastenings: elastic fastenings.
- Turnout: No. 9 turnout on the main line and No. 7 turnout in the Depot and the Stabling Yard.
- The monolithic concrete track bed is used on both the main line and the track in the workshop of the Stabling Yard, and the crushed stone ballast bed is used for other sections.

3.8.7 Power supply system

- **High Voltage Substation**

  For the whole line, two high voltage substations are designed, which are located nearby U.E.T Station and Shahnoor Station. Each high voltage substation is connected to 132kV power supply from the upstream local substation and the Employer shalllay 132KV power lines and lead the power supply into the incoming side of GIS cabinets in the high voltage substation.

- **Traction Substation**

  The whole line is provided with 16 traction substations, among which 14 substations are provided for the main line, 1 for depot and 1 for parking yard. For the station with

a traction substation, the traction substation and lighting and power substation are built separately.

- **Third Rail**

  The whole line is designed with the current collection from DC 750V bottom third rail. The steel aluminum third rail will be applied.
- **Power supervisory control and data acquisition system (PSCADA)**is provided for the whole line, to carry out real-time monitoring, control, data acquisition and processing related to operation status and stray current of the main power supply facilities such as high voltage substation, traction substation, lighting and power substation and third rail.
- **Stray current protection** system is provided for the whole line.
- Dedicated power supply of around 80 MW capacity has to be derived from existing 132kV grid station system of LESCO. The electricity management plan during construction will be given by LESCO at the time of relocation of concerned poles in the respective areas.

3.8.8 Communication system

The communication system is composed of multi-service network system, telephone system, radio-communication system, CCTV system, visual control panel system, public address system, passenger information system, clock system, video & audio recorder system, access control system, power supply system, public wireless communication system, and firefighting wireless communication system.

3.8.9 Signaling system

CBTC system is adopted for the signaling system, i.e. the automatic train control (ATC) system including ATP, ATO, ATS and computer based interlocking (CBI) subsystems.

3.8.10 Ventilation and Air-Conditioning

- Platform screen doors will be designed in the platform of the underground station. Ventilation air conditioning systems will be adopted in public areas of the station in hot season, while mechanical ventilation will be adopted in other seasons.
- Piston ventilation generated when the train operates will be adopted as ventilation in normal condition in section.OTE (Over Track Exhaust) ducts will be designed in section for mechanical ventilation/smoke exhaust when hazard happens.

- Local air conditioning will be equipped in the public areas of ticket hall in elevated station. Natural ventilation will be adopted in public areas of the platform level of station. Natural smoke exhaust will be adopted as a priority for the public areas of the station. When natural smoke exhaust can't meet the requirements, mechanical smoke exhaust measures should be taken.

3.8.11 Water supply & drainage and firefighting system

- Urban tap water is used as the source of water for the whole line. Depth of ground water from which water will be pumped out is about 300 Ft.
- Fire water supply system and chemical fire extinguisher are arranged in the station; and fire hydrant is arranged in the tunnel.
- Fire extinguishing system is arranged in the important equipment rooms of the stations, operation control center, HVS and signal building of the Depot.
- Fire extinguishers within the train will be part of the rolling stock to be provided by the Chinese EPC Contractor namely CR-NORINCO.
- Sewage and wastewater in the station shall be classified and concentrated. The sewage and wastewater will be drained to the municipal drainage system.
- Estimated water requirement during construction is 100000gpd. The civil Contractors will arrange the water from their own source.
- For the elevated viaduct, drain pipes will be provided. The water will be collected through piers into longitudinal pipes running along the alignment and then discharging into the near WASA system. The details will be developed at the time of detailed design.

3.8.12 Fire detection system and building automation system

- The fire detection and warning system will be provided throughout stations, Depot, Comprehensive Maintenance Center and OCC.
- The subsystems of electro-mechanical equipment in station and tunnel will be supervised in OCC, the station master's office, and the Comprehensive Maintenance Center.

3.8.13 Automatic fare collection system

Automatic or semi-automatic ticket selling and automatic ticket checking will be under centralized control of computer.

3.8.14 Escalator and elevator

- Escalator is of reversible operating function.

- The machine-room-less elevator will be adopted.

3.8.15 Systems of Platform Screen Doors and Automatic Platform Gates

- The system of platform screendoors will be set in underground stations.
- The system of automatic platform gates will be set in elevated stations.

3.8.16 Rolling stock depot and comprehensive base

- The rolling stock base will be established in the north and the Stabling Yard in the south.
- The rolling stock base, composed of the rolling stock depot (including the Stabling Yard), comprehensive maintenance center, storehouse, and necessary office and living facilities, etc., is the important base in the rail transit system for the maintenance of all the equipment and facilities, management of materials and apparatus, as well as technical education for the employees.

3.8.17 Operation Control Center

Operation control center and public safety center of this line will be jointly constructed in the depot.

3.8.18 Safety and Security System

- Security equipment of communication and monitoring are constructed together with the communication system.
- Security control room will be set in the station and security center in the depot.
- Safety fence will be provided at cut and cover section and at elevated viaduct for maintenance staff. The details will be developed at the detail design stage and will be provided then.

3.9 Proposed Alternatives

To meet the primary objectives of the project, three different alternatives were studied at the early stages of the project. The detail of these alternatives is given below:

Alternative-I: No Project Option

Alternative-II: Orange Line with cut and cover (1.72 km) and viaduct (5.64) km

Alternative-III: Orange Line with no cut and cover and fully elevated (27.1)

a) Alternative - I No Project Option

Presently, proposed alignment is being used as main access road to travel from all around Lahore and adjoining areas. The accelerated growth of population has led to

increase in vehicular traffic on major roads like Multan Road, Raiwind Road, Hall Road and G.T Road in the city of Lahore. These are the main access roads, which provide links to other major roads. Due to excessive use of these roads, the traffic congestion and traffic load is becoming a major issue. Without the project, the existing traffic problem at these roads and the level of service will further aggravate with the passage of time. Thus, it is important to upgrade the existing public transport facilities to cater the increased vehicular movement and traffic congestion.

b) Alternative – II Orange Line with cut and cover (1.72 km) and viaduct (5.64) km

Alternative II considers solving the problems of lack of quality public transport system, traffic congestion and associated time delays, conflicts/accidents and reduction in air and noise pollution. Reduced fuel consumption and consequent emissions are also the benefits of this option. This option has lesser land acquisition and it minimises affect on the aesthetics of historical/cultural sites falling along the alignment and thus preserves the integrity of the historical sites of Lahore.

c) Alternative – III Orange Line with no cut and cover and fully elevated (27.1) km

Alternative III considers Orange Line with no cut and cover 1.72 km and completely elevated viaduct. This option has lesser cost and lesser land acquisition, however, The alignment passes through structures of historical importance that will affect the visual and aesthetics of the historical sites like Chouburji and Shalamar Gardens thus rendering this option as less feasible.

The following table presents comparison of the different alternatives analysed:

Table 3.4: Comparison of the Different Alternatives

Alternatives		Environmental	Social
Alternative - I	No Project Option	• Existing environmental condition will prevail. However, by the increase in future traffic loads air quality and noise level	• Conflicts • Time delays • Accidents

		will become worse.	
Alternative - II	Orange Line with cut and cover (1.72 km) and viaduct (5.64) km	• Traffic congestion will be solved • Air pollution and noise level will be reduced • Fuel consumption will be decreased • Wear and tear of vehicles will be reduced by smooth travelling facilities	• Reduction in conflicts • Time saving • Reduction in accidents • Land acquisition • Risk of Structural stability historical/cultural sites
Alternative - III	Orange Line with no cut and cover and fully elevated (27.1) km	• Traffic congestion will be solved • Reduction in air pollution and noise due to smooth traffic flow • Fuel consumption will be decreased • Wear and tear of vehicles will be reduced by smooth travelling facilities • Affect on structural stability will be minimised	• Lesser Land acquisition • Time saving • Affect on visual and aesthetics of archaeological/cultural sites.

3.9.1 Selected Option

In the light of above discussion, Alternative II is the most feasible option as it will help resolving traffic congestion resulting in reduction in associated time delays, reduction in fuel consumption, reduction in conflicts/accidents, air pollution and noise. Smooth flow of traffic will also help in lesser wear and tear of vehicles. This option is preferable over alternative III as it does not affect the aesthetics of historical/cultural sites falling along the alignment and preserves the integrity of the historical sites of Lahore.

3.10 Construction Materials

The materials used in construction of the road for the proposed project would include coarse aggregates (crush), fine aggregates (sand), steel, water, asphalt, reinforcement, cement etc. Fine aggregates are locally available in the area, while the soil, cement and steel will be procured from other sources. The details of the construction material for the proposed project are given as under:

Reinforcing steel will be procured from approved list of manufacturers producing steel as per ASTM A615 grade 60 steel. Sand will be Lawrancepur sand while Margalla crush will be used.

To control Environmental impacts associated with material extraction from quarry area, Quarry Management Plan is attached as **Annex I.**

3.11 Construction Camps

Camp sites will be selected keeping in view the availability of adequate area for establishing camp sites, including parking areas for machinery, stores and workshops, access to communication and local markets, and an appropriate distance from sensitive areas in the vicinity. Final locations will be selected by the contractor in consent with supervision consultant after approval from PMA.

3.12 Manpower Requirements

The manpower requirement during construction and operation of the project will include managerial staff, skilled and unskilled labour which will be arranged by EPC Contractor.

3.13 Expected Equipments for Construction

The list of the machinery and the equipment expected to be used for the proposed project is provided in **Table 3.5**.

Table 3.5: Machinery and Equipment Requirement for the Proposed Project

Type of Machinery and Equipment	Type of Machinery and Equipment
Dump Truck	Self-Propelled Pneumatic Roller
Front End Loader	Asphalt Distributor
Dozer	Batching Plant
Grader	Concrete Transit Truck
Vibratory Roller	Concrete Pump
Water Tankers	Excavator
Agg. Spreader	Water Pumps
Three Wheel Rollers	Cranes
Tandem Roller	Vibrators
Asphalt Plant	Generators
Paver	