

CHAPTER – 0

EXECUTIVE SUMMARY AND PROJECT AT A GLANCE

- **PREFACE :**

The Transportation System of a country plays a key role in accelerating the development in all spheres of human life and its settlements. Indian Railways serving the Nation since last century and established a commendable Global Position in Railway Network. Advancement in Technology on construction, operation and maintenance of Railway Track, Indian Railways has remarkable contribution in the field of Socio-Economic Scenario of the country towards fulfilling the aspirations of public in general. Both the passenger and freight traffic on Railway Network is increasing annually by many folds.

Remote and virgin areas are being connected with link Roads and Rails as far as practically possible. The Rail Transport is one of the best modes of transport among all the Surface Transports.

- **PROJECT CONCEPT :**

Indian railways uses four gauges, the 1,676 mm broad gauge which is wider than the 1,435 mm standard gauge; the 1,000 mm metre gauge; and two narrow gauges, 762 mm and 610 mm. Track sections are rated for speeds ranging from 80 to 200 km/h (50 to 124 mph), though trains don't really clock speeds of 200 km/h.

The Project Uni-gauge is in progress to convert almost all tracks to Broad Gauge (B.G) except the existing M.G & N.G lines which are declared as heritage lines and not be converted under the project Uni-gauge.

The share of Broad Gauge (B.G.) in the total route-kilometer has been steadily rising whereas the share of Meter Gauge (M.G) has declined from 45% (24,185 route-km) to 4%. With the changing scenario and more emphasis of IR for new B.G lines to connect new and un explored/ remote areas of the country as well as providing alternative & advance facility, proposal of new B.G Railway tracks are under exploration for construction.

This project is one of the projects under proposal of IR to connect Marwar Jn.(district, Pali) to Mavli Jn. (district ,Udaipur) in the state of Rajasthan by B.G line though existing M.G line is under operation and catering necessary services as usual. The existing M.G route is passing through a rough and mountainous difficult terrain conditions. Total route length of existing M.G rail line from Marwa Jn. to Mavli Jn. Is 151.55 Kms.

- **PROJECT OBJECTIVE:**

To initiate and proceed with the ultimate objective of IR , M/s Pioneer Surveyors of Kolkata has been trusted with the feasibility survey work to propose alternative feasible routes with its study of merits and de-merits for assessment of the competent authorities of IR to finalize the most economic & feasible railway track route alignment only in Ghat section to connect new B.G line between Marwar Jn. Railway Station in Pali district to Malvi in Udaipur in view of modernizing the traffic for faster & comfortable connectivity for both passenger & Freight and also to bear anticipated heavy traffic in future.

This proposed B.G line shall commonly connect at Marwar Jn with the existing B.G Double lines from Palanpur to Ajmer via Marwar Jn and B.G line from Udaipur City to Berach Jn via Mavli Jn.

- **SCOPE OF WORK:**

North Western Railway has engaged “**PIONEER SURVEYORS**” of Kolkata vide letter No. NWR/BNSW/S&C – 484.266032 Vol -O, Dated 19.05.2018 to undertake the Final Location Survey ,Geotechnical Studies, Design, preparation of Drawings and other preliminary activities and work out actual realistic cost & ROR estimated in connection with Gauge conversion Project between Marwar Junction to Mavli Junction of Ajmer Division under control of Western Railway.

Based on desktop study and observations at actual site conditions starting of the project under consideration from existing Marwar Junction at Chainage 0.000 m towards existing Malvi Junction having Geographical location of the Alignment between the Latitude 25° 43' 15.26" N to 24° 47' 41.10" N and Longitude 73° 36' 35.15" E to 73° 58' 24.70" E, ONLY detour alignments have been summarized from existing Km 22.50 (near Phulad Rly. Station) to existing Km 47 (near Kambli Ghat Rly. Station) and match with existing alignment. Keeping other portion of the existing alignment remains unchanged, three Alternative routes shown on Topo map for necessary study and review of the competent authorities of the client for their valued guideline, consideration and formal clearance appropriately.

The Preliminary scope has been followed for alternatives route studies are as follows:

- Rapid investigations of the project area with a view to determine the technical feasibility and approximate cost of one or more routes for a projected Railway line from a general examination with the help of contoured Survey of India maps and other available material with a more careful investigation of the field and with the use

of only those instruments that will rapidly give approximate distances and heights such as GPS, clinometer and similar instruments.

- Preparation of alignment plan and section only for detour portion.
- Verification of some strategic points on ground through Reconnaissance of the area.
- A comparative statement of alternative routes and their merits and demerits. The same has been studied and submitted to Railways for approval of one route based on their assessment.
- Upon receipt of approval of one specific route from Railways based on feasibility Survey report, a Detail Survey Report and Estimate along with necessary drawings is to be prepared for onward submission to the Railways.

- **PROJECT EXECUTION:**

As per the Railway Key Plan of the Marwar Station, it is witnessed that three existing Railway Alignments are passing through Marwar. Therefore, in order to merge the “0.00” chainage to proposed alignment, we would suggest a special junction arrangement at Marwar to take off from the Buffer (at Right side of Marwar Station) towards Palanpur which may be utilized to construct a via duct that would gradually merge into Chainage 4.5Km of existing Marwar-Mavli M.G. line and then collaterally followed upto Phulad (Km.22.50).

From existing Km 22.50 of M.G. route, the proposed B.G alignment has been taken detoured the existing M.G route up to Km 47.0 close to M.G. Kambli Ghat Railway Station. The basic reasons for detouring are due to difficult terrain conditions, lush green forest, wild life sanctuaries and difficult Ghat sections en-route the existing M.G line. There is every possibility of non-compliance of standard specifications in respect of B.G. railway track line ensuring basic future provisions for prospective double track, electrification and all kinds of preventive maintenance. Also forest clearance would be a difficult proposition & bottleneck for a wide range forest en route the existing M.G line. The existing Railway network lies mostly on North – South of the project area. The most critical path considering the topography, Wildlife Sanctuary and Eco – Sensitive Zones, is to negotiate the alignment avoiding the non-congenial factors.

In fact, considering in-depth preliminary study of the existing M.G. line between Marwar Junction to Mavli Junction and expected un-favorable reasons and hurdles , three alternative routes I , II & III have been explored referring relevant Google earth image for verification of route and Geographical contents. Final location survey in connection with Gauge conversion work, starting from existing Marwar Junction Station to existing Mavli Junction

Station portion is entirely based on map studies with Survey of India Topography Sheets No. – 45-G/10, 45-G/11, 45-G/12, 45-G/14, 45-G/15, 45-G/16, 45-K/4, 45-H/13, 45-H/14, 45-L/1 and 45-L/2 of Scale- 1:50,000. Alternative routes has been incorporated in the respective topographic sheets under the heading “L E G E N D” by separate colors viz. Red , Pink & Blue other than the proposed Alignment – PET Survey in light Blue and BEE line in Black color.

● **Brief History:**

- The Project area falls under Pali, Rajsamand, Ajmer and Udaipur Districts in Rajasthan States.
- The proposed Alignment has been taken touching the important locality and suitable Stations have been proposed.
- **Pali**, the District Headquarter town, has varieties of attractions temples such as Jain Temple at Ranakar, Adinath Temple, Parshuram Mahadev Temple, Mahaveer Jain Teertha Pedhi, Somnath Mondir, Hindu Sun Temple, Tapeswar Mahadev Temple etc.
- **Jawai dam:** There are 48 Nos. Dams in the Districts. Some of the reservoirs created by these dams are used for irrigation purposes, as well as drinking water and flood control. Jawai Dam is one of the biggest dams in western Rajasthan. It is situated in Sumerpur Tehsil, Pali district, and has a capacity of 6000 million cubic feet. Jawai Dam is a good tourist spot.
- The area is a Greenland of panoramic beauties and attracts the tourists for the beautiful spots & parks such as Jadan Ashram, Bangur Museum, Lakhotia Garden, Manpura Bhakhari, Maharana Pratap Smarak etc. Jadan Ashram is situated in Marwar Junction Tehsil of Pali district and is hardly 20 km from Pali and is famous for its.
- **Rajsamand**, the District Headquarter town, has varieties of attractions with temples such as Jain Temple, Shrimathiji Temple, Parshuram Mahadev Temple, Mahadev Temple, Dwarkadhesh Temple, Vedi Temple, Muchchal Mahavir Temple etc.
- **Rajsamand Lake** is a beautiful lake and natural view place. It is very famous for enjoying boat ride. It is a perfect picnic point for weekend. This lake is near the Rajsamand city. One of the Best & India's Largest (24 km perimeter) manmade Lake with Sweet drinking water in having historical past. One side of lake is known as Nau Choki Pal, is so beautiful & historical structure. It is Asia's 2nd largest manmade lake.
- **Ajmer**, the District Headquarter town, has lot of famous Temples. These Temples are Ajmer Jain Temple, Nareli Jain Temple etc.
- **Pushkar : Pushkar** located few kilometres from Ajmer, is an important tourist and pilgrimage destination. It is famous for Pushkar Lake and the 14th century Brahma Temple at Pushkar,

dedicated to Brahma, according to the Padma Parana. Pushkar is important pilgrimage site for Lord Brahma.

- **Taragarh Fort:** is the most impressive of structures of city of Ajmer in the Indian state of Rajasthan. A rather ramshackle fort, with its overgrown vegetation, It was constructed in 1354 upon a steep hillside and built under the reign of King Ajaypal Chauhan.
- **Ajmer Sharif Dargah:** It is a shrine of Khwaja Moinuddin Chishti which consists of several white marble buildings arranged around two courtyards, including a massive gate donated by the Nizam of Hyderabad, and the Akbari Mosque, built by the Mughal emperor Shah Jahan and containing the domed tomb of the saint. Akbar and his queen used to come here by foot every year on pilgrimage from Agra in observance of a vow when he prayed for a son.
- **Udaipur**, the District Headquarter town, has varieties of attractions temples such as Mahakaleshwar Lord Shiva Temple, Bohra Ganesh Temple, Maha Laxmi Temple, Lord Vishnu Jagdish Temple, Neemach Ambaji Mata Temple, Lord Shiva Eklingji Temple, Karni Mata Temple, Amba Mata Temple etc.
- **Udaipur** is a popular tourist destination and is known for its history, culture, scenic locations and the Rajput-era palaces. It is popularly known as the "**City of Lakes**" because of its sophisticated lake system. Five of the major lakes, namely **Fateh Sagar Lake, Lake Pichola, Swaroop Sagar Lake, Rangsagar and Doodh Talai Lake** have been included under the restoration project of the National Lake Conservation Plan (NLCP) of the Government of India. Besides lakes, Udaipur is also popular for its massive historic forts and palaces, museums, galleries, natural locations and gardens, architectural temples, as well as traditional fairs, festivals and structures. The Udaipur economy is primarily driver by tourism, though minerals, marble processing, chemical manufacturing and development, electronic manufacturing and the handicraft industry are also contributors.
- Marwar Junction is a 'B' class Station on Palanpur-Ajmer Broad Gauge Section under the administrative control of Ajmer division of North Western Railway. Mavli Junction is a 'B' class Station on Udaipur City-Berach Junction Broad Gauge Section under the administrative control of Ajmer division of North Western Railway.

➤ **Geographical Location:**

- The Geographical Location of Marwar Junction is Latitude is 25⁰ 43' 15.26" N and Longitude is 73⁰ 36'35.15" E. Geographical location of Mavli Junction is Latitude of 24⁰ 47'41.10" N and Longitude of 73⁰ 58'24.70" E. The Project area falls within Pali, Rajsamand Ajmer & Udaipur Civil Districts of Rajasthan State.

- Pali District is picturesque and there are so many number of Tourist spots in the region. The most popular tourist attractions in this District are Jain Temple and other Hindu Temples.
- Rajsamand is also a District town and it is famous for Temples to attract for Hindus devotees.
- Ajmer is the important District Town as well famous Tourist Spot and attractive Temples for devotees.
- The most popular city and District Town is Udaipur and it is famous for Tourist and Picnic a spot which is called “City of Lakes”.
- The project area falls within the range of Ghat / Hill Section and Plain section. The terrain is plain to hilly and some stretches are covered with lush green forest and rocky hills.
- The area close to the alignment is partly agriculture land, Forest Land and main crops are paddy, wheat and green vegetable. The region is covered with ancient and historic places which attracts tourists.
- Surkri Nadi, Chandrabhaga River, Banas River, Modiya Nadi are the major stream flow through the project area.
- Todgarh Raoli Wildlife Sanctuary is coming within the proposed route.
- The Starting of the Project under consideration is from existing **Marwar Junction Station**, reckoned as **Chainage 0.000 m**, increasing towards existing Mavli Junction.
- **Civil Engineering:**
- The Geographical location of the Alignment lies between the Latitude $25^{\circ} 43' 15.26''$ N to $24^{\circ} 47' 41.10''$ N and Longitude is $73^{\circ} 36' 35.15''$ E to $73^{\circ} 58' 24.70''$ E.
- Only detour alignment has been proposed from existing Km. 22.50 (Near Phulad Station) to existing Km. 47 (Khambli Ghat Station) and match with existing alignment. Other portion of the existing alignment is followed with minor modification.
- **Route No.-I:** The route length is about 62.610 Km. There are total 80 nos. Bridges proposed over this Route, out of which 9 Major Bridges, 53 Minor Bridges, 3 ROB, 10 RUB, 5 Viaduct and 538m Tunnel. The Ruling Gradient is kept 1 in 150 (C). In Station Yard 1 in 1200 Grade proposed.
- **Route No.-II:** The route length is about 62.090 Km. There are total 71 nos Bridges proposed over this route, out of which 7 Major Bridges, 52 Minor Bridges, 3 ROB, 7 RUB, 2 Viaduct and 531m Tunnel. The Ruling Gradient is kept 1 in 150 (C). In Station Yard 1 in 1200 Grade proposed.
- **Route No.-III:** The route length is about 45.330 Km. There are total 48 nos Bridges proposed over this route, out of which 18 Major Bridges, 19 Minor Bridges, 2 ROB, 4 RUB, 5 Viaduct and 600m Tunnel. The Ruling Gradient is kept 1 in 100 (C). In Station Yard 1 in 1200 Grade proposed.

- Loading standard of Bridge is “**25 Ton of 2008**”.
- The proposed Track structure will consist of 60 kg new Rails on PSC sleeper of 1660 no per km for Main Line. And 60/52 kg (S.H) Rails on PSC sleeper of 1540 / 1340 Nos per km for Loop Lines. Ballast cushion 350 mm for main line and 250 mm for loop line.
- **Commercial:**
- The Station have been proposed as standard three line X-ing Stations. New Platform has been proposed as per requirement with minimum passenger amenities.
- **Signal & Telecommunication:**
- All new Stations are to be provided with central panel Standard-III interlocking with multiple aspect color light signaling and block working.
- **Traction:**
- At present Diesel Traction is working which is to be electrified in future.

CHAPTER – I

INTRODUCTION

- The Transportation System of a country plays a key role in accelerating the development of the area. Indian Railways serving the Nation since last century and established a commendable Global Position in Railway Network. Advancement in Technology on construction, operation and maintenance of Railway Track, Indian Railways is moving faster to faster. Socio-Economic Scenario of the country is being improved and the aspiration of public in general is increasing day by day. Both the passenger and freight traffic on Railway Network is increasing annually.
- Railway Vision-By 2020, long-felt desires of the common man to be fulfilled i.e., reserved accommodation on trains available on demand, time tabled freight trains, high end technology to improve safety record, elimination of all un-manned level crossings, improved punctuality, higher average speed of freight trains, semi high speed trains running along the golden quadrilateral, zero direct discharge of human waste (Bio-Toilet).
- It is important that Bullet Trains fit into our overall vision for Rail Transport. Inclusion of Bullet Train announced in the last Railway Budget Session 2014-2015, promising to touch the further Mile Stone.
- Railways have taken an ambitious plan to conduct the Final location Survey in connection with Gauge conversion work to find out a feasible & economical alignment only in Ghat section which will be suitable for a new B.G. line in between Marwar Junction – Mavli Junction.
- The proposed route passing through the Civil District of Pali, Rajsamand & Udaipur District of Rajasthan State.
- Day by day the population of the area is increasing. The natural wealth and mineral deposits are being explored. Supply of food grains, medicine and other trading items moves through road by truck which is restricted to small quantities which is an infrastructural constraint for development of the area and expansion of market, trade and business.
- **Pali District** is famous for the natural scenic beauty it offers to the Tourists by Train or Road. It is also very famous for the scenario of sunrise & sunset of the valleys. The area is a Greenland of panoramic beauties and is covered with lot of excellent temples. It offers a variety of attractions to the tourist which includes religious Temples, Jawai Dams. Jawai Dam is a beautiful picnic spot in the area. The terraced villages buzzing with the sweet melodies of the birds take the visitors to a dream land. The simplicity of the tribal folk mixed with the gaiety of their festivals can keep the visitors amused. A visit to the district will be an unforgettable experience. This place is surrounded by small forests in a fascinating manner and natural beauty of it attracts everyone.

- **Jain Temple at Ranakpur:** Ranakpur village is home to important Jain temples. Over 400 marble pillars support the temple. Opposite the Jain temple is the much older Sun Temple. Temples of Ranakpur present a distinct style of their own. The ceilings of the temples are adorned with foliate scrollwork and geometric patterns. The top and bottom part of the domes are joined by Brackets with figures of deities on them. The most important amongst all the temples within the complex is the Chaumukha Temple. Dedicated to the first Jain Tirthankara, Adinath, it is a four faced temple which has a basement of 48,000 square feet (4,500 Sqm). The temple boasts of four subsidiary shrines, 24 pillared halls and 80 domes standing on the support of nearly 400 columns (the total number of columns in the temple complex, however, is much larger, around 1444). Each of the columns is richly carved and no two columns have the same design. Moreover, the columns change colour from golden to pale blue with the passage of every hour during the day.
- The other District, **Rajsamand** is falling under the Project area. It is the District Head Quarter and important town of the District. It has varieties of attraction Temples such as Jain Temple, Shrimathiji Temple, Parshuram Mahadev Temple, Mahadev Temple, Dwarkadhesh Temple, Vedi Temple, Muchchal Mahavir Temple etc.
- The magnificent lake of Rajsamand has regained its beauty after 44 years this year. With good spell of monsoon and lot of efforts by people concerned about the lakes, the water ways to the lake flooded after so many years bringing life back to the lake. Offering landing surface for seaplanes in past, this lake is vast and gives a feeling of an ocean. To add to the beauty, the **Nouchokia Pal** stands as a symbol of royalty, typical of Rajasthan. It is a nice picnic spot to attract the tourist.
- **The Ajmer District**, is the District Head Quarter and important town of the District. It has varieties of attraction Temples such as Jain Temple at Nareli, Jain Temple at Ajmer, etc.
- **Pushkar:** It is famous for Pushkar Lake and the 14th century Brahma Temple at Pushkar, dedicated to Brahma, according to the Padma Purāṇa. Pushkar is important pilgrimage site for Lord Brahma.
- **Anasagar Lake:** This is an historic man-made lake built by Maharaja Anaji (1135–1150 AD). By the lake is the Daulat Bagh, a garden laid out by Emperor Jahangir. Emperor Shah Jahan later added five pavilions, known as the Baradari, between the garden and the lake.
- **Lake Foy Sagar:** It is situated is a picturesque artificial lake that was created as a famine relief project in 1892. It offers views of Aravalli Mountains range as well migrating birds.
- **Prithviraj Smarak:** Prithviraj Smarak is dedicated to Maharaja Prithviraj of Rajput Chauhan dynasty of Ajmer. It is located on the way to Taragarh Fort. This place has a life size statue of King Prithviraj Chauhan mounted on a horse.

- **Mayo College:** The College was founded in 1875 by Lord Mayo, Viceroy of India. It was known as “**Indian Eton**”, as a number of Indian princes studied in this college. The main building, in white marble, is a classic example of **Indo-Saracenic** architecture. In front of the college is memorial statue of Lord Mayo.
- **Nareli Jain Temple:** The Temple is a Jain temple complex of fourteen temples recently built. It is known for its architecture and intricate stone carvings which gives it both a traditional and contemporary look.
- The other **District Udaipur** of Rajasthan State, the District Head Quarters town, has varieties of attractions Temples such as Mahakaleshwar Lord Shiva Temple, Bohra Ganesh Temple, Maha Laxmi Temple, Lord Vishnu Jagdish Temple, Neemach Ambaji Mata Temple, Lord Shiva Eklingji Temple, Karni Mata Temple, Amba Mata Temple etc.
- **Udaipur city** is popularly known as the "**City of Lakes**" because of its sophisticated lake system. Five of the major lakes, namely Fateh Sagar Lake, Lake Pichola, Swaroop Sagar Lake, Rangasagar and Doodh Talai Lake have been included under the restoration project of the National Lake Conservation Plan (NLCP) of the Government of India. The area is a green Land of panoramic beauties and attracts the tourist for the beautiful spots & Parks.
- **Udaipur** is well known for handicrafts such as paintings, marble articles, silver arts and terracotta. The Shilpgram is a platform where regional handicraft and hand-loom products is developed. Craft bazaars are organised by the Shilpgram, with an aim to encourage the regional arts and crafts, the handicraft and hand-loom works.
- **Udaipur**, with its picturesque landscape, lakes, and historic palaces and architecture, is a major destination for tourists, both domestic and foreign nationals visiting the state. Over 1.4 million tourists visited Udaipur in 2016. With numerous hotels to serve visiting tourists, Udaipur is home to some of the world's most renowned and the country's best luxury hotels and resorts. **The Oberoi Udaivilas** has been ranked as the world's number 1 hotel in 2015. **The Taj Lake Palace and the Leela Palace** Udaipur are also amongst the most expensive hotels in the country. With various other renowned hotel chains present in the city, the tourism sector has been a fairly large contributor to the economic growth and fame of Udaipur.
- Day by day the population of Udaipur city area is increasing. Udaipur has dairy, agriculture and road-equipment based industry. Agriculture as in most other parts of the country, remains a leading sector in the city's economy. The Major crops of the area are Maize and Jowar in Kharif season and Wheat and Mustard in the Rabi season. Pulses, Groundnut and vegetables like brinjals are some of the major food products grown in the city. **The Maharana Pratap University of Agriculture and Technology**, along with its affiliated institutions, has been working towards identifying, designing,

preparing and adapting new techniques in the field of production technology for agricultural development since its establishment.

- Supply of food grains, medicine and other trading items moves through road by truck which is restricted to small quantities which is an infrastructural constraint for development of the area and expansion of market, trade and business.
- At present the population of Pali District town and Rajsamand District town area are increasing day by day. Lot of Tourists and Devotees are gathered every day and everywhere.
- The Final Location Survey in connection with Gauge conversion work, starting from existing Marwar Junction Station to existing Mavli Junction Station portion is entirely based on map studies with Survey of India Topography Sheets No. - 45-G/10, 45-G/11, 45-G/12, 45-G/14, 45-G/15, 45-G/16, 45-K/4, 45-H/13, 45-H/14, 45-L/1 and 45-L/2 of Scale- 1:50,000. Google earth image is also used for verification of route and geographical contents. Field verification to some strategic locations along the proposed route was undertaken.
- The existing Railway network lies mostly on North – South of the project area.
- The most critical path considering the topography, Wildlife Sanctuary and Eco-Sensitive Zone, is to negotiate the alignment avoiding the above factors.
- North Western Railway has engaged “**PIONEER SURVEYORS**” of Kolkata, vide letter No.: NWR/ BNSW/ S&C – 484.266032Vol-O, Dated: 19.05.2018 to undertake the Final Location Survey, Geotechnical Studies, Design, preparation of Drawings and other preliminary activities and work out actual realistic cost & ROR estimated in connection with Gauge conversion Project between Marwar Junction–Mavli Junction of Ajmer Division under control of North Western Railway. The Scope of Work related to the work order is as follows.
- **Scope of Work:**
 - Related Topo-Sheets of Survey of India 1:50,000 falls within the Project area will be studied in depth. Possible corridor with alternatives for the proposed new detour B.G Line, will be identified only for Ghat Section from existing Km. 22.50 near Phulad Station to existing Khambli Ghat Station at Km. 47.00.
 - Preparation of alignment plan and section only for detour portion.
 - Verification of some strategic points on ground through Reconnaissance of the area.
 - A comparative statement of alternative routes and their merits and demerits have been studied and submitted to Railways for approval of one Route.

- After receiving approval of Route from Railways on the basis of the Feasibility Survey Report, a Detail Survey Report and Estimate along with necessary drawings will be submitted to Railways finally.

➤ **Terms of Reference:**

- The Terms of Reference (TOR) for the Concerned Project and the Technical parameters of the Survey to be adopted as per TOR, supplied by Railway Department.

➤ **Technical Parameters:**

- **Gauge:** The gauge of the proposed Railway line would be 1676mm (5'6") Broad Gauge, at par with the existing Railway System.
- **Ruling Gradient:** The ruling gradient adopted on the route is 1 in 150 compensated on curves. In Station yards 1 in 1200 grades has been proposed for new Station Yard only. Existing Grade will be followed in existing Station Yard.
- **Fixed Point:** The Center Line of existing **Marwar Junction Station Building (Km. 434.700)** has been considered as **"Fixed Point"** and reckoned as **'Zero'** Chainage of the Gauge conversion work increasing towards existing Mavli Junction Station.
- **Curve:** No curve should be sharper than 2.74 degrees (Radius 638.68m), relaxation up to 4⁰ on need base in Yard approaches. Due to space constrains, Ghat Section and nature of terrain sharpest curve has been adapted on limited case. All curves are provided with suitable transition.
- **Speed Potential:** The maximum speed of the proposed route has been considered as 100 Kmph.
- **Bridges:** All Bridges are to be designed with **25 ton- 2008 Loading Standard**.
- **ROB/RUB:** All roads to be provided with grade separated Crossing (ROB / RUB).
- **Formation width:** Formation width in Bank is 7.850m and Formation width in Cutting is 10.250m including side Drain.
- **Track Structure:** The track is proposed to be laid with 60 kg new rails on PSC Sleeper at 1660 Nos. per Km density over 350mm thick ballast cushion for main Line and for Loop line, the track is proposed to be laid with 60 kg / 52 Kg SH Rails on PSC Sleeper at 1540 / 1340 Nos. per Km density over 250mm thick ballast cushion.
- **Track Centre:** The minimum track centre between two tracks have been kept as per SOD.
- **Level:** All levels related to this survey have been carried out from the Railway Formation Level at existing Marwar Junction Station. The value considered as **269.430m above MSL**.

- **Signal and Interlocking:** Station is proposed to be provided with Standard - III with MACL signaling with centralized Electronic interlocking arrangements.
- **Points & Crossings:** Curved Switches and CMS Crossing on Fan – Shaped layouts to be proposed.
- **Proposed Railway Project:**
 - The project involves, Final location Survey for B.G Line in connection with Gauge conversion work for detour portion only due to Ghat Section in between Mawar Junction –Mavli Junction.
 - **Survey Programme & Methodology:**
 - **Objective of Project Development:** The Project Development objective consists of the following sequences:
 - Assessment of future needs / requirements.
 - Project formulation, which is to determine the various options to meet the demand.
 - Project investigation which is to examine some selected alternatives as defined in the terms of reference and preparation of Techno Economic Survey Reports or Feasibility Reports as the case may be.
 - Project evaluation which may involve economic analysis, or Social Profitability Analysis, in addition to financial appraisal.
 - Selection of a scheme based on such an appraisal.
 - Further detailed examination of the selected scheme by conducting a Preliminary survey wherever necessary for accurate costing and preparation of projects reports and investment decisions.
 - **Route Alignment Survey:** Survey included the following steps:
 - Map study, Project Sheet of existing Line and existing Station Yard Plans.
 - Walkover survey along the existing Railway Line.
 - Route will be carried out for following benefits.
 - Maintenance & additional construction cost can be brought to the minimum.
 - Material Estimation and procurement can be done fairly on realistic basis. Any possible delay/hindrance likely to come during the execution of the work can be avoided, after taking due care of various statutory provisions during the course of selecting route alignment.
 - Limited Reserve / Protected / Private Forest Area.
 - Proper planning can be done for networks keeping provision for future routes etc.
 - Approvals from various Government & Forest authorities etc. can be obtained faster.
 - Preparation of Master Network and fixing construction targets can be done on realistic basis, which will help in the judicious planning of materials flow, cash flow and manpower requirements.

- Appreciable time can be saved during construction & maintenance of routes, if crossing of Rivers, route along hill sections etc., are properly made.

➤ **MAP STUDY:** After drawing various routes of alignment network within the Survey of India Topo-Sheets / Maps, a comparative study will be made on the basis of the following data:

- Route length.
- Nos. and type of important crossing points in each indicating alignment of each route as measured on the map.
- Nature and number of major crossings.
- Mapping the industrial installations, structures, and important places for identification of routes.
- Approach to the line in general for construction & maintenance.
- Reaches through protected or Reserved Forests.
- Continuously long stretches in Hilly Terrain.

➤ **Walkover Survey:** Walkover Survey will be carried out going over the area associated with the routes and collecting features observed other than those existing on the map. In addition the indications on following features are also checked:

- Communication lines.
- Accessibility and smoother approach.
- Logistics of the route.
- Economic viability of the route.
- Existing and Present course of River.
- Power lines (existing HT & LT).
- Expanding villages and towns.
- Rich gardens and plantations.
- Reserved forests and high tree areas.
- National Parks & Wild life sanctuaries.
- Archeological monuments
- Aerodromes, radar centers etc.
- Steep sloping terrain, Areas prone to landslides, soil instability etc.
- Prohibited areas declared under statutory regulations.
- Location of Station and Yard.
- Existing Railway Land Boundary.
- Existing line along with Existing Yard Plan.

➤ **Location of Station:**

- **Reconnaissance Survey:**

Survey Team will rough and rapid investigate of the area with a view to determine the technical feasibility and approximate cost of one or more routes for a projected Railway line from a general examination with the help of contoured Survey of India maps and other available material without a more careful investigation of the field and with the use of only those instruments that will rapidly give approximate distances and heights such as hand GPS and similar instruments.

➤ **Preliminary Survey:**

- In this phase instrumental examination of the route selected as a result of "**Preliminary Survey**" in order to obtain a close estimate of the probable cost of the projected line, under this survey.
- Possible location of Stations and river crossings will be verified on ground.
- Finalizations of the alignment, the following Survey methods are required:
 - Fixation of Horizontal control points by DGPS.
 - Fixation of vertical points (transfer of BM) tertiary leveling and DGPS.
 - Traversing by Electronic Total Station on to fix-up the intermediate station in between two DGPS Control points wherever necessary.
 - Collection of Topographical features particularly on obligatory points like River crossing and down loading the data on computer.
 - Data processing and preparation of alignment plan and profile for approval.

CHAPTER – II

CHARACTERISTICS OF THE PROJECT AREA

➤ **Administrative set up:**

- The project area falls within Pali, Ajmer, Rajsamand & Udaipur Civil Districts of Rajasthan State. The project area is surrounded by Jodpur, Nagur & Jaipur Districts on North, Tonk, Bhilwara, Chittaurgarh & Pratapgarh Districts of Rajasthan State on East, Dungarpur District of Rajasthan State and Gujarat State on South and Sirohi, Jalor & Barmer Districts of Rajasthan State on West.
- The topography of the area is varied with waterfalls, meandering rivers, green forests, High Mountains, hills and undulating plains.
- The project area is now an area of Natural beauty, Famous Temples, Wild Life Sanctuary, Archeological wealth and a historic place of pilgrimage which attract tourists of different interest.
- **National Highway**, NH-8, NH-14, NH-76, NH-48, NH-58 and State Highways pass through the project area and help in connecting to various parts of the District and the State.

➤ **Name of the Districts, Head Quarter , State and Capital:**

<u>Name of the Districts, Head Quarter , State and Capital:</u>				
Sl. No.	Name of District	Name of District Head Quarter	Name of the State	Capital of the State
1.	Pali	Pali	Rajasthan	Jaipur
2.	Rajsamand	Rajsamand	Rajasthan	Jaipur
3.	Ajmer	Ajmer	Rajasthan	Jaipur
4.	Udaipur	Udaipur	Rajasthan	Jaipur

➤ **Area & Population :**

Sl. No.	Name of District	Name of the State	Area (Sq Km.)	Total Population as per Census 2011	Remarks
1.	Pali	Rajasthan	12,387	2,038,533	
2.	Rajsamand	Rajasthan	4,768	1,158,283	
3.	Ajmer	Rajasthan	8,481	2,581,933	

4.	Udaipur	Rajasthan	11,724	3,068,420	
	Total =				

➤ The area is populated with different religious of people; Hindus are the major where as other classes are minor.

➤ **Religions of People (% wise) :**

Sl. No.	Name of District	Hindu	Muslim	Jain	Christian	Sikh	Buddhist	Others
1.	Pali	91.80	7.04	0.93	0.07	0.08	0.01	0.07
2.	Rajsamand	95.60	2.91	1.29	0.07	0.02	0.01	0.01
3.	Ajmer	85.23	12.16	1.77	0.41	0.26	0.02	0.15
4.	Udaipur	93.53	3.40	2.56	0.24	0.14	0.1	0.12
	Total =							

➤ **Literacy rate, Sex Ratio and Density of Population:**

Sl. No.	Name of District	Name of the State	Sex Ratio (female per 1000 male)	Density of population per Sq Km. (No.)	Decadal growth rate (%)	Literacy rate (%)
1.	Pali	Rajasthan	987	165	11.99	63.23
2.	Rajsamand	Rajasthan	990	302	17.18	63.93
3.	Ajmer	Rajasthan	951	305	18.48	70.46
4.	Udaipur	Rajasthan	958	260	23.66	61.82
	Total =					

➤ **Economy:**

- Within this project area people are mostly dependent on Agriculture and some portion of the people are also attached with commercial, Industrial and Cultural activities. The spread of Education and communication facilities and the implementation of various development Projects have helped the inhabitants a lot to change their manners and customs which influence the economy in totality.

- In 2006 the Ministry of Panchayati Raj named **Udaipur District** one of the country's 250 most backward districts (out of a total of 640). It is one of the twelve districts in Rajasthan currently receiving funds from the Backward Regions Grant Fund Programme (BRGF).

➤ **Language:**

- The inhabitants of the area for four Districts of Rajasthan State are mainly Rajasthani, Hindi, Marwari, Dhundhari, speaking people and also English, Punjabi, Bhili, Sindhi, Gujarati and Urdu language speaking peoples are also lived here. This is the border area of two States, Gujarat and Rajasthan for that reason local peoples are habituated both languages in this area. But some local languages are in used in all Districts.

➤ **Literacy:**

- The literacy rate of Pali, Rajsamand, Ajmer and Udaipur Districts of Rajasthan State are about 63.23 %, 63.93%, 70.46% and 61.82 % respectively.

➤ **River:**

- Surkri Nadi, Chandrabhaga River, Banas River, Modiya Nadi are the major Rivers flows through the project area.

➤ **Terrain:**

- The terrain is plain to hilly, river valley with tributaries, green forest and isolated rocky hills.

➤ **Geology:**

- The area falls within Geological System of Quaternary-recent. Soil status varies from gray and brown Soil.

➤ **Climate and Rain Fall:**

- The climate of the area is characterized by an oppressively hot summer with high humidity. Summer generally commences in the month of April and continues up to September. During summer maximum temperature varies up to 35-38⁰ C. The weather remains dry during the winter. In winter Mercury drops down to 0-5⁰ C.
- The rainfall varies from one District to other District. The average annual Rainfall is about 600mm.

➤ **Livelihood Pattern:**

- Among the total population of the projected District Livelihood pattern are of the following nature:
 1. Cultivators

2. Agricultural Labours
3. House hold industry workers
4. Other workers
5. Marginal Workers
6. Non Workers

➤ **Agricultural Crops:**

1. Food Grains (Rice, Wheat, Pulses, Ragi, Bajra)
2. Mustard Oil Seeds, Maize, Jowar etc.
3. Vegetables (Brinjals)
4. Spices (Chilies)
5. Plantation Crops
6. Ground Nut

➤ **Forest Land:**

- Based on legal status, the forests Land of four Districts are furnished below:

Sl. No.	Name of the District	Unit	Total area in District	Total Forest	Reserved Forest	Protected Forest	Un Classified Forest
1.	Pali	Sq Km	12,387	963.58	819.45	141.62	2.51
2.	Rajsemand	Sq Km	4,768	396.58	277.44	119.14	
3.	Ajmer	Sq Km	8,481	570.66	299	271	
4.	Udaipur	Sq Km	11,724	4587.42	2961.25	1626.17	
	Total =	Sq Km					

- **Transport Communication:**

- The following Road Net Work is available at present in and around the project area of four Districts:

Sl. No.	Name of District	Unit	National Highway	State Highway	Major District Road	Other District Road	Rural Road Length	Total Road Length
1.	Pali	Km	259	608	300	3103	409	4679
2.	Rajsemand	Km	155	252	117	308	1982	2814

3.	Ajmer	Km.	163	374	691	633	1916	3777
4.	Udaipur	Km	225	579	270	680	655	2409
	Total =	Km	639	1439	687	4091	3046	13679

- **Industry:**

- The large scale Industry are

1. M/s- Ambuja Cement Ltd. At Pali District,
2. M/s- Maharaja Shree Ummed Mills Ltd. at Pali District,
3. M/s- Shree Cement Ltd. At Pali District
4. M/s- Total Vinetgy Bitumen India Pvt. Ltd. At Pali District,
5. Hindusthan Zinc Ltd. At Udaipur District.
6. Reliance Chemotex Industries Ltd. At Udaipur District,
7. Hindustan Machine Tools Ltd. Ajmer,
8. R. K. Marbles Ltd. Ajmer,
9. Granite Tiles Factory,
10. Marble Blocks Factory,
11. Cement Plant.

- The small scale Industry are

1. Agricultural Implements,
2. Processed Food Products,
3. Hand loom,
4. Textile industries,
5. Wooden based,
6. Paper product.

- **Major Exportable Items:**

1. HMT Machineries,
2. Marble & Granite,
3. Cement,
4. Engineering Goods,
5. The Emery Stone – Flour Mill,
6. Mineral based ball Mill

- **Mineral Resources:**

- The Project area is enriched with mineral deposits. These are Copper, Bauxite, Lime Stone, Granite, Quartz, Dolomite, Mica, Lead Zink and Silver etc.

- **Culture:**

- The folk dances of Rajasthan – Ghoomar Dance, Kalbelia, Kachchho, Bhavai, Ghodi, Garba, Raas, and Dandiya – have spread across the country, and are particularly practiced during the festival of Navratri. Special dancing competitions and lavish feasts are organized during the holy festival and many forms of dances are performed. Raas is a very energetic and colourful dance in which body language; eye contact, expressions and rhythm play a major part. Two circles formed by men and women revolve clockwise and anticlockwise following the rhythm of the music, while clanging their **Dandies** with their respective partners.

- **Kalbelia** dance is the most famous dance form of Rajasthan that is specially practiced in Ajmer and is performed by a tribe of the same name. The Kalbelia dance is performed by both women and men for celebrating joyous occasions. Kalbelias are people who move from one place to another and their main occupation is catching snakes and trading snake venom.

- A type of music called **Fariyad** is also very popular in Ajmer. It is a completely compilation of Qawaalis that are sung in devotion to the Sufi saint Khwaja Moinuddin Chishti. The Khwaja is also praised for his deeds through the Qawaalis. Qawaalis are basically devotional music of the Sufis and they are very popular in Ajmer because of the Sufi saint Khwaja Moinuddin Chishti.

- Folk Songs and Folk dances are the traditional way of amusement and entertainment of the people in the area. These traditional songs are full of classical melody and are based on Ragas. The tribals and people residing in rural areas are fond of singing folk songs and performing the folk dances on the occasion of festivals, fairs, marriages and religious occasions etc. Some of the examples of the marriage folk songs are Mayra Song, Banada and song of Toran. Except that these dances are famous in the District of Sirohi such as Marat Nachna, Gair Dance, Gacchi Ghadi dance and Garba Dance.

- **Festivals:**

- **Gangaur** is one of the most important local festivals in Rajasthan. In some form or the other it is celebrated all over Rajasthan. "Gan" is a synonym for Lord Shiva and "gauri" or "gaur" stands for Goddess Parvati, the heavenly consort of Lord Shiva. Gangaur celebrates the union of the two and is a symbol of conjugal and marital happiness.

- Hindu festivals such as Teej, Holi and Diwali are celebrated with equal enthusiasm. So many People travel to Ajmer and treat it as a base from where they tour the famous **Pushkar festival** that is held annually in Pushkar located near Ajmer, Rajasthan.

- Shilpgram Utsav, Chaitra, Hari Yali Amavasya, Jagannath Rath Yatra and Jal-Jhulni Ekadashi are main festivals in the area.
- **Human Development:**
- Impressive improvement in human development have been noticed since 2001 and scores well in its human development indicators.

No Military base is exists close to the proposed alignment.

CHAPTER – III

DESCRIPTION OF ALTERNATIVE ALIGNMENT

- The proposed conversion of existing Meter Gauge Line to Broad Gauge Line from Marwar Junction Station has been planned dovetailed with the Master Plan of Marwar Junction Station Yard Plan bearing Drawing No. : CAO/C/JP/4016/F-AII-PNU/R-1.
- The proposed B.G. Line will take off from DN Main Line at CSB Ch.: 1202m on Abu Road End and running close to existing Line fly over the Main Line and Proposed DFC Line at Km. 438.70 taking left turn and met with M.G. Alignment near existing Km. 4.500. The route length of the detour portion is about 11.250 Km.
- The existing M.G. embankment has been followed from existing Km. 4.50 to existing Km. 22.50 (near Phulad Station) for conversion to B.G. Route.
- Ghat Section starts from existing Km. 22.50 near Phulad Station (At Km. 25.230) to existing Km. 47 (Khambli Ghat Station at Km. 46.90). The elevation differences of this two Stations is about 294.20m. The Crow fly distance or Bee Line is about 9.50 Km. The inter distance in between this two existing Stations is about 21.670 Km. The existing Grade at present is about 1 in 73.65 which need modification to suit 1 in 150 (C) Grade as per given TOR. For this reason Detour alignment has been proposed from existing Km. 22.50 of M.G. Route near Phulad Station to existing Km. 47 of M.G. Line, very close to Khambli Ghat Station.
- From existing Km. 47 (Khambli Ghat Station) to Mavli Junction Station, the existing M.G. Route has been followed with suitable Junction arrangement at Mavli Junction Station.
- North Western Railway have undertaken the Gauge conversion project for connecting existing Marwar Junction with existing Mavli Junction. Three alternative routes have been drawn and a quick reconnaissance of the area was done **only in Ghat Section**. Some strategic points have been verified on ground. After studying the merits and demerits of three alternatives a comparative statement has been prepared for better appreciation of the route.
- The topography of the area is plain to hilly. The area is covered with isolated small and high hills.
- All the three alignments move through the **Wildlife Sanctuary** which is a highly restricted and protected area where obtaining permission from Forest Department is necessary.
- Different alternative alignments are described below:

➤ **Alternative Alignment –I (Length = 62.610 Km.):**

- The proposed alternative Alignment takes off from existing M.G. alignment at Km. 22.50 (Project Km. 29.00) and moves towards North-East direction and reaches up to project Km. 63. Within this

stretch existing Phulad Station have been relocated and new 4 Stations have been proposed at Project Km. 38.475, Km. 44.830, Km. 52.945 and Km. 61.050 respectively. Thereafter, the proposed alternative Route-I moves towards South-West direction and meets with existing M.G. Line at existing Km. 47 near Khambli Ghat Station (Project Km. 92.200). Within this stretch 2 Stations have been proposed at project Km. 69.100 and Km. 81.030 respectively. Khambli Ghat Station has been relocated at Project Km. 91.610. The route length of the proposed **Alternative alignment-I** is about **62.610 Km**. The alignment is passing through Wild life Sanctuary for about **35.890 km** route length.

➤ **Alternative Alignment –II (Length = 62.090 Km):**

- The proposed alternative Route-II takes off from existing M.G. Alignment at existing Km. 22.50 (Project Km. 29) and moves towards North-East direction up to Project Km 60.50 and meet with Alternative alignment-I at Project Km. 61.10. Within this stretch existing Phulad Station has been relocated at Project Km. 32.10 and 4 new Stations have been proposed at Project km. 38.70, 47.95, 54.17 and 61.460 respectively. Thereafter, the Alternative alignment is common with Alternative alignment –I up to project Km. 91.090. (Existing Km. 47.00). The route length of the proposed alternative alignment Route-II is about **62.090 Km**. This alignment is passing through Wild Life Sanctuary for about **37.438 Km** route length.

➤ **Alternative Alignment –III (Length = 45.330 Km. , Ruling Gradient 1 in 100 C):**

- During study of topo-Sheet, particularly in Ghat Section, one option has been chosen to examine the alternative Route –III with Ruling Gradient 1 in 100 (C).
- The proposed alternative Route-III takes off from existing M.G. Alignment at existing Km. 22.50 (Project Km. 29) and moves towards North-East direction up to Project Km 52. Phulad Station has been relocated at Proj. Km. 32.10. Within this stretch three Station have been located at Proj. Km. 38.225, Proj. Km. 42.360 and Proj. Km. 49.790 respectively. Thereafter, the proposed alignment moves towards South-West direction and meets with existing Khambli Ghat Station at Proj. Km. 74.330 (Existing Km. 47). Within this stretch one new Station has been proposed at Project Km. 62.80. Existing Khambli Ghat has been relocated suitably. The rout length of the proposed alternative alignment-III is about **45.330 Km**. This alignment is passing through Wild Life Sanctuary for about **27.635 Km** route length.

CHAPTER – IV

ANALYSIS OF ALTERNATIVE ALIGNMENT

- Computation of the proposed new route has been calculated considering the following factors since it is on Ghat Section.
- Ghat Section starts from existing Km. 22.50 near Phulad Station (At Km. 25.230) to existing Km. 47 (Khambli Ghat Station). The Location of existing Phulad Station of M.G. Line is Km. 25.23 and the Elevation is about 352.800m above MSL. The Location of existing Khambli Ghat Station of M.G. Line is Km. 46.900 and the Elevation is about 647.000m above MSL. The elevation differences of this two Stations is about 294.20m. (647.00m-352.800m). The Crow fly distance or Bee Line is about 9.50 Km. The inter distance in between this two existing Stations is about 21.670 Km. (Distance = 46900m – 25230m = 21670m). The existing Grade at present is about 1 in 73.65 which need modification to suit 1 in 150 (C) Grade as per given TOR.
- **Now Calculation with Ruling Gradient 1 in 150 (C) :**
- As per given TOR- 2.74° curve (Radius = 638.69m) had to be introduced to suit with hilly terrain and about 50% rout will be on curve. Six new stations are to be proposed for 1200m length each. So, 7200m route length (6 x 1200m = 7200m) will be on 1200 grade i.e. 6m elevation will negotiate.
- As it is on continuous rising gradient, a breathing gradient is to be kept after 5 Km interval approximately for about 700m long stretch. The required route length will be cover (294.20 m-6.0 m) 288.20m elevation, out of which 144.000m elevation will be on 150 Grade and 144.200m elevation, will be on 180 Grade.
- **Therefore the minimum route length required for detour portion up to existing Km. 46.900 (Khambli Ghat Station) :-**

1) 144.00m x 150	=	21600 m
2) 144.200m x 180	=	29565m
3) 6 new Stations x 1200m long	=	7200 m
4) Breathing length @ 5 Km interval		
= (10 stretches x 700m = 7000m)	=	7000 m
Total	=	65365 m

Total Detour Route length is required about 65.365 Km.

- **Now Calculation with Ruling Gradient 1 in 100 (C) :**

- As per given TOR- 2.74⁰ curve (Radius = 638.69m) had to be introduced to suit with hilly terrain and about 50% route will be on curve. Four new stations are to be proposed for 1200m length each. So, 4800m route length (4 x 1200m = 4800m) will be on 1200 grade i.e. 4m elevation will negotiate.
- As it is on continuous rising gradient, a breathing gradient is to be kept after 4 Km interval approximately for about 700m long stretch. The required route length will be cover (294.20 m-4.0 m) 290.20m elevation, out of which 145.000m elevation will be on 100 Grade and 145.200m elevation, will be on 113 Grade.
- **Therefore the minimum route length required for detour portion up to existing Km. 46.900 (Khambli Ghat Station) :-**

1	145m x 100	=	14500 m
2	145.20m x 113	=	16407.60 m
3	4 Stations x 1200m	=	4800 m
4	Berthing length @ 4 Km interval = gradient (8 stretches x 700m)	=	5600 m
	Total	=	413907.60 m

Total Detour Route length is required about 41.391 Km.

- We have examined three Alternative Routes. There are listed below:
 1. Alternative Route-I, Length = 62.610 Km. [Ruling Gradient 1 in 150 (C)]
 2. Alternative Route-II, Length = 62.090 Km [Ruling Gradient 1 in 150 (C)]
 3. Alternative Rout-III , Length = 45.330 Km. [Ruling Gradient 1 in 100 (C)]

Comparative Statement of Three Alternative Routes

Feasibility Report for the proposed Gauge Conversion Project between existing Marwar Junction -
existing Mavli Junction in Rajasthan State.

To find out a suitable B.G. Standard Railway corridor only detour portion in between existing Phulard
Station-Khambli Ghat Station have been Examined.

Sl. No.	Description	Unit	Alignment-I	Alignment-II	Alignment-III	Remarks
1	Route Length	Km.	62.610	62.090	45.330	
2	Grade	Ruling Gradient	m.	150 (C)	150 (C)	100 (C)
		Existing Yard	m.	400	400	400
		Proposed Yard (New)	m.	1200	1200	1200
3	Curve	No.	47	42	45	
	Deg. Of Curve (Maximum)	°	4	4	5	
	Curve Length	Km.	25.349	26.948	21.519	
	% Of Curve Length	%	40.487	43.402	47.472	
4	Bridge	Important	No.	0	0	0
		Major	No.	9	7	18
		Minor	No.	53	52	19
		Viaduct	No.	5	2	5
		RUB	No.	10	7	4
		ROB	No.	3	3	2
		Total =	No.	80	71	48
5	Tunnel No.	No.	1	1	1	
	Tunnel Length	Km.	0.538	0.531	0.600	
	Longest Tunnel Length	m.	538	531	600	
	% Of Tunnel Length	%	0.859	0.865	1.324	
6	Station (New)	No.	6	6	4	
7	Alignment in	Mixed Jungle	Km.			
		Reserved Forests	Km.			
		Protected Forests	Km.			
		Wild Life Sanctuaries	Km.	35.890	37.438	27.635
		Total Forests Length =	Km.	35.890	37.438	27.635
	% of forest length	%	57.323	60.296	60.964	
8	Existing Level Crossing	No.	0	0	0	
9	NH Crossing	No.	0	0	0	

10	SH Crossing	No.	1	1	1	
11	MDR, Village Road Crossing	No.	12	11	5	
12	River Crossing	No.	3	2	0	
13	Filling Quantity	Cum	6,032,827.579	6,429,877.011	12,411,120.927	
14	Cutting Quantity	Cum	10,525,764.696	8,925,933.657	8,976,713.907	
15	Land	Hect.	435.456	428.284	395.954	
16	Comparative Cost per Km. (Approx.)	Crore	10.83	9.40	13.86	

- After in depth study of Survey of India Topography Sheets, field investigation and verification to some strategic Locations along the proposed Route and considering all pros & cons of Comparative Statements of Alternative Alignments, it transpire that **Alternative-II** alignment will get the advantage of preference for first choice on basis of low cost. The main cream of the Route is that it moves close to major Towns and villages. The Zone of influence of the project will cover bit thickly populated area. Major Part of the proposed route is approachable by link roads which will be an added facility during construction Stage. Compare to other Alternative Routes on economic considerations, **Alternative-II alignment** appears to be cheaper than others **Alternatives Route No.-I & Route No. -III**. And also another advantage of the Alternative **Route-II**, is that the height of Cutting and Filling are nominal. The area appears to be hassle free and no other Major constrains is foreseen.
- **Alternative-I:** - The length of Alternative Alignment Route No.-I is coming about 62.610 Km. which is only 0.520 Km longer than alternative Route-II, (Route-II, Length = 62.090 Km.) and 17.280 Km. longer than alternative Route-III, (Route-III, Length = 45.330 Km.). The main demerit of the Route is that the cutting quantity is coming more than other Routes. The height of Abutment and Pier of Major Bridges & Viaducts are coming too high. The length of Viaducts is much more than other routes. For construction point of view it is difficult to construct Major Bridges & Viaduct in the remote area as well as on Hilly terrain. The land acquisition procedure for Construction through **Wild Life Sanctuary** is also very difficult from any other area. The route has been designed with Ruling Gradient of 1 in 150 (C). On basis of construction feasibility and consideration of Railway norms, the alternative alignment -I is not having proper merit for consideration.
- **Alternative-II:** - The length of Alternative Alignment Route No.-II is coming about 62.090 Km. which is 0.510m shorter than Alternative Alignment Route No.-I (Route Length = 62.610Km.) and 16.760 Km longer than Alternative Alignment Route No.-III (Route Length = 45.330 Km.). The

alternative Route is more economical from other routes. The merit of the Route is that the cutting & filling quantity is coming reasonably less than other Routes. The height of Abutment and Pier of Major Bridges & Viaducts are coming normal. The Number & length of Major Bridges is less than other Routes. The route has been designed with Ruling Gradient of 1 in 150 (C). On the basis of construction feasibility & approachable area and considering all pros & cons, the **Alternative Alignment -II** appears to be technically feasible and economically viable.

- **Alternative-III:** - The route has been designed with Ruling Gradient of 1 in 100 (C) considering the Ghat Section and keeping close eye to given TOR particularly for Ruling Gradient . The length of Alternative Alignment **Route No.-III** is coming about **45.330 Km** which is 17.280 Km shorter than Alternative Alignment Route No.-I (Route-I, Length = 62.610 Km.) and 16.760 Km. shorter than Alternative Alignment Route No.-II (Route-II, Length = 62.090). The main essence of this route is shorter length. The main demerit of the Route is that the cutting & filling quantity is coming higher than other Routes. The height of Abutment and Pier of Major Bridges & Viaducts are coming is too high. The number of Major Bridges and length of Major Bridges are much more than others two alternatives. For construction point of view to construction of Major Bridges and Viaducts are also very difficult in the remote area as well as Hilly terrain. In spite of shorter Route length, the alternative alignment –III appears to be not acceptable on economical ground.

CHAPTER – V

CONCLUATION AND RECOMMENDATIONS

➤ CONCLUSIONS:

The following decree and recommendations have been concocted with careful analysis and profound scrutinization of all the merits, demerits & aspects. Detailed study of the *Survey of India* Topo Sheets, Google Earth images and Satellite imageries of the respective area / location have gone into the process along with field verifications. The findings have been made keeping the Meter Gauge Line from (i) Marwar to Phulad and (ii) Khambli Ghat to Mavli intact. The three suggested alignments have been proposed for the Detour section (Km 22 to Km 47.50) only, as elaborated in the '**Comparative Statement**' section (Page 27-28).

➤ RECOMMENDATIONS:

As per the TOR and the specifications therein, we were instructed to propose our conviction considering a Grade of 1:150(C). Accordingly, we have broadly proposed two alignments for the Detour segment (Km 22.50 to Km 47.50): **Alignment I & Alignment II** which have been tabulated based on the findings of the Survey. The remaining portions from (i) Marwar to Phulad and (ii) Khambli Ghat to Mavli have been kept same to the existing M.G. line.

Following close study and understanding of all the consequences and aspects of the mentioned Routes, we could conclude that **Alignment II is the most feasible one from all viewpoints**. This is due to the following factors:

- **Wildlife Sanctuary covered:** Although all the alignments are passing through the restricted zone of Wildlife Sanctuary, Alignment II passes comparatively flat terrain, thereby adding a plus point.
- **Cost effective:** Involves the lowest amount of Total Expense
- Tunnel length is least. i. e. a lesser no. of hills/mountains are countered therefore reducing the total tunnel length in the process of laying a Railway track.
- Fewer number of curves; more feasible
- Minimal count of major bridges enroute

On the contrary, we would like to draw your kind attention to the referred **Alignment III** as can be seen in the Table: '**Comparative Statement**' (Pg 24-26). Apart from **Alignment I & Alignment II** which has been executed with a Ruling Gradient of 1 in 150 (C) (as specified in TOR), we have made an attempt to expand our understanding by studying the impact and consequences of an alignment having Ruling Gradient of 1 in 100 (C). You may note here that, on comparison, it was perceived that despite a higher 'per Km' cost, the overall expense is much lesser due to the fact that the Total Km length is much lesser. You may have a look into the case study. This has been additionally included in the report and is described for your assessment and knowledge.

-: END :-