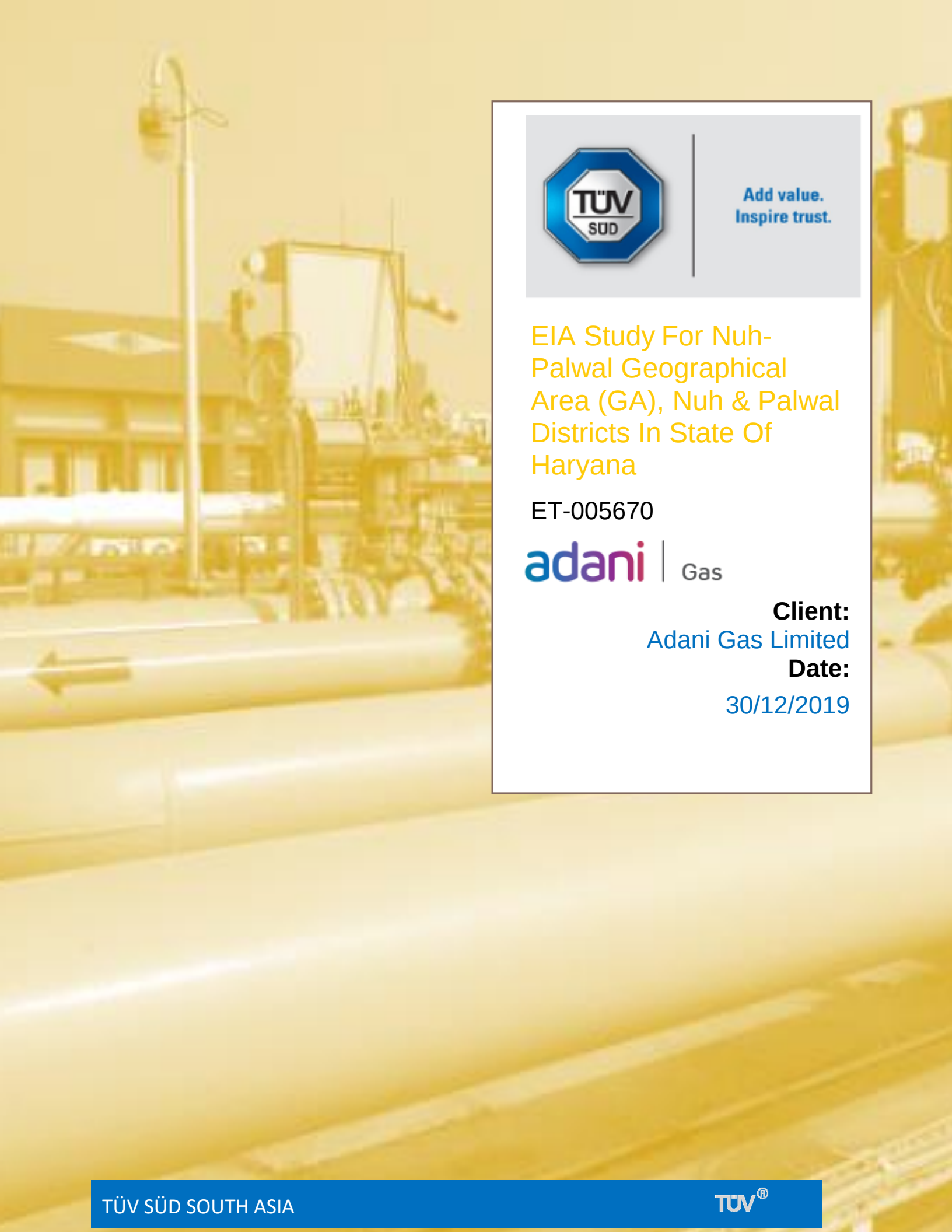

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EIA Study For Nuh-Palwal Geographical Area (GA), Nuh & Palwal Districts In State Of Haryana

ET-005670

adani | Gas

Client:
Adani Gas Limited
Date:
30/12/2019

CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

Adani Gas Limited (AGL) is developing and operating City Gas Distribution (CGD) networks to supply Piped Natural Gas (PNG) to industrial, commercial and domestic (residential) customers and Compressed Natural Gas (CNG) to the transport sector. Natural Gas is a convenient, reliable and environment friendly fuel that allows consumers to enjoy a high level of safety, convenience and economic efficiency. Headquartered in Ahmedabad, India, the company has already set up city gas distribution networks in Ahmedabad and Vadodara in Gujarat, Faridabad in Haryana and Khurja in Uttar Pradesh.

With the Government of India planning to offer additional geographical areas for gas distribution in the Xth round involving 50 GAs comprising of 123 districts coupled with rapid urbanization, AGL is on track to become one of the largest private sector CGD companies of the world. AGL is committed to achieve approximately 23 lakh domestic piped natural gas connections and install approximately 500 CNG stations in these 13 new GAs.

List of 14 GAs (state-wise) for which Adani Gas Limited has been granted authorization to lay City Gas Infrastructure and supply natural gas in the IXth round of CGD bidding is as under:

1. Surendranagar District (Except areas already authorized) -Gujarat
2. Kheda (except areas already authorized), Morbi (Except areas already authorized) & Mahisagar Districts- Gujarat
3. Porbandar District-Gujarat
4. Barwala & Ranpur Talukas-Gujarat
5. Navsari (Except areas already authorized), Surat (Except areas already authorized), Tapi (Except areas already authorized) & The Dangs Districts-Gujarat
6. **Nuh & Palwal Districts (Project Area) - Haryana**
7. Bhiwani, Charkhi Dadri & Mahendragarh Districts- Haryana
8. Jhansi, Bhind, Jalaun, Lalitpur & Datia-Uttar Pradesh and Madhya Pradesh
9. Udupi District- Karnataka
10. Cuddalore, Nagapattinam & Tiruvarur Districts- Tamil Nadu
11. Tiruppur District- Tamil Nadu
12. Bhilwara & Bundi Districts- Rajasthan
13. Chittorgarh (Other than Rawatbhata Taluka) & Udaipur Districts- Rajasthan
14. Balasore, Bhadrak & Mayurbhanj Districts- Odisha

AGL group has been grant authorization for laying, building, operating or expanding the CGD Network in Nuh and Palwal districts in the state of Haryana. The grant has been authorized subject to the petroleum and natural gas regulatory board (authorizing entities to lay, build, operate or expand city or local natural gas distribution networks) regulations, 2008. Under this, the CGD network will be covering 2866 square kilometers of area. The activities of laying, building and operating or expansion of the CGD network had to commence immediately after signing and issuance of authority dated, 13th September, 2018. Also the activities have to be completed as per the mentioned schedule in a tenure of 8 contract years.

1.2 PROJECT BRIEF

Adani group has been grant authorization for laying, building, operating or expanding the CGD Network in NUH and Palwal districts in the state of Haryana. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 2866 square kilometers.

Table 1-1: Description of Work

S.No	Description of Work	Numbers
1	Number of CNG stations (Online and daughter booster stations) to be installed within 8 contract years from the date of authorization	60
2	Number of domestic piped natural gas connections to be achieved within 8 years from 13th September, 2018	181019
3	Inch-km of steel pipeline to be laid within 8 years from 13th September, 2018	803

Source: Adani Gas Limited

Adani group is responsible for designing and installation of optimal size of the infrastructure in terms of pipeline of various types including steel belting of the authorized area, online compressors of adequate capacity for compressing of natural gas into CNG, allied equipment and facilities in the CGD network depending upon the potential demand for natural gas. The infrastructure in the CGD network will be adequate to maintain uninterrupted flow of natural gas in the pipelines and will also be able to maintain supplies at adequate pressure to online CNG stations.

Adani has planned to lay 8” & 4” dia steel pipeline, approx. 165 kms for the gas distribution throughout Nuh & Palwal district. The pipeline runs from Gail Tap-off point (Delhi- Mathura road, near Sikri) to terminal point at Firozpur Jhirkha in their 4-year strategic goal which is divided in three phases.

Phase 1 runs from Gail Tap off point to Hodal city, approximately 48 kms. This line runs parallel to Delhi-Mathura Road, NH-2. Out of 48 kms, 9.2 kms is operational (Sikri tap of point to CNG station at Delhi Mathura Road, NH-2) and 8.5 kms from CNG station to palwal city is under construction, for rest of the route, construction is yet to start.

Phase 2 runs from Hodal city to Palwal city via Bahin, approximately 40 kms in length. This line runs parallel to Hodal- Nuh road which further emerges on Palwal city link road, and runs parallel to it.

Phase 3 runs in two patches, Patch 1: Bahin to Firozpur Jhirka via Nuh, approximately 65 kms. This Patch 2: It runs along the Palwal Alighar road for the approximate length of 12 kms. This stretch is used for close loop pipeline system for connecting to existing delivery points.

Since the project lies in the notified protected forest as well as the Aravalli hills area (Ecologically sensitive region as well as Natural Conservation zone by town and country planning department) as per the published Haryana government gazette, legislative supplement 1981 and the notification of MoEF dated May, 1992. All the project roads are covered under this notification, and are covered under notified protected area. NOC and clearance has to be obtained from Harayana forest department and MoEFCC, as the pipeline would be buried in the Protected area along the Delhi-Mathura Road, NH-2; Hodal- Nuh road; Palwal city link road; Palwal Aligarh road and falls in the arravalli ranges which is a ecological sensitive area.

Also the project district of Nuh falls under the Aravalli plantation region.

1.3 PROJECT IMPLEMENTATION SCHEDULE

A grant of authorization was signed on 13th September, 2018 by PNGRB vide a letter of authorization to AGL group, which was accepted by them on 18th September, 2018. The letter schedule D of the letter stated the year wise work program within the 8 contract year period. The details on which are given in table below:

Table 1-2: Project Implementation Schedule

Tenure	Implementation Schedule		
	Approximate PNG Connections (Cumulative)	Approximate CNG Stations (Cumulative)	Approximate Inch-km of steel pipeline (Cumulative)
September, 2019	Nil	Nil	40

September, 2020	18,102	9	161
September, 2021	36,204	18	321
September, 2022	54,306	27	482
September, 2023	72,408	36	562
September, 2024	1,08,611	45	642
September, 2025	144815	54	723
September, 2026	181019	60	803

Source: Adani Gas Limited

1.4 NEED & SCOPE OF EIA

The purpose of this EIA is to assess the potential environmental impacts due to the proposed project in a study area of 10 km radius around and 500 m on both sides of the pipeline. The assessment covers both construction and operation phases of the project. The EIA forecasts changes (positive and negative) that may occur as a result of key project activities to the baseline environmental conditions in the study area. Early identification of impacts and their mitigation reduces the risk of long-term adverse environmental effects.

Scope of EIA:

- Assessment of the present status of environmental components such as air, water, noise, soil, topography and drainage, traffic and socio- economic conditions based on field data/ secondary data.
- Identification of the potential impacts of various activities proposed to be undertaken during construction and operation phases of the project.
- Prediction and evaluation of the impact of activities.
- Identifying the mitigation measures, management plan and monitoring schedule, if any

1.5 REGULATORY FRAMEWORK

The Ministry of Environment, Forest and Climate Change (MoEF&CC) has notified the Environmental Impact Assessment (EIA) Notification, 2006 under the provisions of the Environment (Protection) Act, 1986, which regulates development and their expansion/modernization of 39 sectors/activities listed in the Schedule to the EIA Notification,

2006. There are two Categories of the projects in the notification namely Category 'A' and Category 'B' projects. Category 'A' projects are appraised at the level of MoEF&CC and Category 'B' projects are appraised by the respective State Environment Impact Assessment Authority (SEIAA) following the procedure prescribed under the EIA Notification, 2006.

The project lies in the notified protected forest area as per the published Haryana government gazette, legislative supplement 1981. As per the gazette, the governor of Haryana declares the strips of government forests land or waste lands whether under tree growth or not on the metaled surface of the roads, under the control of PWD (Building and roads) as on either side of the flowing water course of all canals, branches, distributaries, major-minor channels etc., under the control of irrigation department, the land along the railway track and station yards under the control of northern railways, escape abandoned canals, bunds and other land and transferred to the department for management, mentioned in the schedule to be protected forests and to be provisions of chapter IV of the said Act, to be applicable to them.

As per project/ Activity 6 (a) of Schedule of EIA Notification 2006, Oil and Gas transportation pipelines which pass through national parks, sanctuaries, coral reefs or ecologically sensitive areas sites require Environmental Clearance (EC). The existing MDP facilities and the proposed facilities pass through such areas. Therefore, Environmental Clearance (EC) under project / Activity 6 (a) is applicable for Nuh- Palwal site, as it lies in the Aravalli hills area, which is an ecologically sensitive zone. The clearance is required from MoEF&CC as it lies in Category A. This project requires prior clearance before commencement of activities, since a stretch of 9.2 km is already operational, and an immediate action on the EC is required.

All the project roads are covered under this notification, and are covered under notified protected area. The pipeline would be buried in the Protected area along the Delhi-Mathura Road, NH-2; Hodal- Nuh road; Palwal city link road; Palwal Aligarh road. The approval for the forest land from the State/Central Govt. under Forest (Conservation) Act, 1980 however is not required as the project is exempted under MoEF Notification vide letter no. F.No.11-09/98-FC date 7th November 2014 wherein the laying of underground CNG/PNG pipelines along the roads within existing Right of Way not falling in National Parks and Wildlife Sanctuaries without felling of trees, wherein maximum size of trench is not more than 2 m depth and 1 m width is exempted to obtain general approval under Section-2 of Forest Conservation Act, 1980

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Table 1-3: Applicability of all Act, Laws & Rules to the project

S.No	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
1	Environmental (Protection) Act & Rules, 1986	To protect and improve overall environment	As all environmental notifications, rules and schedules are issued under this act	MoEF&CC GoI, Forest, Ecology & Environment Department, CPCB, HSPCB	Yes
2.	Environmental Impact Assessment (EIA) Notification, 2006	To provide environmental clearance to new development activities following environmental impact assessment	As per project/ activity 6 (a) of Schedule of EIA Notification 2006, oil and gas transportation pipelines which pass through national parks, sanctuaries, coral reefs or ecologically sensitive areas sites require Environmental Clearance (EC). The project lies in Category A of the notification.	MoEFCC	Yes
3.	Forest (Conservation) Act, 1980	To check deforestation by restricting conversion of forested areas into non-forested areas	The project lies along and in the protected forest area. The protected forest area lies along the roads from which the pipeline will pass through	Forest Department, MoEFCC	No
4.	National Forest Policy(Revised) , 1988	To maintain ecological stability through preservation and restoration of biological diversity	As eco sensitive zone exists along the project corridor, from which the pipeline passes through	Forest Department	Yes
5.	Wild Life Protection Act, 1972	To Protect wild life sanctuaries and National Park	No wildlife sanctuary falls within 10 km of the project road.	NBWL, SBWL & Chief Wild Life Warden, MoEFCC	No

S.No	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
6.	Water (Prevention and Control of Pollution) Act, 1974	To control water pollution by controlling emission & Water pollutants as per the prescribed standards	This act will be applicable during construction, for establishments of hot mix plant, construction camp, workers' camp, etc	HSPCB	Yes
7.	Air (Prevention and Control of Pollution) Act as amended in 1987	To control air pollution by controlling emission and air pollutants according to prescribed standards	This act will be applicable during construction; for obtaining NOC for establishment of hot mix plant, workers' camp, stone crusher, construction camp, & other heavy machinery.	HSPCB	Yes
8.	Noise Pollution (Regulation and Control) rules, 2000	Noise pollution regulation and controls	This act will be applicable as vehicular noise on project routes required to assess for future years and necessary protection measure need to be considered in design.	HSPCB	Yes
9.	The Explosives Act (& Rules), 1884	An Act to regulate the manufacture, possession, use, sale, transport, import and export of Explosives	For transporting and storing diesel, bitumen etc.	HSPCB	Yes
10.	Public Liability Insurance Act, 1991	Insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto	Contractor need to stock hazardous material like diesel, Bitumen, Emulsions etc. safely in designated locations within the construction camp	HSPCB	Yes

S.No	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
11.	Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016	Storage, handling, transportation and disposal of hazardous waste	Storage and handling of hazardous waste during construction	HSPCB	Yes
12.	Solid Waste Management Rules, 2016	Management and handling of solid waste	For disposal of solid waste generated during construction	HSPCB	Yes
13.	Construction and Demolition Waste Management Rules	Management of construction and demolition waste	For disposal of solid waste generated due to construction and demolition	HSPCB	Yes
14.	Batteries (Management & Handling) Amendment Rules, 2016	Management and handling of used lead acid batteries	Safe disposal of used lead batteries through authorized e waste recyclers	HSPCB	Yes
15.	E-Waste (Management) Rules, 2016	Effective mechanism to regulate generation, collection, storage, transport, import, export, recycling, treatment and disposal of e-wastes	Handling of e-waste	HSPCB	Yes
16.	Central Motor Vehicles Act , 1988	To control vehicular air and noise pollution	This rule will be applicable to road users and construction machinery	Motor Vehicle Department	Yes

S.No	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
17.	The Petroleum Act 1934, as amended in August 1976 The Petroleum Rules 1976, as amended in March 2002.	Operation, Storage and transportation of Petroleum products	The rule is applicable for as the transportation and distribution of compressed natural gas will take place	Ministry of Petroleum & Natural Gas	Yes
19.	Petroleum and Natural Gas Rules, 1959, amended 2009	As states own the blocks found within their territory and are therefore, responsible for awarding the licenses for onshore blocks,	The rule is applicable for as the transportation and distribution of compressed natural gas will take place through the state of haryana	Ministry of Petroleum & Natural Gas & Harayana State Govt	Yes
20.	The Petroleum and minerals pipeline (acquisition of right of user in land) act, 1962	Acquisition of right of user in land [for laying pipelines for the transport of petroleum and minerals] and Provision of compensation in case of any damage, loss or injury is sustained by any person interested in the land under which the pipeline is proposed to be, or is being, or has been laid	The pipeline passes through residential and commercial areas, It may even passes from or near to private property.	Ministry of Petroleum & Natural Gas	Yes

S.No	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
21.	Petroleum and Natural Gas Regulatory Board Act, 2006	Regulation of refining, processing, storage, transportation, distribution, marketing and sale of petroleum, petroleum products and natural gas excluding production of crude oil and natural gas so as to protect the interests of consumers and entities engaged in specified activities	The project is proposed under this act and is bid out by PNGRB for uninterrupted and adequate supply of petroleum, petroleum products and natural gas in all parts of the country	PNGRB	Yes
22.	The Irrigation Laws (Amendment) Act, 1964	To maintain the uninterrupted flow of natural water ways and canals	For using land under the Right of Way basis for laying the CNG PNG pipeline across a either side of the flowing water course of all canals, branches, distributaries, major-minor channels etc.	Water Resources Department, Govt. of Haryana (PWD)	Yes Application needs to be made
23.	National Highway Authority of India (NHAI)	To manage safety National Highway, State Highway	For using land along the highway on right of way basis for laying the CNG PNG pipeline	National Highway Authority of India (NHAI)	Yes, Application needs to be made

The Environmental issues during pipeline laying & construction stage generally involve equity, safety and public health issues. The construction agencies require complying with laws mentioned below as well:

- **Workmen's Compensation Act 1923** (the Act provides for compensation in case of injury by accident arising out of and during the course of employment);
- **Payment of Gratuity Act, 1972** (gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years);
- **Employees PF and Miscellaneous Provision Act 1952** (the Act provides for monthly contributions by the employer plus workers);
- **Maternity Benefit Act, 1951** (the Act provides for leave and some other benefits to women employees in case of confinement or miscarriage, etc.);
- **Contact Labor (Regulation and Abolition) Act, 1970** (the Act provides for certain welfare measures to be provided by the contractor to contract labour);
- **Minimum Wages Act, 1948** (the employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions);
- **Payment of Wages Act, 1936** (it lays down as to by what date the wages are to be paid, when it will' be paid and what deductions can be made from the wages of the workers);
- **Equal Remuneration Act, 1979** (the Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees);
- **Payment of Bonus Act, 1965** (the Act provides for payments of annual bonus subject to a minimum of 83.3% of wages and maximum of 20% of wages);
- **Industrial Disputes Act, 1947** (the Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment);
- **Industrial Employment (Standing Orders) Act; 1946** (the Act provides for laying down rules governing the conditions of employment);
- **Trade Unions Act, 1926** (the Act lays down the procedure for registration of trade unions of workers and employers. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities);
- **The Child Labour (Prohibition and Regulation) Amendment Act, 2016** An Act further to amend the Child Labour (Prohibition and Regulation) Act, 1986. (the Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry);

- **Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979** (the inter-state migrant workers, in an establishment to which this Act becomes applicable, arerequired to be provided certain facilities such as housing, medical aid, traveling expenses fromhome to the establishment and back, etc.);
- **The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996** and the Cess Act of 1996 (all the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act; the employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for Workers near the workplace, etc.);
- **The Factories Act, 1948** (the Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours and rendering information-regarding accidents or dangerous occurrences to designated authorities).

1.6 CONTENTS OF THE EIA REPORT

The report has been divided in to the following chapters

Chapter 1: Introduction

This chapter provides background information of the existing pipeline, brief description and objectives of the project, scope of the study.

Chapter-2: Project Description

This chapter presents the details of the proposed project with description of the resources required and emissions, waste and wastewater anticipated to be generated.

Chapter-3: Description of Environment

This chapter describes the existing baseline status of environment components collected in a pre-defined study area based on primary and secondary data collection.

Chapter 4: Anticipated environment impacts and mitigation measures

This chapter describes the potential impacts of the proposed project and evaluates their significance based on parameters such as Intensity, Spatial extension, Temporal duration and Environmental Vulnerability. Impact avoidance and mitigation measures are delineated.

Chapter 5: Additional Studies

This chapter assesses the potential risks involved in the construction and operation of proposed facilities and presents a Disaster Management Plan (DMP).

Chapter 6: Analysis of Alternatives

The chapter entails the alternative options for the project.

Chapter 7: Project Benefits

This chapter presents the details of direct and indirect benefits due to proposed project.

Chapter 8: Environment Monitoring & Management Plan

This chapter describes the details of the monitoring schedule to be implemented for checking the effectiveness of mitigation measures. It covers the parameters, frequency and location of monitoring. If existing monitoring schedule is sufficient to cover the proposed development, the same has been clearly mentioned.

The chapter also describes the organizational structure and resources planned for implementing the mitigation measures and monitoring schedule.

Chapter 9: Summary & Conclusions

This chapter summarizes the potential positive and negative environmental impacts of the project.

2 PROJECT DESCRIPTION

2.1 DESCRIPTION OF THE CITY GAS DISTRIBUTION PIPELINE

Adani has planned to lay 8" & 4" dia steel pipeline, approx. 165 kms for the gas distribution throughout Nuh & Palwal district. The 8 inch pipeline has been planned in Palwal stretch for 95 km and 4 inch pipeline has been planned to be put up in remaining stretch. The pipeline runs from Gail Tap-off point (Delhi- Mathura road, near Sikri) to terminal point at Firozpur Jhirkha in their 4 year strategic goal which is divided in three phases.

Phase 1 (Green Line) runs from Gail Tap off point to Hodal city, approximately 48 kms. This line runs parallel to Delhi-Mathura Road, NH-2. Out of 48 kms, 9.2 kms is operational (Sikri tap of point to CNG station at Delhi Mathura Road, NH-2) and 8.5 kms from CNG station to palwal city is under construction, for rest of the route, construction is yet to start.

Phase 2 (Blue Line) runs from Hodal city to Palwal city via Bahin, approximately 40 kms in length. This line runs parallel to Hodal- Nuh road which further emerges on Palwal city link road, and runs parallel to it. This stretch is used for close loop pipeline system for connecting to existing delivery points

Phase 3 runs in two patches, Patch 1 (Orange Line) : Bahin to Firozpur Jhirka via Nuh, approximately 65 kms. This Patch 2 (Red Line): It runs along the Palwal Aligarh road for the approximate length of 12 kms.

Table 2-1: Details with coordinates for different phases of the pipeline project

S.No	Phases	Start Point	End Point	Length (km)
1	Phase 1	$28^0$15'58.34 N, $77^0$17'19.77 E	$27^0$52'19.87N, $77^0$23'25.64 E	48
2	Phase 2	$28^0$08'05.10 N, $77^0$19 45.28 E	$27^0$54'45.77N, $77^0$21'54.78 E	40
3	Phase 3-Patch 1	$27^0$57'42.36 N, $77^0$15'58.70 E	$27^0$46'27.57 N, $76^0$56'41.93 E	65
4	Phase 3-Patch 2	$28^0$08'35.09 N, $77^0$20'06.55 E	$28^0$06'27.10 N, $77^0$27'00.33 E	12

Source: Primary Survey, TUV SUD

The proposed project will be completed in approximately 36 months from the date of approval environmental & other statutory clearances.

2.2 PIPELINE ROUTE & ACCESSIBILITY

The pipeline runs parallel along the various roads, accessibility is not an issue. Project pipeline runs along Delhi-Mathura Road, NH-2; Hodal- Nuh road which further emerges on Palwal city link road; Palwal Aligarh road & the road connecting Bahin to Firozpur Jhirka road. The route covers 55 villages in 5 talukas and 2 districts.

Table 2-2: List of villages, cities, talukas and districts of Haryana falling in the project area

S.No	City/ Village		Taluka	District	State
1	1. Alapur 2. Atoha 3. Bahrola 4. Bamni Khera 5. Dholagarh 6. Softa 7. Prithla	8. Miranpur 9. Patli Kalan 10. Khusropur 11. Jalapur khalsa 12. Durgapur 13. Gailpur 14. Ratipur	Palwal	Palwal	Haryana
2	1. Nangal jat 2. Bahin 3. Manpur 4. Kondal 5. Andhrola 6. Hathin 7. Ghigraka	8. Firozpur Rajput 9. Sanpal 10. Mangoraka 11. Kot 12. Jararai 13. Uttawar 14. Malai	Hathin		
3	1. Hodal City 2. Aurangabad 3. Mitnol 4. Tumsara	5. Bhulwana 6. Sundhad 7. Hussainpur	Hodal		
4	1. Nuh City 2. Adbar 3. Raipuri 4. Thekarka	5. Ujina 6. Marora 7. Malab	Nuh	Nuh	
5	1. Asaisika 2. Bhadas 3. Ferozpur Jhirka 4. Dhanwala 5. Jalalpur Nuh 6. Kherli Nuh	7. Madhi 8. Mandikhera 9. Mohmadbas 10. Nasirbas 11. Pol 12. Pithorpuri 13. Baghola	Firozpur Jhirka		

Source: Primary Survey, TUV SUD

Figure 2-1: Route Map for the pipeline

Source: Adani Gas Limited

Table 2-3: List of canals & Ponds falling in our pipeline route in the districts of Haryana

S.No	River/Canal/Rivulet	Project Phase
Along Phase 1- Delhi Mathura Road, NH-2		
1.	Pokhar	Green Line
2.	Khetala Pond	Green Line
3	Canal Near Bonchari	Green Line
Along Phase-2, Palwal Link Road		
4.	Pokhar	Blue Line
5.	Khetala Pond	Blue Line
6.	Canal Near Bonchari	Blue Line
Along Phase-3, Palwal Aligarh Road (Patch 1)		
7.	Canal crossing near Basant Garh	Red Line
Along Phase-3, Hodal- Nuh Road (Patch 2)		
8.	Canal near Kolonjar	Orange Line
9.	Canal near Ujina	Orange Line
10.	Canal near Nuh Junction point	Orange Line

Source: Primary Survey, TUV SUD

2.3 PIPELINE DESIGN & CODE

As stated in PNGRB Notification 2008, the design, materials and equipment, welding, fabrication, installation, testing, operation and maintenance and corrosion control of CGD network shall be in accordance with requirements of ASME B31.8 except insofar as such requirements are specifically cancelled, replaced or modified by the requirements specified in these regulations.

The CNG Station, CNG Mother Station, CNG On-Line Station and CNG Daughter Station shall be designed, operated and maintained in line with the requirements of the Chief Controller of Explosives as detailed in the Gas Cylinder Rules, 2004 as modified or amended from time to time. This includes compression, handling and transportation activities of compressed natural gas.

It is intended to apply these regulations to all new and such aspects of already existing networks as design, fabrication, installation, testing at the time of construction and commissioning. However, if an Adani has laid, built, constructed or expanded the CGD infrastructure based on some other standard or is not meeting the standards specified in these regulations, then it needs to carry out a detailed technical audit of its infrastructure through a Board authorized or approved third party agency by the Board. Adani thereafter shall submit the recommendations made by the third party along-with its time-based mitigation plan and implementation schedule to the Board for authorization within six months from the date of notification of these regulations.

Technical standards and specifications mentioned in PNGRB notification, 2008 including safety standards (hereinafter referred to as standards) for city or local natural gas distribution networks are as specified in Schedule–I which cover material and equipment (Schedule–1A), welding (Schedule–1B), piping system components and fabrication (Schedule– 1C), design, installation and testing (Schedule–1D), operating and maintenance procedures (Schedule–1E), corrosion control (Schedule–1F) and miscellaneous (Schedule–1G).

Table 2-4: Applicable Standards & Codes

S.No	Standards & Schedule	Applicability
1	ASME B 16.25	Butt welding Ends
2	ASME B 31.8	Gas Transmission and Distribution Piping Systems
3	ASME B 16.11	Forged Fittings, Socket Welding and Threaded
4	ASME B 31.3	Process Piping
5	ASME B 31.4	Pipeline Transportation System for Liquid Hydrocarbons and Others
6	ASME B 16.5	Pipe line flanges and flanged fittings
7	ASME B 16.9	Factory made- Wrought Steel Butt welding Fittings

8	ASME PTC 10	Performance Test Code on Compressors and Exhausters
9	PNGRB T4S	Pipeline Design & Material Selection
10	PNGRB Regulation, 2008-Schedule–I A	material and equipment
11	PNGRB Regulation, 2008-Schedule–1B	welding
12	PNGRB Regulation, 2008-Schedule–I C	piping system components and fabrication
13	PNGRB Regulation, 2008-Schedule–I D	design, installation and testing
14	PNGRB Regulation, 2008-Schedule–I E	operating and maintenance procedures
15	PNGRB Regulation, 2008-Schedule–I F	corrosion control
16	PNGRB Regulation, 2008-Schedule–I E	miscellaneous

Source: Secondary Data Survey, TUV SUD

Table 2-5: Technical details for the proposed pipeline

S.No	Description	Piping Details
1	Pipeline internal Diameter (Inches)	8” & 4”
2	Normal operating pressure	19-40 kg/cm^2
3	Maximum allowable operating pressure	40 kg/cm^2
4	External Coating type & specification	
5	Design Throughput (MMSCMD)	0.3 MMSCMD
6	Pipeline Design Life	25 years
7	Design Temperature (C)	0-60 degree centigrate
8	Rating of Piping Components	Schedule 40 (API 5L *42)
9	Mainline Valve Stations	Will be installed at every 3 kms for the complete length of the pipeline

Source: Adani Gas Limited

2.4 ASSOCIATED FACILITIES

2.4.1 SCADA, TELECOMMUNICATION & LEAK DETECTION

The Master Control Station shall be equipped with Supervisory Control and Data Acquisition (SCADA) software running under multi-programming, multitasking real time operating system environment. The SCADA software shall incorporate control & monitoring of all locations including Block valves. Leak Detection system shall be provided and the Leak Detection Software shall run

in a separate machine at Master Control Station. This package will enable the operator to take optimal control actions and thus ensure the safety and security of the pipeline network.
The CGD system should have leak detection system in position and should be operative. For pipeline network it shall be odorisation based and for enclosures such as CGS, above ground DPRS, it shall be gas leak detection based. Gas detectors shall be installed at strategic locations covering to detect any gas leakage.
The Phase 1 of the project is partially operational, the part of phase 1 which is operational still does not have SCADA as well as the leak detection system.

2.4.2 FIRE ALARM & FIRE FIGHTING SYSTEMS

As per the Petroleum and natural gas regulatory board notification 2008, Schedule 1 D, after construction activities relevant warning signs shall be displayed in the area. A proper Emergency Response Plan shall be in place and emergency contact numbers of relevant agencies should be visible. Firefighting equipment's should be available during commissioning.

As per the PNGRB notification, 2008 AGL operating CGD Networks shall provide for an Emergency Control Room, manned round the clock and equipped with effective communication system and emergency vehicles fitted with communication facilities, first aid equipment, fire extinguishers, gas detectors, repair kits and tools, maps, plans, material safety data sheets etc. at its disposal. The CGD entity shall put in place an Emergency Response Plan, a Disaster Management Plan and a Pandemic Plan. While preparing these plans the entity shall take into confidence the various local authorities (i.e. The Fire authorities, Police authorities, Health authorities, local administration, Disaster Management authorities, Mutual aid, Factory inspectorate etc) and clearly elaborate on their role in case of an incident.

The above mentioned systems are yet to put in place for the operational 9.2 km stretch.

2.4.3 CORROSION PROTECTION

Underground carbon steel section beyond transition fitting is below ground, it shall be protected against corrosion by minimum 400 micron thick 2 pack high build epoxy coating. Above ground service piping shall be Galvanized Iron or copper or carbon steel protected by anti-corrosive coating.

2.5 LAYING OF PIPELINE

The pipeline construction is proposed to be carried out through deployment of 4 to 5 spreads. The sequence and methodology of construction of new pipeline is given below:

- Clearing and grading - A 30 m wide Right of Use (RoU) area will be cleared off vegetation and other obstacles such as boulders. Tree felling will not take place.
- Stringing–Pipes are transported to the site on trucks will be offloaded using side booms. Pipes are then strung adjacent to the trench. Trailers and cranes will be used for maneuvering of pipes. This activity may be done before or after trenching.
- Trenching - Trenchers and backhoe type excavators will be used to dig the trench for laying the pipeline. The topsoil in agricultural areas will be removed and stockpiled for restoration. The excavated sub-soil will be stockpiled separately for backfill.
- Bending – Pipes will be bent using a bending machine to the appropriate angle to match the vertical and horizontal alignment of the trench.
- Welding - Welding will be done using conventional manual/ semi-automatic welding involving a crew of welders and fitters. Once the pipe is strung a line-up crew will position the pipe using side booms in preparation for welding. Pipe strings to be welded will be effectively earthed. During welding, atleast one end of the pipe string will be closed to prevent a forced draught effect.
- Non-Destructive Inspection - Mechanized Ultrasonic Testing (MUT) is the specified method to be applied for the execution of NDT. Each field weld will be 100% radiographed to test for soundness of the weld in compliance with specifications. NDT and its evaluation shall be performed in accordance with API Standard 1104.
- Coating: After welding at each weld joint, coating of field joints of bare pipes and the repair of coating shall be done by.
- Burial - General burial depth of the pipeline along the route will be with a minimum 1.0 m cover. Burial cover will be compacted to avoid future erosion by all weathers.
- Backfilling - The excavated sub-soil will be returned to the trench. The topsoil, which has been preserved on the side of the ROU, will be spread over the filled up trench. A crown of soil will be kept on top of the trenched portion to allow for future settlement. Backfilling will be managed so that damage from sizable rocks is not used or any other materials that may damage the pipeline.
- Crossings - The method used for the crossing of waterways and other infrastructure facilities will vary from place to place depending on the environmental setting and the geo-technical features of the area. The detail method of various types of crossings is specified below.

Table 2-6: Type of crossings required for various type of infrastructure

S.No	Type of Crossing	Method of Crossing
1	National Highway	Conventional Trenching/ HDD
2	State Highway	Conventional Trenching/ HDD
3	Other Roads	Conventional Trenching/ HDD
4	Railway Crossing	HDD
5	Major Lined Canal	HDD

6	Unlined Canal	HDD

Source: PNRGB Notification, 2008

- Restoration - Restoration of the ROU will be conducted progressively following the completion of construction work. This will involve removal of foreign materials such as construction debris and wastes. The ROU will be returned to its original condition by spreading the topsoil over the areas from where it was stripped, so that agricultural activities will be restored. Special focus will be given to restoration of side slopes and beds of natural water body crossings.
- Pipeline warning markers–In the final stages of construction, warning marker posts will be erected indicating the location of the pipeline and the crossing of other pipelines, cables and features. A marker tape will be placed in the trench 500 mm above the pipeline to indicate to future excavators that a pipeline is below and that they are nearing

The major construction activity involved during laying of pipeline are as follows:

- Transport of pipes from the place of availability to stock/lining yard.
- Transporting of pipes from the stock / lining yard to suitable places along the route of the pipeline.
- Application of lining and coating.
- Fabrication of fittings and special lining and coating of the same.
- Excavation and preparation of trenches for the pipes. Topsoil to be kept separately.
- Lowering the pipes into the trench.
- Jointing of pipes inside the trench.
- Welding of pipes.
- Rectification of defects and re-testing
- Finishing the coating and lining at weld joints.
- Back-filling of the trench with top soil layer.
- Construction of valve chambers and erection of valve.
- Construction of necessary pipe supports, anchor blocks.
- Providing line markers

2.5.1 SITE PREPARATION & LAYING METHODOLOGY

The project is for laying of a Gas pipeline with open trenching. However, for the Portion passing through, train tracks, Canals, ponds bridges will be done by Horizontal Directional Drilling Method (HDD) to reduce the environmental impacts to minimum.

The usual approach to pipeline installation is to dig an open trench, place the pipeline and then bury it. Proposed pipeline is passing through commercial, industrial residential, agricultural areas, water bodies, public spaces etc shall be laid by:

1. Horizontal Directional Drilling (HDD) method for pipeline.
2. Open cut method for remaining portion of pipeline.

Horizontal Directional Drilling (HDD) is a Trench-less methodology that provides an installation alternative that can offer a number of benefits over traditional open-cut method.

- In a sensitive wetland environment such as a river/creek crossing, wildlife habitats would be destroyed and extensive mitigation efforts would be required while pipe laying by open cut method. As a result, trenchless or "no-dig" technology has been used extensively worldwide.
- HDD can be implemented with very little disruption to surface activities, requires less working space, and may be performed more quickly than open-cut methods.
- 8” Nominal bore, & 4” Nominal bore pipelines Steel Pipelines laid together by HDD methodology and remaining length of CRZ portion by Open Cut Method.

Open Cut Method is a usual approach to pipeline installation is to dig an open trench, place the pipeline and then bury it.

- Pressure shall be between 16-40 Bar, 3 layer PE coated steel pipes for the transportation of gas to its delivery centers.

2.5.2 PIPELINE BURIAL

As per the Petroleum and natural gas regulatory board notification 2008, all types of pipes (plastic and steel) and fittings shall be laid underground and shall not be exposed. The buried service lines are provided with a minimum cover of 1.0- 1.5 m. Where it is impractical to provide 1.0 m cover due to physical constraints, additional protective measures such as concrete slabs or high impact resistance plastic sheets shall be installed at least 300 mm above the service line. In no case the depth of cover shall be less than 600mm. For transition from plastic pipe to GI pipe, transition fittings shall be used. Plastic part of transition fitting protruding above ground shall be protected by encasing it with concrete guard.

In case carbon steel section beyond transition fitting is below ground, it shall be protected against corrosion by minimum 400 micron thick 2 pack high build epoxy coating. Above ground service piping shall be Galvanized Iron or copper or carbon steel protected by anti-corrosive coating.

In cases where HDD is used for pipeline burial, plastic or carbon steel, adequate depth of 2-2.5m shall be maintained under if the pipeline is going below from any of the listed features, i.e river/ canal beds, highways, roads, houses and industries.

Table 2-7: Minimum depth of cover for buried steel pipeline

S.No	Location	Minimum Cover (m)
1	Normal/ Rocky Terrain	1.0
2	Minor River/ unlined canal/ nala crossing/ tidal areas/ other water courses	1.5
3	Major River Crossings	2.5
4	Rivers with rocky bed	1.5
5	Lined canals/ drains/ nalahs	1.5
6	Drainage ditches at roadways and railways	1.0
7	Rocky Areas	1.0
8	Cased/ uncased road crossing	1.2
9	Cased railroad crossing	1.7

Source: PNGRB Notification, 2008

2.6 PROJECT REQUIREMENT

2.6.1 LAND

The land required for the project is only for CNG Stations and Tap off points. 60 CNG stations have to be setup for this project and one tap off point. The land for the Tap off point has been bought near to the GAIL Tap off point, as the LPG/CNG will be bought from Gail and converted to CNG and transported further. Vacant land has already been bought with an area of 1.5 Acres. Rest all the required land will be bought in the near future.

2.6.2 MANPOWER RESOURCES

During the construction phase, local skilled and unskilled labour will get temporary employment based on required skill sets. However, as the development will be phase wise, the total number of locals employed at any one time may not be more than 500- 600. Adani, has contracted out the construction work and management of labour to shanti contractors, local skilled and unskilled workers and service providers are preferred in order to boost local employment generation. As far as operation phase is considered, guards will be employed to patrol the pipeline areas, which will be around 20-30 people for this stretch. Skilled workers will be employed for the operation and maintenance. All these will also be contracted out to the subcontractors.

2.6.3 POWER REQUIREMENT

Power requirement will be bet from DG Sets during construction phase of the project.

2.6.4 WATER REQUIREMENT

Water requirement will be minimal for the project associated only with domestic use by the workers during construction and office staff during constructions and operations period at the

distribution centers. The water requirement for construction phase will be contracted out to private tankers. During the operation phase, water requirement will only be at the CNG stations.

2.6.5 EMISSION AND DISCHARGES

Fugitive dust shall be the main air pollutant, from the small diesel engines used for the construction works & movement of vehicles for which dust suppression system will be used as relevant points. No effluent will be generated during operation of the proposed project.

3 ENVIRONMENTAL DESCRIPTION

3.1 STUDY AREA

This chapter summarizes the available baseline data on physical and biological resources within the principal area of interest i.e. the project area that would comprise of project components and associates facilities. Key existing sources of information used for this section comprises of government departments, analysis of available research papers and secondary data review from established sources such as Indian Meteorological Department, etc. Reconnaissance visits and physical, social and biological field surveys were carried out in November, 2019 to supplement the existing baseline data.

The scope of environmental assessment, existing features of the project and proposed improvement, methodology and regulations applicable to environmental assessment is highlighted in the previous sections. In this chapter, an attempt has been made to prepare a baseline environmental setting to meet out the applicability of Government of India (GoI) regulatory requirements. Considering the existing environmental scenario, potential impacts of road improvement will be identified and accordingly management plan will be proposed in forthcoming sections. The baseline environmental conditions will help in comparing and to monitor the predicted negative and positive impacts resulting from the project during construction and operation phases.

The area falling within 10 km radius from the project boundary has been considered as “Study Area” for the purpose of conducting EIA Study. The baseline data generation includes site visits, ecological surveys, social surveys and interviews, and secondary data review from established sources such as Indian Meteorological Department, Census of India.

The details pertaining to both the project taluka and district, from authentic government sources, have been presented where project area / project site specific information was not available in public domain.

3.2 TOPOGRAPHY

Palwal District has mountainous physiography and have alluvium deposits. The alluvial plains have been divided into two units. Khadar that is the low lying flood plain of newer alluvium and Banger, an upland plain made of older alluvial and is spread towards west.

Mewat District, officially known as Nuh District has distinct and undulating topographic features with flat alluvial plains over most of the region, long and narrow pediments and local undulations caused by windblown sands at the foot hill zones and the plains is more or less bowl shaped. The area does not have a general slope and rather shows distinct altitude differences in certain domains. The general slope in the area is NW-SE in the western part, NE-SW in north-eastern part. The central part is more or less flat.

The project sites fall in Seismic Zone III as per IS 1893 (Part I) – 2002 which is considered as the moderate seismic risk prone area which is liable to MSK VII. The IS code assigns zone factor of 0.16 for Zone III. The sites lie in a wind speed zone of 47m/s, considered as high damage wind zone.

3.3 GEOMORPHOLOGY

Major geomorphological units found in the study area are residual hills, structural hills, linear ridges, piedmont plain, paleochannels, pediment inselbergs complex, alluvial plain and aeolian plain. Residual hills are resulted from the end product of pediplanation which reduces the original mountains into a series of scattered knolls standing on the pediplains. These units are considered as poor potential zones, as they have unfractured rock material, low infiltration and behave largely as runoff zone which cover 8.01 km2 area. Structural hills (97.09 km2) are the linear or acute hills exhibiting definite trend lines and mostly act as runoff zones. Linear ridges (19.64 km^2) are characterized by massive structure and high resistance to erosion. They also act as runoff zone and have poor potential for groundwater. Piedmont plain (56.61 km^2) has low relief and surface water remains for considerable time before meeting major rivers.

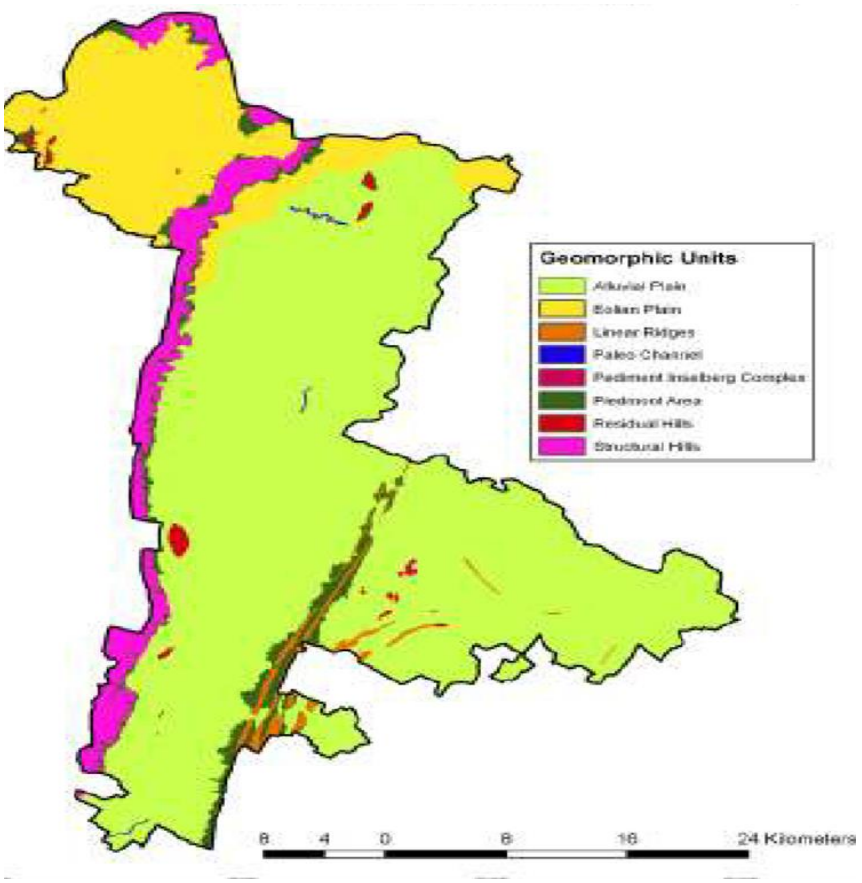


Figure 3-1 : Geomorhplogy Map of Nuh district

3.4 HYDROGEOLOGY

Palwal district is occupied by Indo-Gangetic alluvial plain of Quaternary age, and falls in Yamuna sub -basin of Ganga basin. The permeable granular zones comprising fine to medium grained sand and occasionally coarse sand and gravel. Their lateral and as well as vertical extent is limited. Ground water occurs in alluvium and the underlying weathered/fractured quartzites. Alluvium comprises sands silt, Kankar and gravel. Which form the principal ground water bearing horizon. In Quartzite formation, occupying the north- western part of the district, ground water occurs in weathered and jointed fractured horizons. Weathering and fracturing has resulted in formation of semi-consolidated sand bads (BADARPUR SANDS) which form potential aquifer zones. This quartzite formation has not been explored for ground water occurrence. In alluvium, granular zones are evenly distributed in entire thickness which is negligible near the quartzite outcrops to over 350 m in the eastern parts near Yamuna River.

Nuh district area is mainly underlain by alluvium of Quaternary age which forms the principal ground water reservoir. Some amount of ground water also occurs in fractures, joints and crevices

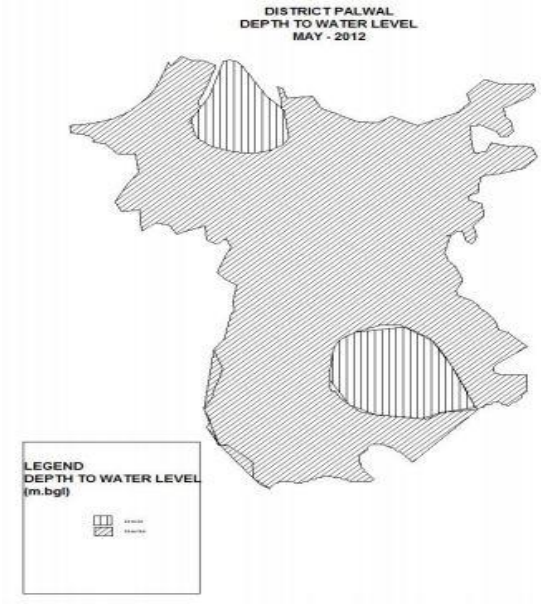
of hard rocks found as strike ridge in the district. The ground water in the upper zone, is known to exist down to 70 m depth, and hold water under phreatic condition. The aquifers that occur at deeper levels are confined to semi-confined.

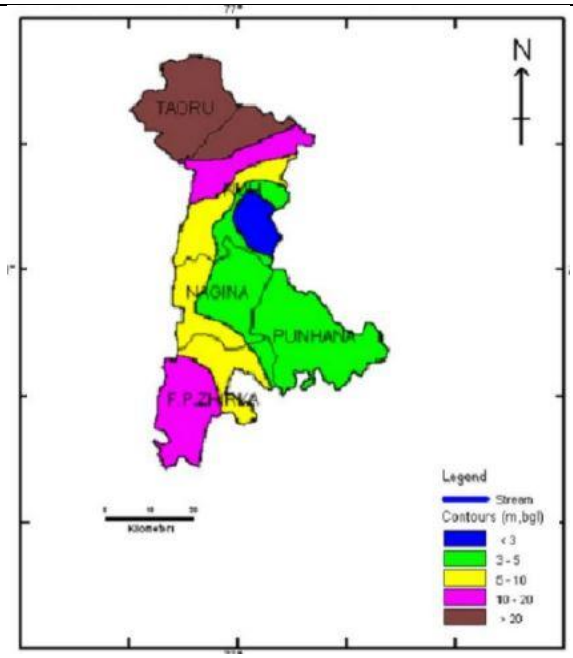
3.5 DEPTH TO WATER LEVELS

As per Central Ground Water Board, North-western region, the depth of water level (May,2011) in Palwal district ranges from 2.00 to 10.75 meter below ground level (mbgl) during pre-monsoon season whereas the depth of Water (November, 2011) in the district ranges from 2.00 to 9.40 meter below ground level (mbgl) during post monsoon. The water level trend during pre-monsoon period indicates average fall of 0.20m/year. The long term water level trend is show small decline and other places rise in Palwal district.

The depth to water table is between 2-32 mbgl. In central part of Nuh district, it is between 2 to 10 m bgl. Water logging and shallow water conditions occur in a large area in the central and south eastern parts of the district covering blocks like Nuh, Nagina and Punhana with water level ranging between 3 – 5 mbgl. As per Central Ground Water Board, North-western region, the depth of water level (May,2011) in Nuh district ranges from 1.15 to 27.35 meter below ground level (mbgl) during pre-monsoon season whereas the depth of Water (November, 2011) in the district ranges from 1.05 to 27.30 meter below ground level (mbgl) during post monsoon. On a long term basis most parts of Nuh district show rising trend of water levels from 0.20 to 4 m over the period of 10 years.

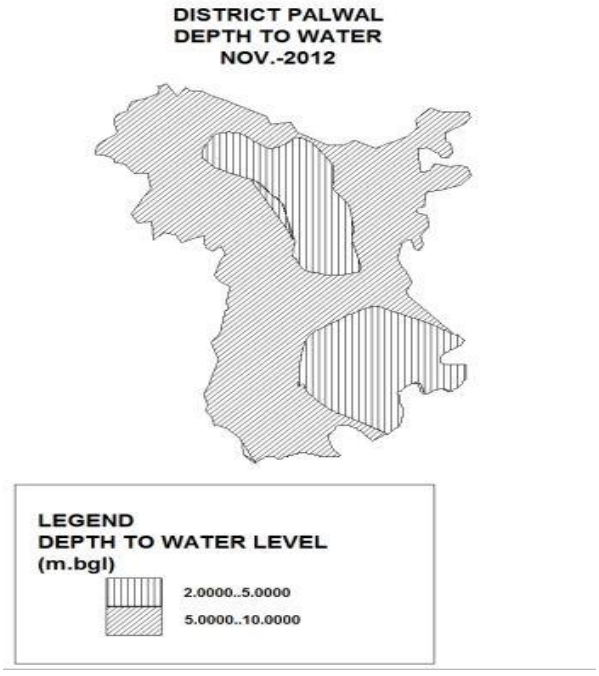
The depth to water levels during pre-monsoon and post-monsoon in Palwal and Nuh districts are given in **Figure 3-2** and **Figure 3-3** respectively.

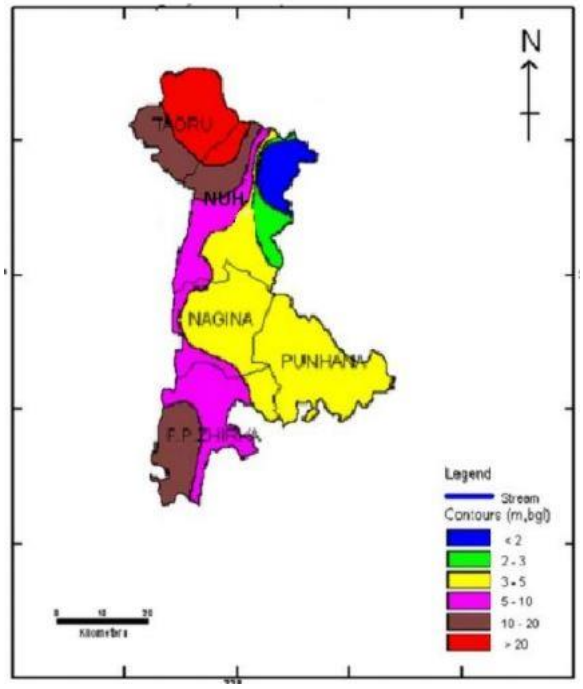




Palwal district	Nuh District

Figure 3-2: Depth to Water Levels (Pre-Monsoon)





Palwal district	Nuh district

Figure 3-3: Depth to Water Levels (Pre-Monsoon)

3.6 GEOLOGY

Major parts of Palwal district is occupied by alluvial plains of recent to sub-recent age, which include older (Banger) and newer (Khadar) alluvial and kankar. The kankar occurs mainly in the northern part and is poor in calcareous matter on the other hand NuH district occupied by scattered isolated strike ridges of old rocks, former Aravali mountain chain of Pre-cambrian and alluvium, sand of recent to sub-recent origon and the subsurface which forms the clay between 90% and 95% of gross lithology in Firozpur-Jhirka, and Nagina areas. Furthermore, the area between Firozpur Jhirka and Mandkola ridge, the bedrock below the alluvium is quartzite and limestone.

Geology of the Nuh district is dominated by Quaternary sediments and Delhi supergroup of rock formations. Quaternary sediments include alluvium deposits consisting a sequence of interlayered clay/silt and sand with occasional kankar formations in case of older alluvium formations and coarse to fine aeolian sand in case of aeolian deposits. These are largely distributed over 1135.27 km^2 and 166.69 km^2 area, respectively. Delhi supergroup rock formation in south-eastern part (51.05 km^2) is dominated by quartzite, phyllite and slate while quartzite and schist dominates the western edges (130.99 km^2) of the study area.

3.7 WATER RESOURCES

3.7.1 SURFACE WATER

There are two main canals i.e. Agra canal and Gurgaon canal which passes through western and central part of the Palwal district respectively from north to south. In the northern part of the district Budia nala is flowing from east to west and discharges its rainy water in river Yamuna. The Gaunchi main drain passes through north south direction of the district running in between Agra canal and Gurgaon canal.

There is no river flowing in Nuh district and area is drained by artificial drains namely Nuh, Ujina & Kotla drains. They carry rain water into Yamuna river. Gurgaon canal carries water to the area which is distributed through Nuh, Firozpur Jhirka, Uttawar, Mandkola, Hathin and Chhyansa distributaries. Seasonal streams from the hills west of Nuh drain flow towards southeast and fill up the natural depressions in central part of the district. Some topographic depressions in the area give rise to natural lakes.

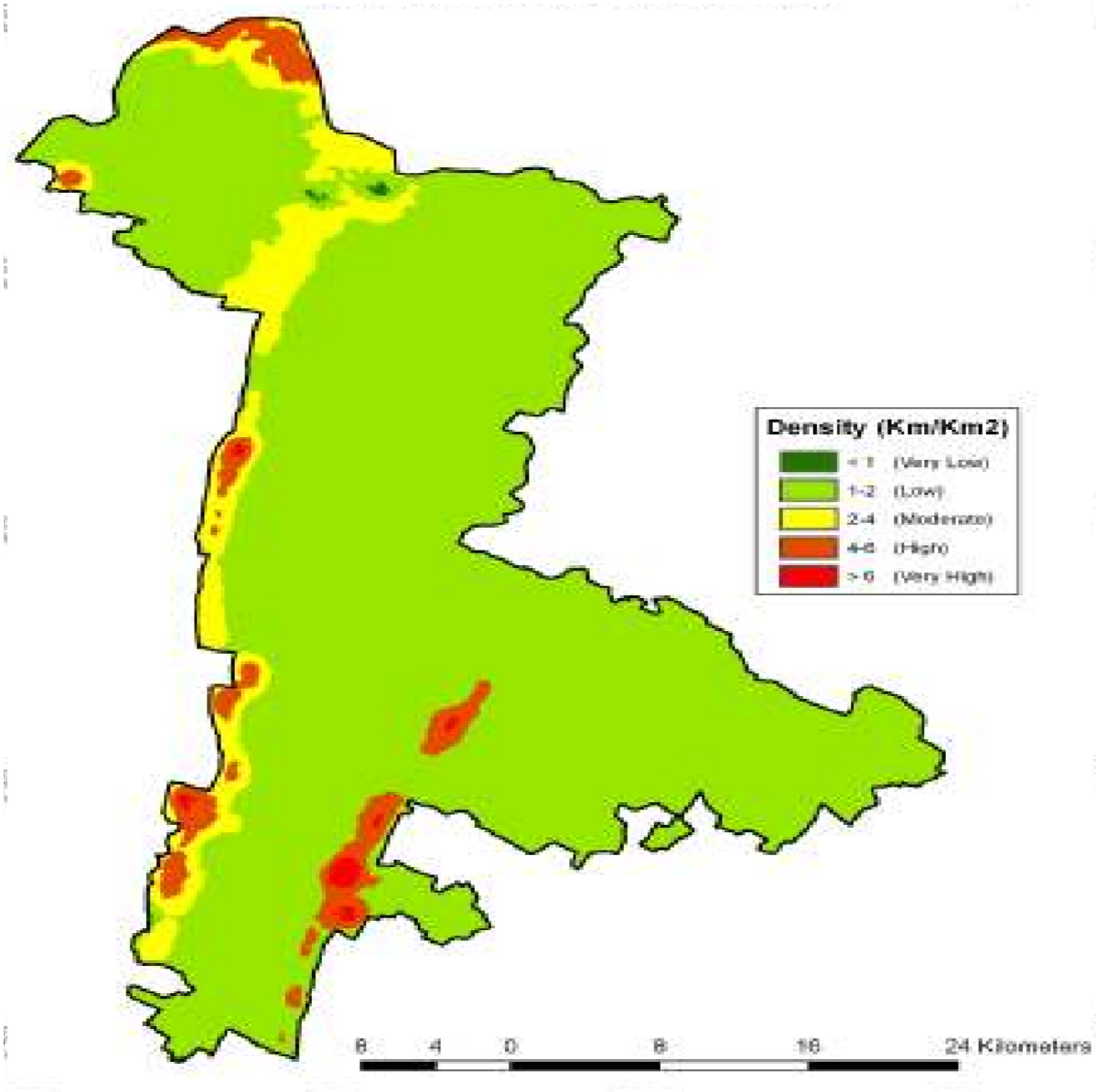


Figure 3-4 : Drainage Density Map of Nuh district

3.7.2 GROUND WATER

Ground water resources have been estimated jointly by Central Ground Water Board and State Ground Water Department as per the norms recommended by GEC' 97 as on 2013 for the Palwal and Nuh districts. The stage of ground water development ranges between 89% (Hathin) to 113% (Palwal). The total replenish able ground water resource in the district is 44769 Ham of which the

total existing ground water draft by all means is 46891 Ham. The net utilizable ground water resources for future irrigation development are -2074 Ham on the other hand net annual ground water availability in Nuh district is 21623 Ham out of this 1830 Ham has been kept reserved for domestic and industrial purposes upto next 25 years. The present net ground water draft in the district is 14453 Ham. The average level of ground water development in the district is 67% and falls in critical category. Therefore, care is required for further development of ground water. Since a large area has shallow ground water levels within 5.0m, there is substantial potential recharge in the district. Summarized block wise estimate of dynamic groundwater resources is given in Table 3-1.

Table 3-1: Ground Water Potential of Palwal District

Block	Net annual groundwater availability (ham)	Existing gross ground water draft for irrigation (ham)	Existing gross groundwater draft for all uses (ham)	Provision for domestic & industrial water requirement supply to 2025 (ham)	Net annual ground water availability for future irrigation development (ham)	Stage of ground water development (%)	Category
Palwal	19552	21702	22048	346	-2496	113	Over exploited
Hathin	8364	7263	7457	329	772	89	Safe
Hodal	9569	9610	9888	278	-318	103	Safe

Source: Groundwater Information Booklet, Palwal District, Haryana, 2013

Table 3-2: Ground Water Potential of Nuh District

Block	Net annual ground water availability (ham)	Existing gross ground water draft for irrigation (ham)	Existing gross groundwater draft for all uses (ham)	Provision for domestic & industrial water requirement supply to 2025 (ham)	Net annual ground water availability for future irrigation development (ham)	Stage of ground water development (%)	Category
Nuh	4526	1701	2011	507	2318	44	Safe
Nagina	4185	1813	2025	354	2018	48	Safe

Ferozpur Jhirka	4727	2741	3011	450	1536	64	Over exploited

Source: Groundwater Information Booklet, Nuh District, Haryana, 2013

3.8 CLIMATE

The project districts experiences tropical steppe, semiarid and hot climate which is mainly characterized by the extreme dryness of the Air except during monsoon months. During three months of south west monsoon from last week of June to September, the moist air of oceanic penetrate into the district and causes high humidity, cloudiness and monsoon rainfall. The period from October to December constitutes post monsoon season. The cold weather season prevails from January to the beginning of March and followed by the hot weather or summer season which prevails up to the last week of June.

3.8.1 TEMPERATURE

As per the Indian Meteorological Department, Gurgaon (1981-2010) the mean annual daily maximum and minimum temperature recorded is 31.5°C and 17.5°C. The district experiences the highest temperature during the month of May whereas the lowest temperature during the month of January i.e. 40.20C and 6.40C respectively.

Table 3-3: Temperature details of IMD Gurgaon (1981 - 2010)

Months	Max. Temp.(°C)	Min. Temp. (°C)	Months	Max. Temp.(°C)	Min. Temp. (°C)
January	20.7	6.4	**July**	35.5	26.4
February	23.7	8.8	**August**	34.0	25.6
March	29.6	13.5	**September**	34.1	23.8
April	36.6	19.1	**October**	32.8	17.3
May	40.2	24.1	**November**	28.3	11.3
June	39.8	26.5	**December**	23.1	7.0

Source: Climatological Normals (1981-2010)

3.8.2 RAINFALL

The normal annual rainfall in Palwal and Nuh districts is about 542 mm & 594 mm spread over 27 days & 31 days respectively. The south west monsoon sets in the last week of June and withdraws towards the end of September and contributes about 85% & 75 % respectively for the project districts of the annual rainfall. July and August are the wettest months 15% & 25 % respectively of the annual rainfall occurs during the non-monsoon months in the wake of thunder storms and western disturbances. The observations of rainfall for Palwal and Nuh district for the last five years

(2014-2018) as provided by the Hydro-met division of the India Meteorological Department is as given in Table 3-4 below:

Table 3-4: Rainfall details of Palwal District (5 years)

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	10.0	21.8	16.2	15.4	7.5	17.2	52.0	27.0	58.8	0.0	0.0	4.6
2015	27.2	0.0	63.4	42.8	1.3	13.8	183.8	53.0	6.8	5.3	0.0	0.0
2016	0.0	0.0	5.8	0.0	8.0	42.8	195.4	155.3	43.5	0.0	0.0	0.0
2017	16.3	0.0	9.0	0.0	10.8	76.0	53.0	30.0	135.3	0.0	0.0	4.5
2018	0.0	0.0	0.0	20.5	24.3	65.5	176.8	54.1	68.0	0.0	1.3	0.0

Source: India Metrological Department

Table 3-5: Rainfall details of Nuh District (5 years)

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	0.0	9.4	18.2	0.0	8.3	16.4	97.8	39.4	57.1	0.0	0.0	3.0
2015	26.2	0.0	74.9	23.5	3.0	4.5	181.9	63.4	142.3	0.0	0.0	0.0
2016	0.0	0.0	19.0	0.0	34.8	79.7	205.2	125.0	42.9	3.4	0.0	0.0
2017	26.0	0.0	11.4	0.4	10.8	152.1	60.8	87.4	104.0	0.0	0.0	6.5
2018	0.0	0.0	0.0	9.0	10.1	131.5	184.1	91.4	99.8	0.0	0.0	0.0

Source: India Metrological Department

3.8.3 WIND

The average annual wind speed observed at IMD Gurgaon is 3.3 m/ s. Table below gives the monthly values of the wind speed at IMD Gurgaon. The wind-rose diagram for Palwal and Nuh District is given in Figure 3-5. The Wind Hazard Map of India shows that the area lies in High Damage Risk Zone with a wind velocity of V<47 m/s. The Wind Hazard Map is shown in Figure 3-6.

Table 3-6: Wind Speed (IMD Gurgaon)

Month	Wind Speed (m/s)	Month	Wind Speed (m/s)
January	2.8	July	4.1
February	3.4	August	2.1
March	4.1	September	2.6
April	4.3	October	1.9
May	4.6	November	1.6
June	5.5	December	2.0

Source: Climatological Normals (1981-2010)

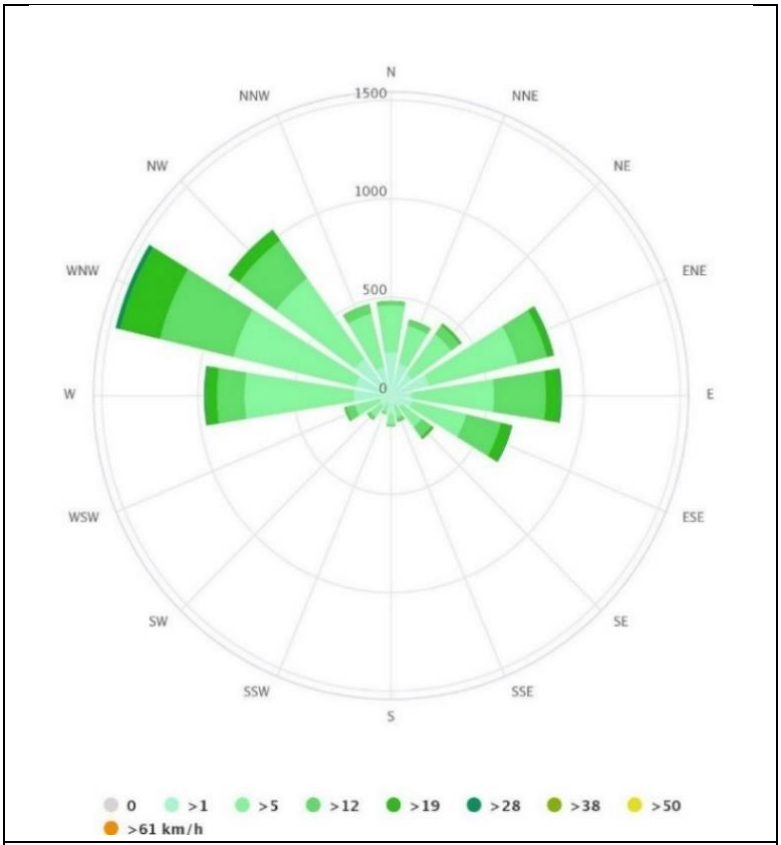


Figure 3-5: Wind Rose Diagram of Palwal District

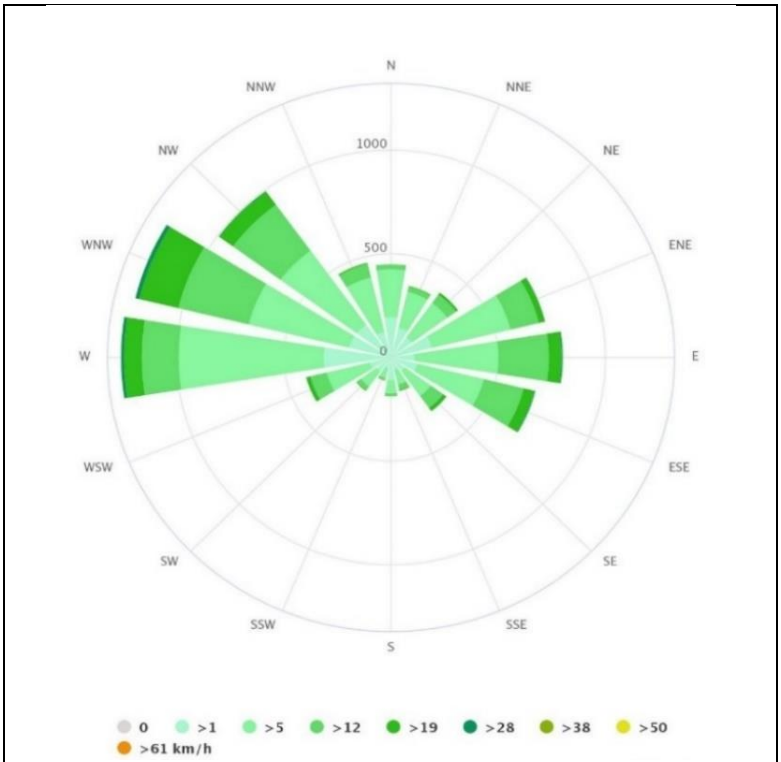
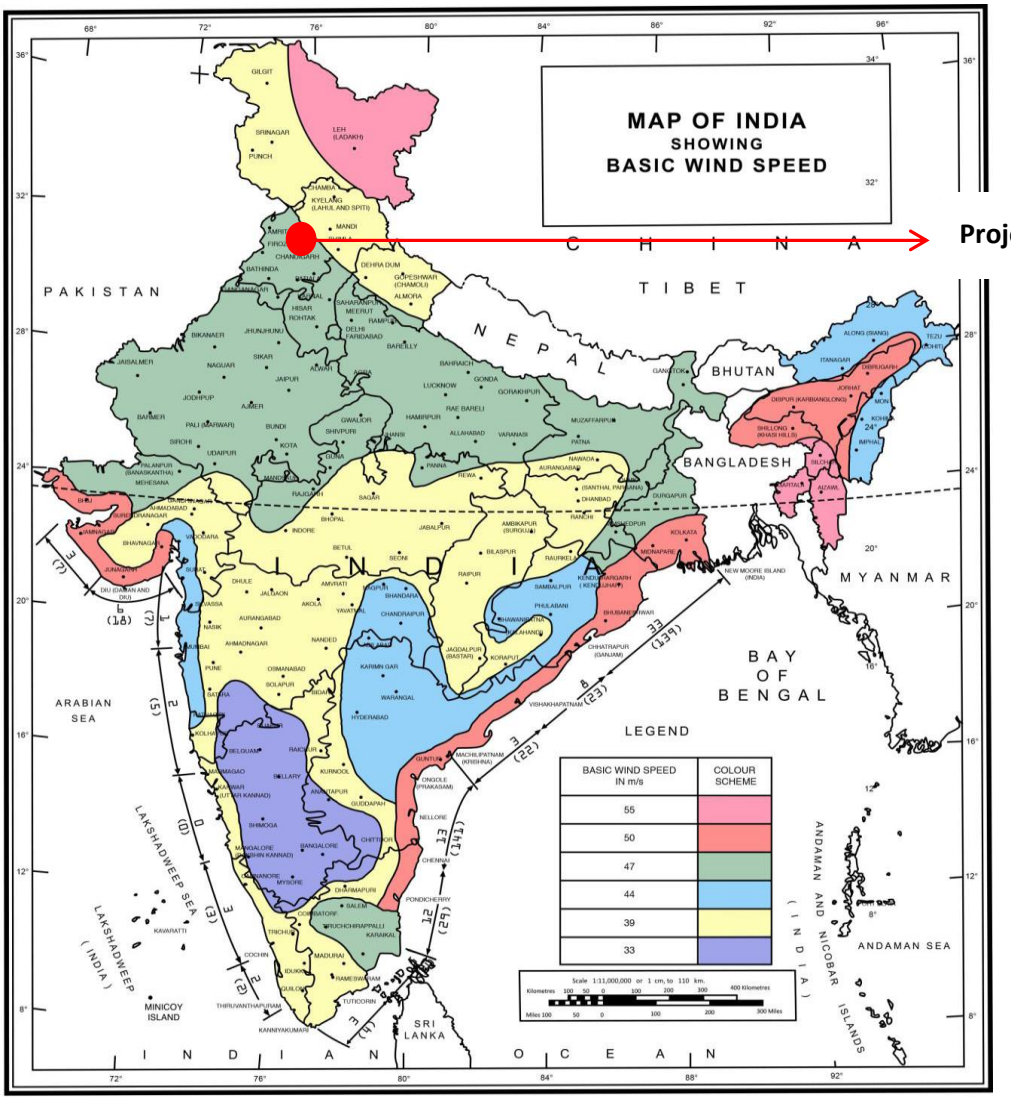


Figure 3-6: Wind Rose Diagram of Nuh Districts

Source: Climatological Normals (1981-2010

Figure 3-7: Wind Hazard Map showing Project Site



Source: Climatological Normals (1981-2010)

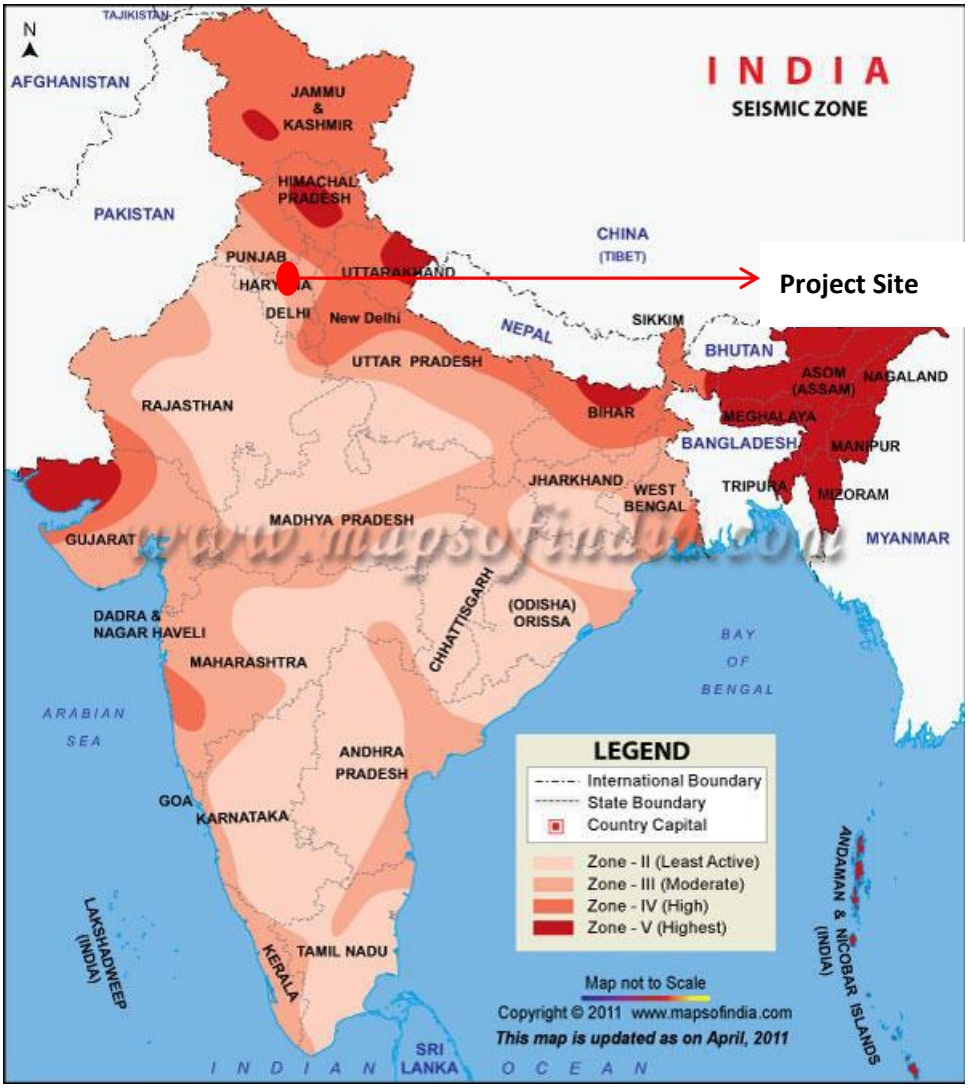
3.8.4 NATURAL HAZARDS

Natural hazards are naturally occurring physical phenomena caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis and volcanic activity), hydrological (floods), climatological (droughts, etc.), meteorological (cyclones and storms/wave surges) or biological (disease epidemics and insect/animal plagues). Natural hazards can have impacts on the developments; hence assessment of the natural hazards in the area is important for any development.

Seismicity

As per the seismic zoning map of India (given in the earthquake resistant design code of India [IS:1893, Part 1, 2002], the project site area falls in seismic Zone III, i.e the moderate active seismic zone. The IS code assigns zone factor of 0.16 for Zone III. The project under the Palwal and Nuh Districts of Haryana hence lies in seismic zone III (Moderate Damage Risk Zone (MSK VII) as shown in Figure 3-7 below.

Figure 3-8: Geological Map of India with Seismic Zonation showing Project Site



Source: Map of India, Secondary Research, TUV SUD

3.9 BIOLOGICAL ENVIRONMENT

3.9.1 FOREST AREA/ RESERVED FOREST/ NATIONAL PARKS & SANCTAURIES

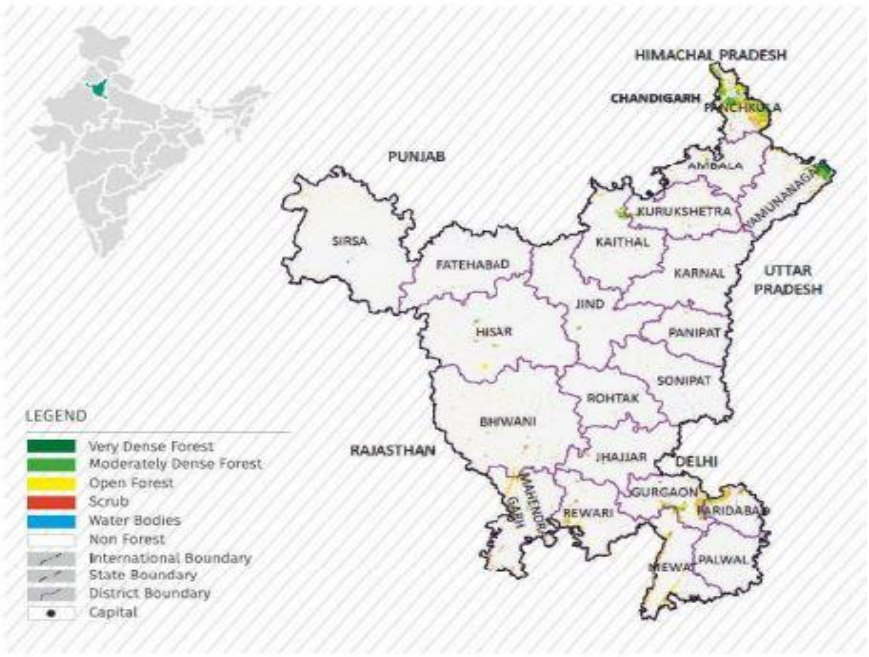
According to India State of Forest Report, 2017, the recorded forest area of Haryana State is 44,212 km^2 which constitute 3.59% of its total geographical area. Figure 3.12 presents the Forest Cover Map of Haryana state. Comparative details between the Project Districts & State forest Cover have been presented in below

Table 3-7: Forest Cover in Project District and State

District / State	Area in Km^2					% of Geographical Area
	Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	
Palwal	1359	0	2	12	14	1.03
Nuh	1507	0	14	96	110	7.30
Haryana	44212	28	452	1108	1588	3.59

Source: India State of Forest Report, 2017

Figure 3-9: Forest Cover Map of Haryana State showing project location



Source: India State of Forest Report, 2017

The study area comprising of core zone (pipeline stretch and 500 m on both sides) and buffer zone (10 km around Pipeline Route) was assessed for the presence of important wildlife habitats and protected areas, mangroves, breeding and nesting habitats of fauna, coastal habitats, important wetlands, and grassland area from Gas Pipelines (core area).These important areas such as Protected areas (National Park, Wildlife Sanctuaries, Conservation Reserves etc.), Wetlands of national importance, Ramsar sites, Important Bird Areas (IBAs), classified by the Birdlife International and Bombay Natural History Society etc. Data collected and information gathered from secondary sources on flora, fauna, protected area, natural habitats, wildlife species etc., were analysed and results are presented hereby.

The Palwal district situated at 60 Km away from Delhi on the Delhi-Mathura highway (NH-2) is located between 28.40° N and 76.59° E at an average elevation of 195 meters (639 ft). According to **land suitability analysis**, the eastern Khadar belt of Palwal block is highly suitable for agriculture. The western side of Palwal town has very critical water depth and the water is saline. Badha and Nagli Pachanki are two villages where the soil quality is very poor leading to lesser yield.

In terms of hazards and disaster, out of five blocks of the district, Palwal is more prone to environmental and human induced hazards and disaster. Khadar belt is flood prone whereas south-west is drought prone area.

Table 3-8: Details of protected areas, forests & ecologically sensitive areas in Palwal District

Ecological sensitive habitat	Description
National Parks/ Wildlife Sanctuary/ Biosphere reserves/ Elephant Reserve/ Any Other Reserve	Asola Wildlife Sanctuary is at a distance of 23 km from Site. The Aravalli ranges have been designated as Natural Conservation Zone in the Plan in accordance with Regional Plan-2021. The project stretches fall in the range. The distance of the proposed pipeline varies from 1.2-5 kms at various points from Aravali mountain range.
Reserved Forests	None
Wildlife Corridors & Routes	Northern Aravalli leopard wildlife corridor, passes through Nuh, Faridabad and Gurugram districts. However, there is no intersection of Pipeline stretch with Wildlife Corridor along the route.
Wetlands / Water bodies	875 including seasonal marshlands, tanks, village ponds and fish-ponds
Ramsar Site	None
Important Bird Habitats	None
Breeding/nesting areas of endangered species	Sarus Crane breeding has been observed

Mangroves	None

There are no forests or wildlife sanctuaries or biosphere reserves or nesting or breeding grounds for any of the rare species or other protected areas within the project area. There are no mangroves or mangrove forests in the project area. There are no national parks or wildlife sanctuaries or biosphere reserves or nesting sites of Marine turtles either in the study area or around it in a radius of over 10 Km.

Asola Wild Life Sanctuary is the nearest sanctuary, 23 kms from the project district which is one of the last surviving remnants of Delhi Ridge hill range and its semi-arid forest habitat and its dependent wildlife.

The proposed pipeline passes through three districts namely- Faridabad, Palwal, Nuh. Major part of the proposed Palwal project pipeline is in Faridabad and some part is in Gurgaon. Details of the proposed pipeline length are given below in **Table 3-9**.

Table 3-9: Details of proposed Pipeline

Sl. No.	Pipeline Name	Districts	State
1	GAIL Tap off to CGS	Faridabad	Haryana
2	Pipeline Along NH2	Faridabad, Palwal	
3	MSN Aligarh Road	Palwal	
4	Loop Line	Palwal	
5	Nuh Line	Palwal, Nuh	
	Total		

- Forest block area, part of Aravali range is around 15 km away on N-W side from pipeline along NH-2 i.e. proposed CGS of Palwal GA point of study area. This block has Damdama lake.
- Forest block area- “Palwal rural” is around 1 km away on E side from pipeline along NH-2 between Palwal and Ramnagar of study area.
- Forest block area-“Bahin” is around 1 km away on N-W side from the joint of pipeline “Loop line” and “Nuh line” between bahin and Pahari villages of study area.
- Continuous Forest block area runs parallel to W side from the pipeline which is from “Nuh to Firozpur Jhirka. Distance of this forest block from pipeline ranges from 2 to 3 km.

- Sultanpur National Park is approximately 44 kms away on N-W side from pipeline along NH-2 i.e. proposed CGS of Palwal GA point of study area.

The proposed pipeline does not encounter any protected forest or un-classed Forest along its entire length. (Declared Protected under "The Indian Forest Act, 1927") and "Forest (Conservation) Act, 1980 with Amendments Made in 1988". No Forest Clearance is required for the proposed pipeline locations at Palwal district. The proposed pipeline does not come in any ecologically sensitive area.

***Note:* Forest blocks areas** *are subdivisions of large forest areas. A block forest is a main territorial division of the forest, generally bounded by natural features, bearing a local proper name. Forests blocks have clear-cut boundaries all around with numbered pillars along it.*

References gathered:

ENVIS Centre on Wildlife & Protected Areas:

Map of forest protected area, Haryana

http://wiienvis.nic.in/Database/Maps_PAs_1267.aspx

Haryana forest department:

Map of protected forest, Haryana

http://haryanaforest.gov.in/en-us/Map

Aravali Range

The Aravalli Range is a mountain range located in northwestern India. The range has a length of 430 miles, and stretches from the northern parts of India, near Delhi, passing through Haryana, and ending in Gujarat. The range contains a series of ridges and peaks, which have widths between 6 miles and 60 miles, and elevations that vary between 1,000 ft and 3,000 ft.

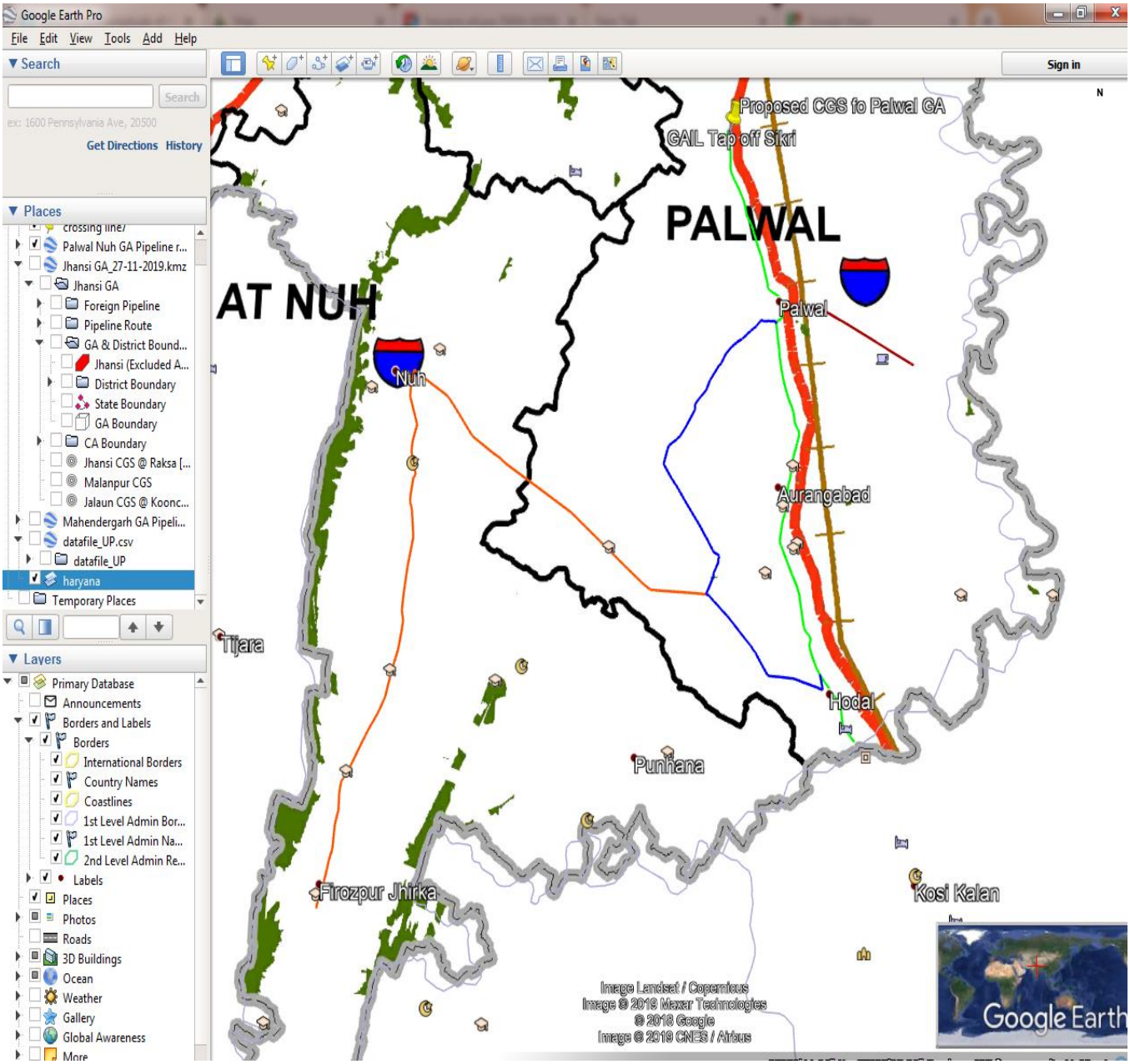
Nuh lies in Mewat region. As per secondary references, Mewat district comprises of hills and hillock of the Aravali mountains on one hand and plains on the other.

The proposed pipeline at Nuh is adjacent to Aravali mountain range. The distance of the proposed pipeline varies from 1.2-5 kms at various points from Aravali mountain range.

Sources

- *http://haryanaforest.gov.in/en-us/Map*
- *https://healingourcities.files.wordpress.com/2019/12/haryana-forest-cover-image.jpg?w=679&h=961*
- *https://healingourcities.files.wordpress.com/2019/12/haryana-forest-cover-image.jpg?w=679&h=961*
- *https://www.rgics.org/wp-content/uploads/PW-7.08.pdf*

Figure 3-10: Pipeline Route of Nuh-Palwal Stretch



Water Bodies and irrigation

Canals are the most popular and important source of irrigation in the Sub-Region due to easy supply and regular flow of water to the agriculture fields. In the inland drainage basin, the drains excavated are made to outflow in canals through lift pumps. The canal network is dense in Palwal district.

Source: Sub-Regional Plan for Haryana Sub-Region of NCR-2021, Department of Town and Country Planning, Govt of Haryana

875 water bodies are recorded at Palwal district, including seasonal marshlands, tanks, village ponds and fish-ponds.

*Source***:** *Wetland loss and water-bird use of wetlands in Palwal District, Haryana India by K. S. Gopi Sunder, Aditya Singh Chauhan, Swati Kittur, Suresh Babu.*

Proposed pipeline has 59 Waterbodies, 6 canal crossings in the study area.

Forest

District Palwal has 5 % of total forest area in Haryana state

Forest Area (in Ha)

District	Reserved Forest	Protected Forest (PF)						Unclassified Forest	Forest u/s 38 of IFA 1927	Forest u/s 4&5 of PLPA, 1900	Others	Grand Total
		Compact	Road	Rail	Canal	Bund	Total					
Palwal	138.61	37.78	1462.04	0	1165.71	17.64	1683.17	92.26	0	25.2	9.4	2948.64

Source: Sub-Regional Plan for Haryana Sub-Region of NCR-2021, Department of Town and Country Planning, Govt of Haryana

3.9.2 FLORA

The study area is mainly represented by modified habitats such as agricultural lands, roads and habitations interspersed with small patches of natural vegetation. The topography of the study area is characterized by plains, hills and gently sloping lands. The terrain is generally flat to gently undulating. Most of the plain areas are utilized for agriculture purposes whereas uncultivated patches are covered mainly by open thorny scrub. The overall natural vegetation cover of study area is scanty and bushy.

Palwal district has Tropical dry deciduous type of forest vegetation. These forests are dominated by smaller trees and shrubs and have abundance of shrubs intermixed with grasses and few other

herbaceous species. The chief characteristic feature of the forests is open canopy of small (10-15 m high) trees and abundance of shrubs.

The flora assessment in study area shows that 47 species of trees and 16 species of shrubs and herbs are present in Study Area.

The major tree species observed in Study Area are *Ficus benghalensis, Ficus racemosa, Ficus religiosa, Mangifera indica, Melia azedarach, Tamarindus indica, Tectona grandis, Bombax ceiba, Dalbergia sissoo, Moringa oleifera, Phoenix sylvestris, Pithecellobium dulce, Pongamia pinnata, Prosopis juliflora, Syzygium cumini, Acacia leucophloea, Acacia nilotica, Aegle marmelos, Albizia lebbeck, Albizia procera, Azadirachta indica, Ziziphus mauritiana, Zizyphus xylopyra, cassia fistula etc.*

Some of grasses, herbs and shrub species are Parthenium hysterophorus, Datura stramonium, Adhatoda vasica, Annona squamosa, Argemone mexicana, Calotropis gigantean, Calotropis procera, Ipomoea spp., Lantana camara, Sida acuta, Aloe vera, Cassia tora, Tephrosia purpurea, Tribulus terrestris and Tridax procumbens. The list of flora is given below in **Table 3-10**.

Table 3-10: List of Flora within the Project Area

Sr. No.	Botanical Name	Common Name	Family
Trees			
1.	*Acacia leucophloea*	Harmo	Fabaceae
2.	*Acacia nilotica*	Desibaval	Fabaceae
3.	*Aegle marmelos*	Bel	Rutaceae
4.	*Albizia lebbeck*	Siras	*Fabaceae*
5.	*Albizia procera*	Kala Siras	Fabaceae
6.	*Azadirachta indica*	Limdo	Meliaceae
7.	*Bauhinia variegata*	Kachnar	Fabaceae
8.	*Bombax ceiba*	Simlo	Bombacaceae
9.	*Cassia fistula*	Garmalo	Caesalpiniaceae
10.	*Cassia siamea*	Kesia	Fabaceae
11.	*Capparis decidua*	Karir	Capparaceae

12.	*Cordia dichotoma*	Gundo	Boraginaceae
13.	*Dalbergia sissoo*	Shisham	Fabaceae
14.	*Emblica officinalis*	Amla	Euphorbiaceae
15.	*Erythrina indica*	Coral Tree	Fabaceae
16.	*Ficus benghalensis*	Vad	Moraceae
17.	*Ficus racemosa*	Umro	Moraceae
18.	*Ficus religiosa*	Piplo	Moraceae
19.	*Jacaranda mimosifolia*	Jacaranda	Bignoniaceae
20.	*Kigelia pinnata*	Kigelia	Bignoniaceae
21.	*Mangifera indica*	Aam	Anacardiaceae
22.	*Melia azedarach*	Bakayan	Meliaceae
23.	*Moringa oleifera*	Mithosaragavo	Moringaceae
24.	*Phoenix sylvestris*	Khajur	Arecaceae
25.	*Pithecellobium dulce*	Jungle jalebi	Fabaceae
26.	*Polyalthia longifolia*	Ashoka	Annonaceae
27.	*Pongamia pinnata*	Karanj, Kanji	Fabaceae
28.	*Prosopis cineraria*	Khijdo	Fabaceae
29.	*Prosopis juliflora*	Gando baval	Fabaceae
30.	*Syzygium cumini*	Jambu	Myrtaceae
31.	*Tamarindus indica*	Imli	Fabaceae
32.	*Tectona grandis*	Sag	Verbenaceae
33.	*Terminalia arjuna*	Arjunsad	Combretaceae
34.	*Ziziphus mauritiana*	Bor	Rhamnaceae
35.	*Zizyphus xylopyra*	Ghatbor	Rhamnaceae
36.	*Adhatoda vasica*	Adulsa	Acanthaceae

37.	*Annona squamosa*	Sitafal	Annonaceae
38.	*Argemone mexicana*	Pila Dhatura	Papaveraceae
39.	*Calotropis gigantea*	Shivark, Akdo	Apocynaceae
40.	*Calotropis procera*	Mudar	Asclepiadaceae
41.	*Crotalaria juncea*	Indian Hemp	Fabaceae
42.	*Euphorbia neriifolia*	Thor	Euphorbiaceae
43.	*Ipomoea fistulosa*	Beshram	Convolvulaceae
44.	*Lantana camara*	Lantana	Verbenaceae
45.	*Nyctanthes arbortristis*	Tamat, Harsingar	Oleaceae
46.	*Opuntia dillenii*	Opuntia	Cactaceae
47.	*Sida acuta*	Chikan	Malvaceae
Shrubs and Herbs			
48.	*Achyranthes aspera*	Unga, Keora	Amaranthaceae
49.	*Agave americana*	Ram Baas	Agavaceae
50.	*Aloe vera*	Gwarpatha	Liliaceae
51.	*Cannabis sativa*	Bhang	Cannabaceae
52.	*Cassia tora*	Puwad, Panwar	Fabaceae
53.	*Cassia glauca*	Bathu	Fabaceae
54.	*Chenopodium album*	Goosfoot	Amaranthaceae
55.	*Datura stramonium*	Dhatura	Solanaceae
56.	*Parthenium hysterophorus*	Gajar Ghaas	Asteraceae

57.	*Tephrosia purpurea*	Sarpankha	Fabaceae
58.	*Tribulus terrestris*	Gokharu	Zygophyllaceae
59.	*Tridax procumbens*	Kumru	Asteraceae
60.	*Asparagus racemosus*	Shatavari	Asparagaceae
61.	*Cuscuta reflexa*	Amarbel	Convolvulaceae
62.	*Momordica charantia*	Jungli Kerala	Cucurbitaceae
63	*Tinospora cordifolia*	Neem Giloy	Menispermaceae

3.9.3 FAUNA

This section of the report presents the details of the higher faunal species, namely, birds, mammals, reptiles' amphibians and fishes, having recorded ranges that include the study area.

The details of the faunal species having recorded ranges that include the study area are accordingly presented under two separate sub-sections. The faunal tables that follow also give the conservation status of each species, as per the IUCN Red Data List.

Mammals

S.No	Common Name	Scientific Name	IUCN Status
1	Rhesus Macaque	Macaca mulatta	Least Concern
2	Hanuman Langur	Semnopithecus entellus	Least Concern
3	Sambar	Cervus unicolor	Vulnerable
4	Indian Muntjac	Muntiacus muntjak	Least Concern
5	Spotted Deer	Axis axis	Least Concern
6	Nilgai	Boselaphus tragocamelus	Least Concern
7	Blackbuck	Antilope cervicapra	Least Concern
8	Four-horned Antelope	Tetracerus quadricornis	Vulnerable
9	Indian gazelle	Gazella bennettii	Least Concern
10	Wild pig	Sus scrofa	Least Concern

11	Sloth Bear	Melursus ursinus	Vulnerable
12	Jackal	Canis aureus	Least Concern
13	Striped Hyena	Hyaena hyaena	Near Threatened
14	Wolf	Canis lupus	Least Concern
16	Indian Fox	Vulpes bengalensis	Least Concern
17	Red Fox	Vulpes vulpes	Least Concern
18	Common Leopard	Panthera pardus	Vulnerable
19	Caracal	Caracal caracal	Least Concern
20	Jungle Cat	Felis chaus	Least Concern
21	Leopard Cat	Prionailurus bengalensis	Least Concern
22	Fishing Cat	Prionailurus viverrinus	Vulnerable
23	Honey Badger	Mellivora capensis	Least Concern
24	Smooth-coated Otter	Lutrogale perspicillata	Vulnerable
25	Small Indian Civet	Viverricula indica	Least Concern
26	Common Palm Civet	Paradoxurus hermaphroditus	Least Concern
27	Grey Mongoose	Herpestes edwardsii	Least Concern
28	Small Indian Mongosse	Herpsestes javanicus	Least Concern
29	Ruddy Mongoose	Herpestes smithii	Least Concern
30	Indian Pangolin	Manis crassicaudata	Endangered
31	Indian Hare	Lepus nigricollis	Least Concern
32	House Shrews	Suncus murinus	Least Concern
33	Pygmy Shrew	Suncus etruscus	Least Concern
34	Indian Porcupine	Hystrix indica	Least Concern
35	Three-Striped Palm Squirrel	Funambulus palmarum	Least Concern
36	Five-Striped Palm Squirrel	Funambulus pennantii	Least Concern
37	Large Bandicoot-Rat	Bandicota indica	Least Concern
38	Lesser Bandicoot-Rat	Bandicota bengalensis	Least Concern
39	Indian Gerbil	Tatera indica	Least Concern
40	House Rat	Rattus ratus	Least Concern
41	Brown Rat	Rattus norvegicus	Least Concern
42	Soft-Furred Field Rats	Millardia meltada	Least Concern
43	Long-tailed Tree Mouse	Vandeleuria oleracea	Least Concern
44	House Mouse	Mus musculus	Least Concern
45	Little Indian Field Mouse	Mus booduga	Least Concern
46	Indian Flying Fox	Pteropus giganteus	Least Concern
47	Fulvous Fruit Bat	Rousettus leschenaulti	Least Concern
48	Short-Nosed Fruit Bat	Cynopterus sphinx	Least Concern

49	Naked-Rumped Tomb Rat	Taphozous nudiventris	Least Concern
50	Black- Bearded Tomb Rat	Taphozous melanopogon	Least Concern
51	Woolly Horseshoe Bat	Rhinolophus luctus	Least Concern
52	Fulvous Leaf-Nosed Bat	Hipposideros fulvus	Least Concern
53	Greater False Vampire	Megaderma lyra	Least Concern
54	Hodgson's Bat	Myotis formosus	Least Concern
55	Asiatic Greater Yellow House Bat	Scotophilus heathii	Least Concern
56	Indian Pipistrelle	Pipistrellus coromandra	Least Concern
57	Dormer's Bat	Pipistrellus dormeri	Least Concern

Status assigned by the International Union for Conservation of Nature and Natural Resources, where - LC – Least Concern

Sources: Vivek Menon (2003), Indian Mammals: A Field Guide. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India, pp 1-522; IUCN (2016). The IUCN Red List of Threatened Species. Version 2016-3

Birds

Sl. No	Common Name	Scientific Name	Migratory/Resident	IUCN status
1	Black Francolin	Francolius francolinus	Resident	Least Concern
2	Grey Francolin	Francolinus Pondicerianus	Resident	Least Concern
3	Common Quail	Coturnix coturnix	Winter Migratory	Least Concern
4	Rain Quail	Coturnix coromandelica	Resident	Least Concern
5	King Quail	Coturnix chinensis	Resident	Least Concern
6	Jungle Bush Quail	Perdicula asiatica	Resident	Least Concern
7	Rock Bush Quail	Perdicula argoondah	Resident	Least Concern
8	Indian Pea Fowl	Pavo cristatus	Resident	Least Concern
9	Lesser-Whistling Duck	Dendrocygna javanica	Summer visitor	Least Concern
10	Greylag Goose	Anser anser	Winter Migratory	Least Concern
11	Bar-headed Goose	Anser indicus	Winter Migratory	Least Concern
12	Knob-billed duck	Sarkidiornis melanotos	Resident	Least Concern
13	Common Shell duck	Tadorna tadorna	Occassional	Least Concern
14	Ruddy Shell duck	Tadorna ferruginea	Winter Migratory	Least Concern
15	Cotton Pygmy-goose	Nettapus coromandalianus	Resident	Least Concern

16	Gadwall	Anas strepera	Winter Migratory	Least Concern
17	Eurasian Wigeon	Anas penelope	Winter Migratory	Least Concern
18	Mallard	Anas paltyrhynchos	Winter Migratory	Least Concern
19	Indian Spot-billed Duck	Anas poecilorhyncha	Resident	Least Concern
20	Northern Shoveler	Anas clypeta	Winter Migratory	Least Concern
21	Northern Pintail	Anas acuta	Winter Migratory	Least Concern
22	Garganey	Anas querquedula	Winter Migratory	Least Concern
23	Common Teal	Anas crecca	Winter Migratory	Least Concern
24	Red-crested Poachard	Netta rufina	Winter Migratory	Least Concern
25	Common Poachard	Aythya ferina	Winter Migratory	Vulnerable
26	Ferruginous Duck	Aythya nyroca	Winter Migratory	Near Threatened
27	Tufted Duck	Aythya fuligula	Winter Migratory	Least Concern
28	Little Grebe	Tachybaptus ruficollis	Resident	Least Concern
29	Great Crested Grebe	Podiceps cristatus	Winter Migratory	Least Concern
30	Painted Stork	Mycteria leucocephala	Resident	Near Threatened
31	Asian open Bill	Anastomus oscitans	Resident	Least Concern
32	Black Stork	Ciconia nigra	Resident	Least Concern
33	Whooly-necked Stork	Ciconia episcous	Resident	Vulnerable
34	White Stork	Ciconia ciconia	Resident	Least Concern
35	Lesser Adjutant	Laptoptilos javanicus	Winter Migratory	Vulnerable
36	Lesser Flamingo	Phoeniconaias minor	Isolated Record	Near Threatened
37	Black-headed Ibis	Threskiornis melanocephalus	Winter Migratory	Near Threatened
38	Painted Francolin	Francolinus pictus	Resident	Least Concern
39	Red spur Fowl	Galloparadix spadicea	Resident	Least Concern
40	Painted spur Fowl	Galloparadix lunulata	Resident	Least Concern
41	Red-naped Ibis	Pseudibis papillosa	Winter Migratory	Least Concern
42	Eurasian Spoonbill	Platalea leucorodia	Resident	Least Concern
43	Black-crowned Night Heron	Nyctocorax nyctocorax	Resident	Least Concern
44	Indian Pond Heron	Ardeola grayii	Resident	Least Concern
45	Grey Heron	Ardea cinerea	Resident	Least Concern

46	Purple Heron	Ardea purpurea	Resident	Least Concern
47	Cattle Egret	Bubulcus ibis	Resident	Least Concern
48	Great Egret	Ardea alba	Resident	Least Concern
49	Intermediate Egret	Ardea intermedia	Resident	Least Concern
50	Little Egret	Egretta garzetta	Resident	Least Concern
51	Darter	Anhinga melanogaster	Resident	Least Concern
52	Little Cormorant	Microcarbo niger	Resident	Least Concern
53	Indian Cormorant	Phalacrocorax fuscicollis	Winter Migratory	Least Concern
54	Great Cormorant	Phalacrocorax carbo	Passage visitor	Least Concern
55	Common Kestrel	Falco naumanni	Winter Migratory	Least Concern
56	Laggar Falcon	Falco jugger	Resident	Least Concern
57	Peregrine Falcon	Falco peregrinus	Winter Migratory	Least Concern
58	Barbary Falcon	Falco pelegrinoides	Winter Migratory	Not Assessed
59	Black-winged Kite	Elanus caeruleus	Resident	Least Concern
60	Black Kite	Milvus migrans	Resident	Least Concern
61	Black-eared Kite	Milvus migrans lineatus	Winter Migratory	Not Assessed
62	Osprey	Pandion haliaetus	Winter Migratory	Least Concern
63				
64	Oriental Honey-buzzard	Pernis ptilorhynchus	Resident	Least Concern
65	Himalayan Vulture	Gyps Himalayensis	Winter Migratory	Near Threatened
66	Griffon Vulture	Gyps fulvus	Winter Migratory	Least Concern
67	CinereeousVulture	Aegypius monachus	Winter Migratory	Near Threatened
68				
69	Short-toed Snake Eagle	Circaetus gallicus	Resident	Least Concern
70	Crested Serpent Eagle	Spilornis cheela	Resident	Least Concern
71	Eurasian Marsh Harrier	Circus aeruginosus	Winter Migratory	Least Concern
72	Pallid Harrier	Circus macrourus	Winter Migratory	Near Threatened
73	Shikra	Accipiter badius	Resident	Least Concern
74	White-eyed Buzzard	Butastur teesa	Resident	Least Concern
75	Long-legged Buzzard	Buteo rufinus	Winter Migratory	Least Concern

76	Greater Spotted Eagle	Clanga clanga	Winter Migratory	Vulnerable
77	Tawny Eagle	Aquila rapax	Resident	Vulnerable
78				
79	Bonelli's Eagle	Aquila fasciata	Resident	Near Threatened
80	Booted Eagle	Hieraaetus pennatus	Winter Migratory	Least Concern
81	Ballion's Crake	Porzana pusilla	Winter Migratory	Least Concern
82	White-breasted Waterhen	Amaurornis phoenicurus	Resident	Least Concern
83	Brown Crake	Zapornika akool	Resident	Least Concern
84	Small Buttonquail	Ternix sylvaticus	Summer visitor	Least Concern
85	Yellow-legged Buttonquail	Turnix tanki	Summer visitor	Least Concern
86	Barred Buttonquail	Turnix suscitator	Resident	Least Concern
87	Purple Swamphen	Porphyrio porphyrio	Resident	Least Concern
88	Common Moorhen	Gallinula chloropus	Resident	Least Concern
89	Common Crane	Grus grus	Winter Migratory	Least Concern
90	Saras Crane	Antigone antigone	Resident	Vulnerable
91	Eurasian Thick-knee	Burhinus oedicnemus	Resident	Least Concern
92	Great Thick-knee	Esacus recurvirostris	Resident	Near Threatened
93	Pheasant-tailed Jacana	Hydrophasianus chirurgus	Resident	Least Concern
94	Bronze-winged Jacana	Metopidus indicus	Resident	Least Concern
95	Black -winged Stilt	Himantopus himantopus	Winter Migratory	Least Concern
96	Pied Avocet	Recurvirostra avosettta	Resident	Least Concern
97	Northern Lapwing	Vanellus vanellus	Winter Migratory	Near Threatened
98	River Lapwing	Vanellus duvaucelii	Resident	Near Threatened
99	Yellow-wattled Lapwing	Vanellus malabaricus	Resident	Least concern
100	Red-wattled Lapwing	Vanellus indicus	Resident	Least concern
101	White-tailed lapwing	Vanellus leucurus	Winter Migratory	Least concern
102	Little Ringed Plover	Charadius dubius	Resident	Least concern

103	Kentish Plover	Charadius placidus	Winter Migratory	Least concern
104	Greater Painted-snipe	Rostratula benghalensis	Resident	Least concern
105	Ruff	Philomachus pugnax	Winter Migratory	Least concern
106	Common Snipe	Gallinago gallinago	Winter Migratory	Least concern
107	Black-tailed Godwit	Limosa limosa	Winter Migratory	Near Threatened
108	Eurasian Curlew	Numenius arquata	Winter Migratory	Near Threatened
109	Spotted Redshank	Tringa erythropus	Winter Migratory	Least concern
110	Common Redshank	Tringa totanus	Winter Migratory	Least concern
111	Marsh Sandpiper	Tringa stagnatilis	Winter Migratory	Least concern
112	Common Greenshank	Tringa nebularia	Winter Migratory	Least concern
113	Green Sandpiper	Tringa ochropus	Winter Migratory	Least concern
114	Wood Sandpiper	Tringa glareola	Winter Migratory	Least concern
115	Common Sandpiper	Actitis hypoleucos	Winter Migratory	Least concern
116	Little Stint	Calidris minuta	Winter Migratory	Least concern
117	Temminck's Stint	Calidris temminckii	Winter Migratory	Least concern
118	Indian Courser	Cursorius coromandelicus	Resident	Least concern
119	Small Pratincole	Glareola lactea	Resident	Least concern
120	Pallas's Gull	Ichthyaetus ichthyaetus	Winter Migratory	Not assessed
121	Brown-headed Gull	Chroicocephalus brunnicephalus	Winter Migratory	Not assessed
122	Black-headed Gull	Chroicocephalus ridibundus	Winter Migratory	Least concern
123	Gull billed Tern	gelochelidon nilotica	Winter Migratory	Least concern
124	River tern	Sterna aurantia	Resident	Near Threatened
125	Little Tern	Sternula albifrons	Summer Visitor	Least concern
126	Whiskered tern	Chlidonias hybrida	Resident	Least concern
127	Indian Skimmer	Rynchops albicollis	Resident	Vulnerable
128	Chestnut-bellied Sandgrouse	Pterocles exustus	Resident	Least concern
129	Common Pigeon	Columba livia	Resident	Least concern
130	Oriental Turtle Dove	Streptopelia orientalis	Winter Migratory	Least concern
131	Eurasian Collared Dove	Streptopelia decaocto	Resident	Least concern

132	Red collared Dove	Streptopelia tranquebarica	Resident	Least concern
133	Sptted Dove	Stigmatopelia chinensis	Resident	Least concern
134	Laughing Dove	Stigmatopelia senegalensis	Resident	Least concern
135	Yellow-footed Green Pigeon	Treron phoenicopterus	Resident	Least concern
136	Alexandrine Parakeet	Psittacula eupatria	Resident	Near Threatened
137	Rose-ringed Parakeet	Psittacula krameri	Resident	Least concern
138	Plum-headed Parakeet	Psittacula cyanocephala	Resident	Least concern
139	Jacobin Cuckoo	Clamator jacobinus	Summer Visitor	Least concern
140	Common Hawk Cuckoo	Hierococcyx varius	Resident	Least concern
141	Asian Koel	Eudynamys scolopaceus	Resident	Least concern
142	Sirkeer Malkoha	Taccocua leschenaultii	Resident	Least concern
143	Southern Coucal	Centropus(sinensis) parroti	Resident	Not assessed
144	Barn Owl	Tyto alba	Resident	Least concern
145	Indian Scops Owl	Otus bakkamoena	Resident	Least concern
146	Spotted Owk	Athene brama	Resident	Least concern
147	Eurasian Eagle Owl	Bubo bubo	Resident	Least concern
148	Dusky Eagle Owl	Bubo coromandus	Resident	Least concern
149	Brown Fish Owl	Ketupa zeylonensis	Resident	Least concern
150	Jungle Nighjar	Caprimulgus indicus	Summer Visitor	Least concern
151	Indian Nightjar	Caprimulgus asiaticus	Resident	Least concern
152	Savanna Nightjar	Caprimulgus affinis	Resident	Least concern
153	Little Swift	Apus affinis	Resident	Least concern
154	Common Hoopoe	Upupa epops	Resident	Least concern
155	Indian Roller	Coracias benghalensis	Resident	Least concern
156	White-throated Kingfisher	Halcyon smyrnensis	Resident	Least concern
157	Common Kingfisher	Alcedo atthis	Resident	Least concern
158	Pied Kingfisher	Ceryle rudis	Resident	Least concern
159	Green Bee-eater	Merops orientalis	Resident	Least concern
160	Blue-cheeked Bee-eater	Merops persicus	Summer Visitor	Least concern
161	Blue-tailed Bee-eater	Merops philippinus	Summer Visitor	Least concern

162	Indian Grey Hornbill	Ocyceros birostris	Resident	Least concern
163	Brown-headed Barbet	Megalaima zeylanica	Resident	Not assessed
164	Coppersmith Barbet	Megalaima haemacephala	Resident	Least concern
165	Yellow-crowned Woodpecker	Dendrocopos mahrattensis	Resident	Least concern
166	Lesser Goldenback	Dinopium benghalense	Resident	Least concern
167	Common Woodshrike	Tephrodornis pondicerianus	Resident	Least concern
168	Black-winged Cuckooshrike	Coracina melaschistos	Winter Migratory	Least concern
169	Small Minivet	Pericrocotus cinnamomeus	Resident	Least concern
170	Isabelline Shrike	Lanius isabellinus	Winter Migratory	Least concern
171	Bay=backed Shrike	Lanius vittatus	Resident	Least concern
172	Long-tailed Shrike	Lanius schach	Resident	Least concern
173	Southern Gey Shrike	Lanius meridionalis	Resident	Vulnerable
174	Black Drongo	Dicrurus macrocercus	Resident	Least concern
175	White-bellied Drongo	Dicrurus caerulescens	Resident	Least concern
176	Indian Golden Oriole	Oriolus(oriolus) kundoo	Summer Visitor	Least concern
177	White-browled Fantail	Rhipidura aureola	Resident	Least concern
178	Rufous Treepie	Dendrocitta vagabunda	Resident	Least concern
179	Indian Jungle Crow	Corvus (macrorhynchos) culminatus	Resident	Not assessed
180	House Crow	Corvus splendens	Resident	Least concern
181	Plain Martin	Riparia paludicola	Resident	Least concern
182	Dusky Craig Martin	Ptyonoprogne concolor	Resident	Least concern
183	Streak-throated Swallow	Petrochelidon fluvicola	Resident	Least concern
184	Wire-tailed Swallow	Hirundo smithii	Resident	Least concern
185	Barn Swallow	Hirundo rustica	Winter Migratory	Least concern
186	Red-rumped Swallow	Cecropis daurica	Resident	Least concern
187	Bengal Bushlark	Mirafra assamica	Resident	Least concern
188	Indian Bushlark	Mirafra erythroptera	Resident	Least concern
189	Rufous-tailed Lark	Ammomanes phoenicura	Resident	Least concern
190	Greater Short-toed Lark	Calandrella brachydactyla	Winter Migratory	Least concern

191	Ashy-crowned Sparrow Lark	Eremopterix griseus	Resident	Least concern
192	Crested Lark	Galerida cristata	Resident	Least concern
193	Oriental Skylark	Alauda gulgula	Resident	Least concern
194	White-eared Bulbul	Pycnonotus leucotis	Resident	Least concern
195	Red-vented Bulbul	Pycnonotus cafer	Resident	Least concern
196	Grey-breasted Prinia	prinia hodgsonii	Resident	Least concern
197	Graceful Prinia	Prinia gracilis	Resident	Least concern
198	Jungle Prinia	Prinia sylvatica	Resident	Least concern
199	Ashy Prinia	Prinia socialis	Resident	Least concern
200	Plain Prinia	Prinia inornata	Resident	Least concern
201	Rufous-fronted Prinia	Prinia buchanani	Resident	Least concern
202	Zitting Cisticola	Cisticola juncidis	Resident	Least concern
203	Common Tailorbird	Orthotomus sutorius	Resident	Least concern
204	Clamorous reed Warbler	Acrocephalus stentoreus	Winter Migratory	Least concern
205	Blyth's Reed Warbler	Acrocephalus dumetorum	passage visitor	Least concern
206	Booted Warbler	Iduna caligata	passage visitor	Least concern
207	Sykes's Warbler	Iduna rama	Winter Migratory	Least concern
208	Common Chiffchaff	Phylloscopus collybita	Winter Migratory	Least concern
209	Hume's Leaf Warbler	Phylloscopus humei	Winter Migratory	Least concern
210	Greenish Warbler	Phylloscopus trochiloides	passage visitor	Least concern
211	Green Warbler	Phylloscopus (trochiloides) nitidus	passage visitor	Least concern
212	Lesser Whitethroat	Sylvia curruca	Winter Migratory	Least concern
213	Hume's Whitethroat	Sylvia althaea	passage visitor	Least concern
214	Common Babbler	Turdoides caudata	Resident	Least concern
215	Striated Babbler	Turdoides earlei	Resident	Least concern
216	Large Grey Babbler	Turdoides malcolmi	Resident	Least concern
217	Jungle Babbler	Turdoides striata	Resident	Least concern
218	Yellow-eyed Babbler	Chrysomma sinense	Resident	Least concern
219	Oriental White-eye	Zosterops palpebrosus	Resident	Least concern
220	Bank Myna	Acridotheres ginginianus	Resident	Least concern
221	Common Myna	Acridotheres tristis	Resident	Least concern

222	Asian Pied Starling	Gracupica contra	Resident	Least concern
223	Brahminy Starling	Sturnia pagodarum	Resident	Least concern
224	Common Starling	Sturnus vulgaris	Winter Migratory	Least concern
225	Bluethroat	Luscinia svecica	Winter Migratory	Least concern
226	Oriental Magpie Robin	Copsychus saularis	Resident	Least concern
227	Indian Robin	Saxicoloides fulicatus	Resident	Least concern
228	Black Redstart	Phoenicurus ochruros	Winter Migratory	Least concern
229	Common Stonechat	Saxicola torquatus	Winter Migratory	Least concern
230	Pied Bushchat	Saxicola caprata	Resident	Least concern
231	Desert Wheatear	Oenanthe deserti	Winter Migratory	Least concern
232	Brown Rock Chat	Cercomela fusca	Resident	Least concern
233	Blue Rock Thrush	Monticola solitarius	Winter Migratory	Least concern
234	Red-breasted Flycatcher	Ficedula parva	Winter Migratory	Least concern
235	Grey-headed Canary Flycatcher	Culicicapa ceylonensis	Winter Migratory	Least concern
236	Purple Sunbird	Cinnyris asiaticus	Resident	Least concern
237	House Sparrow	Passer domesticus	Resident	Least concern
238	Chestnut-shouldered Petronia	Gymnoris xanthocollis	Resident	Least concern
239	Black-breasted Weaver	Ploceus banghalensis	Resident	Least concern
240	Streaked Weaver	Ploceus manyar	Resident	Least concern
241	Baya Weaver	Ploceus philippinus	Resident	Least concern
242	Indian Silverbill	Euodice malabarica	Resident	Least concern
243	Red Avadavat	Amandava amandava	Resident	Least concern
244	Scaly-breasted Munia	Lonchura punctulata	Resident	Least concern
245	Yellow-wagtail	Motacilla flava	Winter Migratory	Least concern
246	Citrine Wagtail	Motacilla citreola	Winter Migratory	Least concern
247	Grey Wagtail	Motacilla cinerea	Winter Migratory	Least concern
248	White Wagtail	Motacilla alba	Winter Migratory	Least concern
249	White-browed Wagtail	Motacilla maderaspatensis	Resident	Least concern
250	Paddyfield Pipit	Anthus rufulus	Resident	Least concern
251	Tawny Pipit	Anthus campestris	Winter Migratory	Least concern
252	Tree Pipit	Anthus trivialis	Winter Migratory	Least concern

253	Olive-backed Pipit	Anthus hodgsoni	Winter Migratory	Least concern
254	Rosy Pipit	Anthus roseatus	Winter Migratory	Least concern
255	Common Rosefinch	Carpodacus erythrinus	Winter Migratory	Least concern
256	Red-headed Bunting	Emberiza bruniceps	passage visitor	Least concern

***** *Status assigned by the International Union for Conservation of Nature and Natural Resources, where CR – Critically Endangered and EN– Endangered*
Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; IUCN (2016). The IUCN Red List of Threatened Species. Version 2016-3.

SIDENT - Those species which were observed during all the months of the year were regarded as the resident species.

LOCAL MIGRATORY - Those species which were observed irregular from the study site but are resident of India or move within the country were considered as the local migratory species.

WINTER MIGRATORY - The species which were found only during the winter season were regarded as winter migratory.

SUMMER MIGRATORY - The species which found only during the summer season were regarded as summer migratory.

Endemic / Restricted Range Species

There are no species which are reported as being endemic to, or have restricted ranges that include, the region in which the study area is situated.

Migratory Species

The entire Indian subcontinent, including the study area, falls within the limits of the Central Asian Flyway (CAF), one of the eight globally identified flyways. The CAF connects a large swathe of the Palaearctic region with the Indian subcontinent and contains several well-established routes along which a number of bird-species migrate annually. This flyway covers a large part of the continental area of Eurasia and includes the whole of the Indian sub-continent. Thus, the study-area is very likely to be situated in the flight-path of the various winter, summer and passage visitor-birds migrating either to or through the region in which it is situated.

Migratory Species of the Study Area

There are 84 winter migratory bird species in the Palwal. There are 9 summer migratory birds and a total of 93 birds migrate to Palwal in any given year.

Designated areas

Designated areas include nationally or internationally designated ecologically sensitive areas such as legally protected areas, namely, Protected Forests, Reserve Forests, Wildlife Sanctuaries, National Park, as also, Important Bird Areas and Ramsar Sites.

Legally Protected Areas

The Sultanpur National Park, spreading over 142 Ha area, is the nearest legally protected area. It is situated about 71 km North-west of the study area. Every year more than 100 migratory bird species arrive at Sultanpur in search of feeding grounds and to pass the winter.

Important Bird Areas (IBA)

Haryana has 5 IBA sites but Palwal district has none. Basai Wetlands is the nearest Important Bird Area. It is situated approximately 60 km from Study area. It is known to hold Globally threatened species, Congregations on a regular basis.

Ramsar Sites

There is no Ramsar Site in Haryana state.

3.9.4 ECOSYSTEM SERVICES

Provisioning services

The study area provides provisioning ecosystem services through the soil in which agricultural crops are cultivated by the local communities, as also, wild plants that serve the food, fodder, fuel-wood and timber needs of the local communities.

Major Field Crops:

Rabi

1. Wheat
2. Barley
3. Rapeseed Mustard

4. Potatoes
5. Other vegetables

(Source: Census of India: Palwal 2011)

Kharif Source

1. Paddy
2. Bajra
3. Jowar
4. Maize
5. Moong
6. Mash
7. Other Pulses
8. Sesamum
9. Cotton American
10. Sugarcane
11. Other fresh fruits

(Source: Census of India: Palwal 2011)

Horticulture Crops- Fruits

1. Guava
2. Ber
3. Citrus

Horticulture crops- Vegetables

1. Radish
2. Cauliflower
3. Carrot
4. Tomato

Livestock

1. Cattle
2. Buffaloes
3. Sheep
4. Goat
5. Camels
6. Pig

Fodder
The natural vegetation of the study area, including the plant cover of fallow lands, provides fodder to the livestock of the area.

Fuelwood and Timber
The trees and shrubs growing naturally in the study area provide fuel-wood and timber to the local communities.

Regulating services

The natural functioning of the ecosystems in the study area leads to the following processes that provide both, direct and indirect benefits to the local communities.

Ground Water Recharge

Surface Water Purification
The plants and soil organisms of the study area absorb and process a number of chemical compounds dissolved in local water-flows, effectively recycling wastes and purifying the water. The vegetation cover of the study area, especially its collective root systems, also acts as a physical filtration system, filtering out particulate matter as the water flows towards the area's ponds, lakes, streams and rivers. Thus, the study area contributes to the regulation of the water-quality of the area by purifying surface water.

Soil Erosion Control
The vegetation cover of the study area anchors soil-particles and binds them together, lowering the rate of soil erosion by water and wind. Thus, the study area contributes to control of soil erosion in the area.

Pollination and Pest Control
The vegetation cover of the study area provides habitats to a range of faunal species that include pollinator species, such as, pollen or nectar feeding insects and birds, as well as, insectivorous species, including frogs, lizards, birds and bats. By harboring such species, the study-area provides pollinator-services and pest-control services to natural, as well as, agricultural plants in the area.

Supporting services

The natural functioning of the ecosystems of the study area lead to the following processes that create or maintain basic natural resources, such as soil-nutrients and photosynthetic production, that support human life-sustaining activities, such as farming, food-gathering, cooking and grazing of livestock.

Nutrient Capture and Recycling

The food-chains constituted by the organisms of the study area are continuously involved in the capture and transfer of the macro and micro nutrients in the soil, water and air, effectively recycling nutrients and making them available in the nutrient-sinks of the local ecosystems. The biomass generated by the study-area, and transferred physically by water and wind, helps recharge the soil-fertility in the surrounding area. Thus, the natural vegetation and topography of the study-area contribute to the natural productivity of the area.

Primary Production

The photosynthetic organisms of the study-area act as primary producers, creating food-reserves that directly or indirectly support the consumers of the area, including the local communities. This primary production includes, besides a number of resources utilized directly by local communities (and covered under Provisioning Services), the grass blades and leaves consumed by grazing and browsing animals like grasshoppers, bugs, beetles, snails, goats and sheep, the flowers, pollen and flower-nectar consumed by butterflies, moths, bees and sunbirds, the seeds consumed by seed and grain-eaters like ants, sparrows, larks, pipits and mice, and the fruits consumed by birds and bats.

3.10 DEMOGRAPHY & SOCIO-ECONOMICS

A meeting with the project proponent was initially conducted to develop a common understanding of the project activities, land acquisition for tap off point and status of payment of compensation to the affected PAP, and to identify a continuous point of contact for all future correspondence.

The baseline information included aspects like demographic information, economic activities, literacy profile, land use, infrastructure resource, economic facilities, cultural heritage, life style and other value system.

The following methods were used as a benchmark to collate the baseline information:

- Stakeholders consultation meeting which included the Project Influenced and benefitted Population in Palwal and Nuh;
- Consultations with along the pipeline route to understand the socio-economic status, education facilities and the literacy levels.

The delineation of Preliminary Stakeholders were based on the following points,

- The type of stakeholders, and;
- Their connection and influence levels on the project.

An open ended questionnaire was prepared for the focus group discussions prior to the start of the consultation process to obtain the information from the population. Different stakeholder groups were consulted to understand the concerns/ issues, expectations/ benefits and other advantages that they have on the project.

3.10.1 PALWAL & NUH DISTRICT PROFILE

Palwal is the 21st district of Haryana State in northern India. Palwal city is the headquarters of this district. The city is situated at a distance of 60 kms. from Delhi on the Delhi-Mathura highway (NH-2). It is a place of great antiquity, supposed to figure in the earliest Aryan traditions under the name of Apelava, part of the Pandava kingdom of Indraprastha, which was later restored by Vikramaditya.

Mewat, officially known as Nuh, is one of the 22 districts in the Indian state of Haryana. It is the most backward district in India.[1] There are four sub-divisions in this district: Nuh, Ferozepur Jhirka, Punahana, and Taoru. It has an area of 1,860 square kilometres (720 sq mi) and had a population of 1.09 million in 2011. It is bounded by Gurugram District to the north, Palwal District of Haryana to the east and Alwar District of Rajasthan to the south and west. Its boundaries also touch Bharatpur District of Rajasthan and Mathura District of Uttar Pradesh near Bichhor Village and Nai Village of Punhana Tehsil. It is predominantly populated by farmers of Meo ethnicity.

3.10.2 VILLAGES FALLING UNDER STUDY AREA

There are 65 villages along the proposed pipeline route, in which most of the settlements are ribbon developed along the main route. The main villages through which the proposed pipeline passes are given below in Table 3.11 below.

Table 3-11: Results of Noise Level Monitoring- Residential Areas

S.No	City/ Village		Taluka	District	State
1	1. Alapur	8. Miranpur	Palwal		
	2. Atoha	9. Patli Kalan			
	3. Bahrola	10. Khusropur			
	4. Bamni Khera	11. Jalapur khalsa			
	5. Dholagarh	12. Durgapur		Palwal	
	6. Softa	13. Gailpur			
	7. Prithla	14. Ratipur			

2	1. Nangal jat 2. Bahin 3. Manpur 4. Kondal 5. Andhrola 6. Hathin 7. Ghigraka	8. Firozpur Rajput 9. Sanpal 10. Mangoraka 11. Kot 12. Jararai 13. Uttawar 14. Malai	Hathin		Harayana
3	1. Hodal City 2. Aurangabad 3. Mitnol 4. Tumsara	5. Bhulwana 6. Sundhad 7. Hussainpur	Hodal		
4	1. Nuh City 2. Adbar 3. Raipuri 4. Thekarka	5. Ujina 6. Marora 7. Malab	Nuh	Nuh	
5	1. Asaisika 2. Bhadas 3. Ferozpur Jhirka 4. Dhanwala 5. Jalalpur Nuh 6. Kherli Nuh	7. Madhi 8. Mandikhera 9. Mohmadbas 10. Nasirbas 11. Pol 12. Pithorpuri 13. Baghola	Firozpur Jhirka		

3.10.3 DEMOGRAPHIC DETAILS

According to the 2011 Census, the total population of Palwal & Nuh Districts was 1,042,708 and 1,089,263 which comprised 0.041% and 0.042% of the State's (Haryana) population respectively. As compared to the 2001 Census Data, the population has seen a rise of 25.76% from 2,13,6587 in Palwal & 38.65% from 3,03,669.

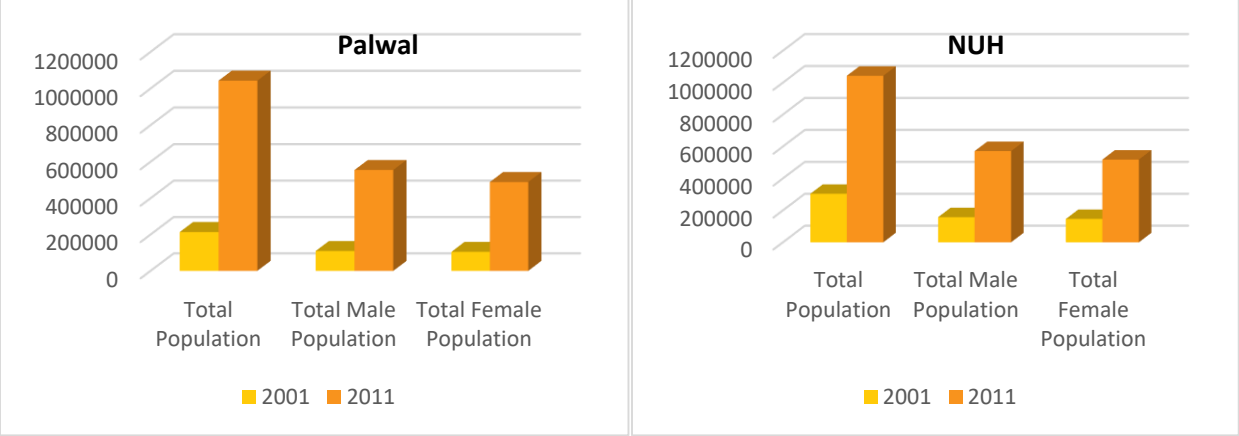
The male and female population as per the 2011 Census Data comprised 53.17% and 46.83% in palwal district & 52.43% and 47.57% in Nuh district of the total population. The male and female (in increasing trend) population have shown a slight variation as compared to the 2001 Census Data, wherein the male population comprised of 24.50% and female population was 27.23% in Palwal district & the male population comprised of 38.05% and female population was 39.33% in Nuh district of the total population. The sex ratio as per the 2011 Census data was 880 females (to every 1000 males) in palwal district & 907 females (to every 1000 males) in Nuh district which is higher than a decade ago (2001) with 862 females (to every 1000 males) in Palwal district & 899 females (to every 1000 males) in Nuh district. The households in the District as per the 2011

Census Data was 170,618 in Palwal district & 159,858 in Nuh district. There are no ST population in the project districts.

Table 3-12: Demographic Profile of Project Districts

Parameters	District	
	Palwal	**Nuh**
Total Population	1,042,708	1,089,263
Male population	554,497	571,162
Female Population	488,211	518,101
Sex Ratio (Per 1000)	880	907
Literacy rate (%)	69.32	54.08
Male Literacy Rate (%)	82.66	69.94
Female Literacy Rate (%)	54.23	36.60
Population Density	767	723
Population Growth Rate (%)	25.76	38.65
Scheduled Castes Population	203,123	75,251
SC Male	107,741	39,743
SC Female	95,382	35,508
Scheduled Tribes Population	0	0
Male ST	0	0
Female ST	0	0
Child Population	177,494	248,128
Male Population 0-6	95,132	130,168
Female Population 0-6	82,362	117,960
Working Population	309,563	289,964
No. of Agriculture labour	60,685	55,278
Main Working Population	216,932	204,178
Non-Working Population	733,145	799,299

Figure 3-11: Decadal Population Growth of Palwal & Nuh District



Religion wise Demography details

The religion-wise demography profile indicates that maximum population belongs to Hindus (79.25%) followed by Muslims (20.00%) in Palwal district whereas maximum population belongs to Hindus (20.37%) followed by Muslims (79.20%) in Nuh district. Most part of the study area has been occupied by Hindus in Palwal district on the other hand in Nuh district the maximum area has been occupied by Muslims. The details of religion-wise demography status of Pokhran Tehsil are given below in **Table 3-13**.

Table 3-13: Religion-wise demographic Profile as per Census data, 2011

District	Population	Hindu	Muslim	Christian	Sikh	Buddhist	Jain	Others	Not Stated
Palwal	1,042,708	79.25%	20.00%	0.09%	0.38%	0.03%	0.09%	0.0%	0.16%
Nuh	1,089,263	20.37%	79.20%	0.11%	0.05%	0.05%	0.13%	0.0%	0.09%

4 ANTICIPATED ENVIRONEMENTAL IMPACTS & MITIGATION MEASURES

This section of the report provides an assessment of the potential impacts on different identified environmental components, which are likely to occur during the laying of pipeline and supply of Petroleum products through the pipeline. However, by adopting appropriate management measures, the majority of the assessed impacts can be mitigated.

The major potential impacts associated with the proposed project are impact on soil, impact on water resources and area drainage, air quality degradation, noise impacts, impact on ecological environment, impact on agriculture, land use changes, impact on health and safety, impact on socio-economic features, impact on community activities, impact on cultural heritage and impact on aesthetics. These impacts can occur at any one of the three stages i.e. planning or design stage, the construction stage and the operation stage.

The identified impacts due to the proposed project can be mitigated through the incorporation of appropriate measures at different stages of the project. This will ensure the best design with minimal damage to or loss of significant or sensitive features such as roadside vegetation, local water resources, etc.

4.1 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

The environmental impacts associated with the proposed project on various environmental components such as air, water, noise, soil, flora, fauna, land, socioeconomic, etc. has been identified using Impact Identification Matrix.

Table 4-1: Impact Identification matrix for the proposed pipeline route and the CNG stations

	Physical				Biological		Socio-Economic		
	Ambient Air Quality	Ground/Surface Water (Quantity/Quality)	Ambient Noise	Land (Land use, Topography, drainage, soil)	Flora	Fauna	Livelihood and Occupation	Infrastructure	Health & Safety
Augmentation of Facilities									
Construction Phase									

Civil and mechanical works	●	●	●	●	●	●	●	●	
Movement of vehicles	●		●			●		●	●
Hydro testing									●
Waste generation, handling and disposal				●					●
Operation Phase									
Operation of pumps and compressors	●	●	●						
Storage of Gas/ Crude	●								
Cleaning & maintenance		●		●					
Movement of vehicles	●		●			●			
Waste generation, handling and disposal		●		●				●	●
Leakage from pipeline	●	●							
Laying of New Pipeline									
Construction Phase									
Preparation of Right of way	●		●	●		●	●	●	●
Pipe laying	●			●					●
Chemical use/handling		●		●					
Movement of vehicles	●		●			●		●	●
Hydro testing		●							●
Waste generation, handling and disposal				●					●
Operation Phase									
Operation of compressors	●		●						
Cleaning & maintenance		●		●					
Waste generation, handling and disposal			●						●
Movement of vehicles	●					●		●	
CNG Stations									
Construction Phase									
Civil and mechanical works	●		●	●	●		●		●
Movement of vehicles	●	●	●			●			●
Waste generation, handling and disposal		●		●	●			●	●
Operation Phase									

Leakage due to corrosion, equipment failure, accidents, human error and as a result of third party interference	●	●							

4.2 IMPACT AND MITIGATION MEASURES- CONSTRUCTION PHASE

4.2.1 AIR ENVIRONMENT

The air quality along the project stretch may get affected during the construction period. Particulate matter will be the predominant pollutant affecting the air quality during the construction phase. As the construction activities are likely to generate dust. Mostly the additional automobile traffic and construction machineries involved during construction activities will generate petroleum pollutants. However, this will not lead to any tangible effect, as the additional traffic volume related to construction activities will be low.

a. Impacts

Potential emissions sources during construction phase include the following:

- Deterioration of air quality due to fugitive dust emissions from construction activities (especially during dry season) like excavation, back-filling and dumping of earth materials, from construction spoils, vehicular movements along unpaved roads, loading / unloading and transportation of construction materials
- Equipment deployed during the construction phase is also likely to result in marginal increase in the levels of SO2, NOX, and particulate matter
- Operation of equipment and machinery for earth-moving, grading, pipeline laying and civil works at pipeline ROW and other sites
- Operation of temporary Diesel Generator (DG) sets, emission of PM, CO, NOx, & SOx

b. Mitigation Measures

During construction phase of the proposed project appropriate mitigative measures have to be implemented to ameliorate the anticipated air quality problems. The following mitigative measures will be employed during construction period to reduce the pollution level to acceptable limits

- Proper and prior planning, appropriate sequencing and scheduling of all major construction activities have to be done, and timely availability of infrastructure supports needed for construction to be ensured to shorten the construction period vis-à-vis reduce pollution.

- Construction materials to be stored in covered godowns or enclosed spaces to prevent the windblown fugitive emissions.
- Stringent construction material handling / overhauling procedures to be followed.
- Adequate dust suppression measures such as regular water sprinkling on unpaved haul roads, at vulnerable areas of construction sites to be undertaken to control fugitive dust during material handling and hauling activities particularly near habitations especially in dry seasons.
- The construction material delivering vehicles to be covered in order to reduce spills.
- Low emission construction equipment, vehicles and generator sets to be used
- It has to be ensured that all construction equipment and vehicles are in good working conditions, properly tuned and maintained to keep emission within the permissible limits and engines tuned off when not in use to reduce pollution
- Vehicles and machineries to be regularly maintained so that emissions confirm to standards of Central Pollution Control Board (CPCB)
- Monitoring of air quality at regular intervals to be conducted during construction phase
- Construction workers to be provided with masks to protect them from inhaling dust.

4.2.2 NOISE ENVIRONMENT

During construction phase, noise will be generated due to movement of vehicles, and operation of light and heavy construction machineries including pneumatic tools (hot mixer, dozer, tipper, loader, excavator, grader, scrapper, roller, concrete mixer, generator, pump, vibrator, crane, compressor, HDD etc.). During construction the noise generating range will be approximately between 55-70 dB(A). The main sources of noise during construction period are:

- Movement of vehicles during the construction period for procurement of construction material.
- During site preparation, surface preparation, pipeline laying etc.

Noise generated from sources mentioned above will be mostly during daytime. Moreover, villages / settlements being near to the route, significant impact on local people is apprehended (as a few congested human habitations are along the site), as the noise generated will be a problem. However, the workers are likely to be exposed to high noise levels that may affect them.

a. Impacts

- Increase in noise level due to construction activities like operation of construction equipment and vehicular traffic
- Operation of construction machinery will lead to rise in noise level to the range between 80-100 dB(A). The magnitude of impact from noise will depend upon types of equipment used, construction methods and also on work scheduling.

- Since there is a mix of residential, commercial and industrial area in the vicinity of the project, noise have to be kept in check.
- The impacts will be significant on construction workers, working close to the machinery.

b. Mitigation Measures

- Construction camp and temporary labour sheds will be located away from the immediate vicinity of construction sites and major road traffic.
- Protective gears such as earplugs, etc. will be provided to construction personnel exposed to high noise levels as preventive measures.
- It will be ensured that all the construction equipment and vehicles used are in good working condition, properly lubricated and maintained to keep noise within the permissible limits and engines tuned off when not in use to reduce noise.
- Construction activities carried out near residential locations will be scheduled to the daytime (i.e. from 10.00 a.m. to 6.00 p.m.) only so as to have minimum disturbance to the residents.
- Whenever possible static noisy machinery will be placed on vibration isolators or temporary sheeting will be provided to check noise propagation.
- Ensuring equipment is maintained to manufacturers standards and that noise baffles are fitted.
- Reducing exposure times for people working near noisy machinery;
- Noise level will be monitored at regular intervals during construction phase, which will help in taking appropriate action to maintain it within the prescribed limit

4.2.3 WATER ENVIRONMENT

Small quantity of water will be used during construction process and hydro testing of the pipeline. Wastewater from construction activities would mostly contain suspended impurities. Other pollutants, which may find their way to it, will be insignificant concentrations and may not cause significant impact on the receiving water bodies. The deterioration of water quality during construction phase is expected due to wastewater disposal from the workers camp and sludge generated from construction sites. If adequate arrangements are not made to ensure proper drainage of wastewater from construction sites, such waters may form stagnant pools and aggravate soil erosion. Stagnant pools of water promote breeding of mosquitoes and create generally unsanitary conditions.

a. Impacts

- Increase of sediment / silt load in the runoff from construction sites / earth moving activities and increase in turbidity in receiving stream / water bodies.
- Erosion of soil into the water bodies due to removal of vegetation.

- Contamination by fuel and lubricants by spills from machineries.
- Contamination of water bodies due to improper sanitation and disposal of wastes at the construction Camps.
- Contamination of water bodies due to water from Hydrotesting of the pipeline.
- Impact on ground water quality due to leachates from the solid waste dumpsites.

b. Mitigation measures

- Quality of construction wastewater emanating from the construction site to be controlled through suitable drainage system with sediment traps (silting basin as water intercepting ditch) for arresting the silt / sediment load before its disposal into the main natural drainage system around the site.
- The trench shall be excavated only so far in advance of pipe laying that it do not causes increased soil erosion and silting of water bodies.
- The discharge of the trench de-watering pumps shall be conveyed either to drainage channel or to natural drains after passing through a catch pit for settling the silt.
- The trench shall be excavated to the exact gradient specified so that no making of the sub-grade by back filling is required and the concrete bed, where required, may be prepared with greatest ease giving a uniform and continuous bearing and support for the pipe.
- All the construction and preparatory activities to be carried out during dry seasons only.
- Construction materials to be stacked together by fencing it with brick or earth in order to prevent spillage into the water bodies, also these materials to be stacked away from the water bodies.
- Proper sanitation facilities to be provided at the construction site to prevent health related problems due to water contamination.
- Waste disposal and sanitation to workers in the construction camp to be properly maintained or taken care off in order to check their entry into the water bodies like ponds, streams etc.
- Vehicle maintenance and refueling to be confined to areas near construction camps designed to trap discarded lubricants and fuel spills from entering into the water bodies;
- Drinking water supply for the workers in the construction camps to meet the Indian National Standards. In order to assess the portability of the supplied water to the construction labour camps water quality to be periodically monitored.
- Garbage to be collected in tanks and disposed off daily in order to check the solid wastes entering into the ponds, streams etc

4.2.4 LAND & SOIL ENVIRONMENT

The construction activities such as earth moving may lead to reduction in vegetal cover on ground thus leading to soil erosion. During the construction period the movement of heavy vehicles will result in compaction of soil by making it hard and impermeable. The erosion at construction stretches will result in increased sediment load in recipient streams. Any leakage of lubricants in equipment yard will cause soil contamination. Solid waste disposal along roadside also adds to impact on the land environment during the construction. During construction activity for laying of pipeline cutting of existing land will be done and the dug material generated will be replaced back after laying of the pipes.

a. Impacts

- Loss of topsoil from excavation areas.
- Loosening of topsoil and loss of vegetative cover (land clearing) along the route and construction areas due to excavation and back filling which lead to enhance soil erosion.
- Compaction of alluvial soils by earth moving equipment.
- Solid waste disposal along the route also adds to impact on the land environment during the construction phase.

b. Mitigation measures

- During excavation, care will be taken to see that the topsoil and the subsoil are stored separately. Topsoil (50cm) of route pits will be conserved and restored after excavation is over and will be replaced back for filling of the pit areas. Whereas the top soil (25cm) stripped from agricultural field and forest area will be stacked separately as top soil dump of not more than 1m in height and the same will be redistributed to the pit after laying of pipeline. During refilling, care will be taken to see that the topsoil is replaced back at the top while refilling after laying of pipeline. This will help grasses growing earlier on the surface, to grow back. Also, the less fertile soil of lower horizon will not be placed on the top thus avoiding degradation of land.
- Back filling shall be carried out immediately after the pipeline has been laid in the trench. On no account the topsoil from ROW shall be used for this purpose. The backfill material shall not contain any extraneous material and/or hard lumps of the soil. After the initial backfill has been placed into the trench to a level slightly above the surrounding ground, the backfill material shall be compacted.
- When the trench has been dug through driveways or roads all backfills shall be executed with sand or a suitable material and shall be thoroughly compacted
- Trench excavated in dykes which are the property of the railways or which is part of main road shall be graded and backfilled in their original profile and condition

- Also necessary contour bunding, gully plugging and staggered trenching shall be carried out wherever required in the pipeline corridor and in areas where excavated soil will be dumped to check soil erosion
- Stone pitching will be provided at the slopes near the irrigation and natural drainage / rivers to prevent silting of soil into these water bodies.

4.2.5 ECOLOGICAL ENVIRONMENT

The initial construction work at the pipeline route involves land clearance, but it would not include clearing of trees. However, the pipeline runs along/ in the protected forest area as well as the ecologically sensitive region.

All the construction work will be carried out in the premises of the pipeline boundary and the CNG station boundary only. Development of Green belt all around the stations will be started along with the construction activities to contain the dust and noise due to construction activities within the boundary. Therefore, no impact on the ecological environment is proposed due to the construction activity of the project.

a. Impacts

- The proposed pipeline passes through notified protected forest land, but no vegetation clearance will be undertaken as part of the pipeline route laying activity.
- The proposed project may not cause any impacts on fauna and wildlife of the study area during construction phase.
- No wildlife corridor and migratory routes comes in the pipeline route. Construction activity during monsoon and post monsoon period may not cause any impact on the movement of wildlife.

b. Mitigation measures

- No vegetation clearance will be undertaken in the pipeline route as well as the CNG stations plot boundary
- While planning / selection of route care to be taken to route the pipeline alignment in such a way to avoid areas with trees and shrubs and thus no major impact of loss of vegetation is anticipated.

4.2.6 SOCIO-ECONOMIC ENVIRONMENT

The project will provide either direct or indirect job opportunities to the local population as far as possible. There will be some migration of skilled labor force from outside the project area during construction phase, which may put some pressure on the local settlements and resources. Considering the size and type of construction activities envisaged the immigration of work force for construction phase (including contractor' labours) would have marginal impact on demography (e.g. changes in total population, sex ratio, literacy level, main workers etc.) of the immediate vicinity area.

In addition, Traffic volume might will increase on nearby roads and the project roads due to movement of heavy vehicles during the construction phase, which may cause public inconvenience. This will have minimal affect considering the size and nature of the Project.

a. Impacts

- Strain on civic amenities (like road, transport, communication, water supply and sanitation, health care and recreational utilities etc.) due to increase in floating population.
- Increase in traffic volume and congestion in the areas and roads.
- Increase in employment opportunity to non-workers in the project area as nonskilled and semi-skilled workers.

b. Mitigation Measures

- It is difficult to assess the above impacts quantitatively on a measurable scale. However, most of these impacts will be short term and limited to the construction period only.
- Development of traffic management plan to ease the situation.
- Transport of construction materials and machineries shall be carried out during lean traffic period of the day or during night.

4.3 IMPACTS & MITIGATION MEASURES- OPERATION PHASE

The impact during the operation phase will be continuous in nature. For a gas-based pipeline and CNG station the potentials for imparting adverse impacts is not high. However whatever impact on environment is present will be minimized through incorporation of efficient technologies for pollution control measures.

4.3.1 AIR ENVIRONMENT

a. Impacts

- The pipeline will be 1.2-2 m below the ground and thus no air pollution due to operation of the project is anticipated.
- Some vehicular emission from maintenance is anticipated during maintenance phase, which will be temporary
- The impacts of the operational CNG station would not have any impacts on Air pollution of the area. The increased frequency of the vehicles at the station would not lead to any increased air pollution.

b. Mitigation Measures

Not Required

4.3.2 NOISE ENVIRONMENT

a. Impacts

- The pipeline will be 1.2 m below the ground and thus no noise pollution due to operation of the project is anticipated
- The residents / staff may be exposed to high noise levels during maintenance phase, which will be temporary.
- Noise and vibration during operations will be gas engine, various major and large compressors, air compressor, ventilation fans and miscellaneous equipment's for the CNG stations

b. Mitigation Measures

- In the stations, a closely spaced green belt to be planted all around the premises to attenuate noise
- Machinery to be maintained and lubricated as per manufacturers' guidelines to reduce noise generation.
- Personnel deployed in compressor stations will be issued personal noise protection equipment (ear plugs, ear muffs)
- If necessary, their duty hours will be regulated to keep noise exposure levels within standards.
- All equipment in the station would be designed / operated to have a noise level not exceeding 85dB, as per the requirement of Operational and Safety and Health Administration Standard (OSHA).
- Adopting modern design and the use of sound-absorbing materials will minimize noise and vibration from the station.

4.3.3 WATER ENVIRONMENT

a. Impacts

- The material/product to be transported is compressed gas, so during the operation period, the expected impacts on the water resources are not anticipated.
- The aquatic biological environment in the vicinity of the proposed project pipeline will not be affected, as no discharge is proposed form the CNG stations. Hence, there will be no impact on aquatic ecosystem due to operation of the project.

b. Mitigation Measures

- The discharge from the toilets from the stations will be routed to through the sewage pipelines to the nearest treatment plant, No open discharge will be done.

4.3.4 ENVIRONMENT, HEALTH AND SAFETY

c. Impacts

- There could be impacts on environment, health and safety due to leakage from pipelines from likely external physical forces, e.g. seismicity, floods, landslides, permafrost, vegetation;
- . **Mitigation Measures**
  - Leak Detection and Control System shall be in place
  - SCADA monitoring shall be carried out by AGL
  - Mock Drills shall be conducted at regular intervals in line with Emergency Response and Disaster Management Plan of AGL

Prevent leaks by

- Installing positive pipe corrosion control measures, for example, coatings, cathodic protection, chemical additives, heaters;
- Ensuring that the SCADA is well maintained and used correctly to control flow and pressure.
- Detect leaks by installing leak detection equipment, e.g. monitoring the flow in the pipe through pressure sensors connected to alarms and automatic pump shutdown systems;
- Continuous metering to provide a comparison between input and output for leak detection;

- **Emergency response**

- Introduce accident, fire and explosion precautions and emergency response procedures;
- These should be tested and drills should occur regularly with appropriate reporting on response times etc.;
- Introduce environment, health and safety training for all employees and contractors;
- Plan the route of the pipeline to reduce the impact on the surrounding area;
- Bury pipelines along the entire length to a minimum of 1m to the top wherever possible;
- Schedule periodic inspection and maintenance to avoid disturbance/disruption of sensitive habitats;
- Good housekeeping should be maintained at all times in all areas of the site;
- Prevent unauthorised or unintentional intrusion to protected areas through fencing or flagging;

5 ADDITIONAL STUDIES

5.1 QUANTITATIVE RISK ASSESSMENT

Quantitative Risk Assessment (QRA) study should be undertaken for the proposed 8"& 4" diameter underground pipeline for the transfer of compressed natural gas. The aim of QRA study will be to identify potential hazards, assess the consequences and frequency of hazards and evaluate the risk to personnel, property and public. To assess the relative level of risk posed by the proposed project, a comparison will be made with risk criteria that is considered tolerable (ALARP) for similar operations

The overall approach and methodology employed for the study will be based on the guidelines given in IS 15656 : 2006, Indian Standard – Hazard Identification and Risk Analysis – Code of Practice, May 2006, using PHAST Software/Correlations.

The pipeline system will be provided with state of the art safety systems like protection system, SCADA, leak detection system / pipeline application software, Fire and gas detection systems, etc. The proposed transfer of gas will be examined for inherent hazards or the potential to result in an unplanned event or sequence of events at different sections along the pipeline route. Several hazards that can cause failure of pipelines will be identified. These included loss of integrity/ damage due to interference from third parties, corrosion, accidents, human error, sabotage, etc., during normal operation. Analysis of past accidents are to be used to establish the credibility of accident scenarios.

5.2 GUIDELINES FOR EMERGENCY RESPONSE PLAN

Emergency response plan will be developed with the resources available within the company. The important stages of the response plan are declaration of an emergency, identification of resources & manpower, ending of an emergency and rehearsal of the plan. Declaration of an emergency would involve recognizing a leak and reporting to Station in charge of nearest compressor station.
Other features are summarized below:
Emergency Response Structure: An emergency response structure will be developed for effective response to the emergency. The structure defines the main functions of the decision makers and the individual roles as well.

Roles & Responsibilities of Team: Emergency response team (ERT) to respond to fire, accidents and technical emergencies will be constituted from operations personnel, who can be

called upon 24 hours a day, supported by senior management field personnel as and when required. The ERT will receive specific training for their roles and exercised on a regular basis. The proposed functions of employees that are planned to be deployed will be finalized prior to commissioning.

Operations Control: The pipeline operation will be monitored and controlled through Local control system and POC in command which will have the provision for emergency shut down or isolation of Pipeline. Security: Surveillance of the entire pipeline will be held periodically through ground patrolling. Using operators with knowledge of local area will be deployed for ground patrolling of the pipeline route.

Medical and First Aid: All arrangements will be made available at SHPPL site offices and camps for medical and first-aid. First–Aid facility will be provided at compressor stations, master pipeline operation center/ local control center, MLVs and M&Rs. Adequate first-aid training will be provided to employees at these locations.

Communication: Responsibility for external and internal communication will be assigned at each station. Dedicated fiber optic cable based communication system will be provided for quick communication between the control stations, dispatch and delivery station(s) of the pipeline. The backup system will consist of appropriate combination of fixed telephone lines/data-bandwidth of the local service provider, mobile phones, VHF sets etc.

Emergency control room: A safe location will be designated as emergency control room (ECR) within the compressor stations.

Emergency Procedures: SHPPL will evolve easy-to-follow procedures for responding to the identified situation. The plan will be rehearsed once in three months.

Ending of an emergency: After controlling an emergency, the site ERT Leader will declare as “All Clear”. The siren will be sounded for 2 minutes to indicate that the Emergency is over.

The basic elements for an effective plan have been included in the development. Prior to the commissioning of the project, copies of the plan are to be given to the authorities.

5.3 STAKEHOLDER CONSULTATIONS

Stakeholder Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate.

Consultations were done at all districts of the projects, along the pipeline route. These meeting included the Project Influenced and benefitted Population in Palwal and Nuh. This was undertaken to understand the socio-economic status, education facilities and the literacy levels of the population as well as their interest in the upcoming project in their area.
The delineation of Preliminary Stakeholders were based on the following points,

- The type of stakeholders, and;
- Their connection and influence levels on the project.

An open ended questionnaire was prepared for the focus group discussions prior to the start of the consultation process to obtain the information from the population. Different stakeholder groups were consulted to understand the concerns/ issues, expectations/ benefits and other advantages that they have on the project.

Figure 5-1: Photographs taken during the stakeholder consultations

Stakeholder Consultation in Nuh District

Stakeholder Consultation in a commercial Area in Palwal District


ADMISSION OPEN
For Classes : Pre. Nur. to VII

6 ANALYSIS OF ALTERNATIVES

Route selection is a process of identifying constraints, avoiding undesirable areas and maintaining the economic feasibility of the pipeline. Diversion of pipeline around obstacles can be very costly. The ideal route, of course, would be a straight line from the origin to the terminal point. However, physiographic, environmental, design and construction constraints usually alter the route

The pipeline route should be optimized based on the following considerations:

- Safety of public lives and property and safety of the pipeline from engineering and other considerations.
- Shortest pipeline length.
- Easy and favorable terrain condition free of large water bodies, low lying marshy lands, obstacles like ravines, depressions and unstable grounds, meandering rivers, etc.
- Ground profile for pipeline hydraulics and avoidance of steep rising and falling ground, hills and valleys having sloping right of way.
- Availability of infrastructure and access to the pipeline route during construction and maintenance.
- Environmental impact and avoidance of environmentally sensitive lands, such as reserved forests, marine parks, built-up areas, places of worship, burial and public events.
- Minimum crossing of existing pipelines, transmission lines, parallel alignment, etc.
- Minimum road, rail, river and canal crossings.
- Avoidance of rugged and intricate grounds with hard strata, exposed rocks, boulders and quarries.
- Existing and future developments in the region, such as roads, rail lines, canal network, reservoirs, townships, industrial units, etc.
- Scope for future expansion of the pipeline.

The Petroleum and Natural Gas Regulatory Board (PNGRB) was constituted under The Petroleum and Natural Gas Regulatory Board Act, 2006 (NO. 19 OF 2006) notified via Gazette Notification dated 31st March, 2006. The Act provide for the establishment of Petroleum and Natural Gas Regulatory Board to protect the interests of consumers and entities engaged in specified activities relating to petroleum, petroleum products and natural gas and to promote competitive markets and for matters connected therewith or incidental thereto.

Further as enshrined in the act, the board has also been mandated to regulate the refining, processing, storage, transportation, distribution, marketing and sale of petroleum, petroleum products and natural gas excluding production of crude oil and natural gas so as and to ensure

uninterrupted and adequate supply of petroleum, petroleum products and natural gas in all parts of the country. Hence the project was acquired through the bidding process and the area, number of customers, total CNG stations were already mentioned in it. So the route selection was done within the allotted area.

The options for applying and analysis for alternatives was not a feasible option, as the deadlines have been already mentioned and the work was supposed to start from the date of signing the document. Since all the requirements in the projects were predefined, scope for alternate analysis was quite slim, as to which the route passes through mix and heavily populated area, eco-sensitive zones and the notified protected forest zones.

7 PROJECT BENEFITS

7.1 CONTRIBUTION TO NATIONAL ENERGY SECURITY

Energy is the key input for economic growth and Indian Energy sector play a vital role in country's Economy. Energy is a key input to the production processes that transform inputs to goods and services. India became the third largest energy consumer in the world after United States and China. Key drivers for increasing energy demand in India are population growth, industrialization and urbanization. Energy security and sustainability are interdependent because emissions from energy consumption contributes to climate change in greater extend globally. Indian government is also committed to increase the share of natural gas in country's energy mix up to 15% by 2030 and Ministry of Petroleum and Natural Gas intervening with policy reforms in natural gas sector. India requires a sustained supply of energy to support its ambitious growth and welfare targets for the coming years. In a survey by NITI Aayog, it was noted that India's energy consumption will reach 2,300 million tonnes of oil equivalent (mtoe) by 2047 out of which natural gas will contribute 173 mtoe under the determined effect scenario.

According to the International Energy Agency(IEA), Indian gas market is considered one of the most growing energy markets in the world, the Agency expected that Indian gas demand will increase in the coming decades at 5.4% per annum over 2007-30 (IEA ,2009) reaching 132 BCM by 2030. India had about 43.8 TCF of proved natural gas reserves by the end of 2012; production of natural gas arrived in 2011, 2012 to 47.559 BCM, India was self-sufficient in natural gas until 2004, where it began to import liquefied natural gas from Qatar to meet the growing needs where India occupied the sixth rank globally in the import of natural gas. In spite of the Indian increase production of gas in 2010, an increase of up to more than 44%, but India and because of the high economic growth has increased the import at an annual rate of 10 % from 2001-2011. In 2011, India consumed 2.3 trillion cubic feet (TCF) which is equivalent to a quarter of the Indian natural gas needs. Qatar is India's main supplier of liquefied natural gas, where the parties signed long-term contracts to supply India around 7.5 million tons of LNG every year from Qatar for 25 years and the first shipments has reached to India in 2004.

With the growing need for oil and gas in India since the nineties of the last century, the Indian government has worked to develop the oil and gas sector through the development of mechanisms of action and the issuance of new regulatory laws, 1993, private investors have been allowed to import and market liquefied petroleum gas (LPG) and kerosene freely, private investment is also allowed in lubricants, which are not subject to price controls. In the 11th Five Year Plan, the Indian government has focused in particular on the energy sector in order to self-

reliance for energy resources, particularly oil and gas by encouraging of exploration and extraction operations and reduce dependence on overseas. The government also worked on the development of oil and gas infrastructure such as pipelines, refinery, ports, and railways. India currently has 22 refineries with a capacity (215.066 MMTPA),17 refineries under public sector and 3 under private sector. The Indian government is also working to improve of the oil and gas pipelines, and in spite of networks of gas and oil pipelines are still weak but the government is seeking to develop it, in collaboration with private sector companies.

7.2 REDUCED RISKS & COSTS

Natural gas pipeline has been regarded as the most cost effective and safest channel of gas transportation and has extraordinary strategic significance for the country. Pipeline is regarded as the most cost effective and safest channel to transport the oil and gas from upstream oil field or port to the downstream users or refineries. The gas is significantly replaced by oil in all sectors i.e. power generation, domestic and transportation due to price hike in oil prices globally and cheaper availability of natural gas. During the last five years the oil import has reduced by 8 %. The other reason for that may be the availability of cheaper, safe and durable mode of gas transportation system (main and distribution network of pipeline), which is continuously expending.

The gas pipeline projects helps in reducing the travel cost in comparison to other resources and it is also very safe and cheaper for domestic, commercial and industrial uses. The proposed pipeline project would be very feasible and cost effective as it is totally underground and there will be continuous access to the gas for the use.

7.3 SOCIO- ECONOMIC DEVELOPMENT

The proposed project will create socio-economic development across the pipeline route and in the near vicinity as well. The project will provide employment during construction and operation phase to the local labours. Further, it also helps in the development across the project area by providing the CNG stations along the roads and gas pipeline supplies to the households and commercial establishments. The proposed project will provide 60 CNG stations throughout the project route due to which the local community can easily access the cheapest way for their transportation.

8 ENVIRONMENTAL MANAGEMENT & MONITORING PROGRAM

8.1 INTRODUCTION

The Environmental Management Plan (EMP) provides an essential link between predicted impacts and mitigation measures during implementation and operational activities. EMP outlines the mitigation, monitoring and institutional measures to be taken during project implementation and operation to avoid or mitigate adverse environmental impacts, and the actions needed to implement these measures. The likely impacts on various components of environment due to the project during developmental activities have been identified and measures for their mitigation are suggested. The EMP lists all the requirements to ensure effective mitigation of every potential biophysical and socio-economic impact identified in the EIA. For each attribute, or operation, which could otherwise give rise to impact, the following information is presented:

- A comprehensive listing of the mitigation measures
- Parameters that will be monitored to ensure effective implementation of the action.
- Timing for implementation of the action to ensure that the objectives of mitigation are fully met

The EMP comprises a series of components covering direct mitigation and environmental monitoring, an outline waste management plan and a project site restoration plan. Therefore, environmental management plan has been prepared for each of the above developmental activities.

8.2 ENVIRONMENT MANAGEMENT PLAN

Table 8-1: Environment Management Plan

Aspect	Impacts	Mitigation Procedure	Monitoring Action	Responsibility	Timing
Air Pollution	Dust generation	• Access limited to demarcated ROW and specified access roads. · Strict enforcement of project speed limits · • Reinstatement as early as practical · • Damping down of ROW · • Identification of areas of particularly sensitive receptors (e.g., villages or crops)	• Review and approval of the contractors Transport management plan, Pollution Prevention Management Plan, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction

	Metal Vapour Emissions	Ensure adequate ventilation and dispersion of vapours Ensure welding is undertaken by appropriately trained personnel	• Review and approval of the contractors Employment and Training Management Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Combustion gases (CO2, CO, NO2, NO, SO2, PM, CH4, VOCs)	• Maintenance of all vehicles and plant to meet relevant international standards and manufacturer's recommendations· • Monitoring of vehicle and plant emissions · • Optimization of plant running time (where appropriate)	• Review and approval of the contractors Transport management plan, Pollution Prevention Management Plan, Construction Camp Management Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period

			• Spot checks on the contractor's performance • Routine review of discharge monitoring data	AGL	• Throughout Construction Period
	Vehicle movements	• Selection of appropriate routes for vehicles using public road network and project access roads · • Provision of environmental training for vehicle drivers and equipment operators · • Control of operational speeds and operating times · • Maintenance of vehicles and plant	• Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan and Employment and Training Management Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of traffic management and training processes	Contractor	• Throughout Construction Period
			• Collection and review of incident and near miss data	Contractor	• Throughout Construction Period
			• Spot checks on procurement and waste management processes Routine review of incident and near miss reports	AGL	• Throughout Construction Period
Noise Pollution	Noise emissions	• Control of vehicle and plant noise generation ·	• Review and approval of the contractors Transport management plan,	AGL	• Pre-construction

		• Control of operating hours · • Appropriate selection and maintenance of plant, vehicles and access routes · • Appropriate selection of construction techniques · • Community liaison • Ensure environmental considerations are incorporated into the siting and design of camps · • Implement workforce education with respect to minimising disruptive activities. • Incorporate into the project induction training· • Implementation of camp rules including restrictions on noisy activities	Construction Camp Management Plan, Pollution Prevention Management Plan, Infrastructure and Services Management Plan, Community Liaison Management Plan, Procurement and Supply Management Plan and detailed construction method statements.		
			• Routine monitoring, documentation and review of application of mitigation measures	Contractors	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-monitoring
Water Pollution	Disposal of liquid wastes/water (Hydro test	• Risk assessment to be undertaken before any chemical additives are used in hydro test water	• Review and approval of the contractors Pollution Prevention Management Plan, Procurement and Supply	AGL	• Pre-construction

	Specific Measures)	• Controlled discharge of water to reduce soil erosion Testing and treatment of water before discharge • Responsible disposal of waste water; no disposal of incompatible water in areas of groundwater or surface water vulnerability	Management Plan, Waste Management Plan, Infrastructure and Services Management Plan and detailed construction method statements		
			• Routine monitoring, documentation and review of application of mitigation measures	Contractors	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Abstraction of Ground Water	• Sampling and analysis of water from existing boreholes · • Adherence to national and local licensing policy for abstractions · • Test-pumping of new abstractions and monitoring of impacts on existing abstractions · • Monitoring of water levels in wetlands	• Review and approval of the contractors Pollution Prevention Management Plan, Infrastructure and Services Management Plan, Community Liaison Management Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractors	• Throughout Construction Period

		• Ensure appropriate consolidation of backfill · • Implementation of erosion control measures • Ensure that groundwater disposal is undertaken in accordance with the Construction Environmental Management Plan· • Filter discharge if contains visible suspended solids · • Use of appropriate measures to minimise scour at the discharge point	• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
	Disruption of drainage / irrigation channels	• Undertake pre-construction surveys of irrigation and drainage systems as necessary to identify existing systems and devise temporary replacement measures if required, · • Undertake liaison with land owners/land occupiers/land users ·	• Review and approval of the contractors Infrastructure and Services Management Plan, Community Liaison Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period

		• Include provisions for drainage/irrigation management	• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
	Increased flood risk	• Ensure that gaps are left in topsoil stacks to allow floodwater through · • Ensure the continued viability of pre-existing drainage and irrigation systems throughout the project	• Review and approval of the contractors Infrastructure and Services Management Plan, Community Liaison Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction

	Disposal of trench-water	• Ensure that trench-water disposal is undertaken in an appropriate manner	• Review and approval of the contractors Pollution Prevention Management Plan, Waste Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Sediment release	• Avoid open cut river crossings during monsoon season· • Include environmental considerations in the selection of crossing design and choice of methodology	• Review and approval of the contractors Pollution Prevention Management Plan, Emergency Response Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period

	Modified river flow		• Review and approval of the contractors Infrastructure and Services Management Plan, Community Liaison Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
Land & Soil	Use of raw materials & natural resources	• Development and implementation of procurement, supply and waste management procedures	• Review and approval of the contractors Procurement and Supply Management Plan and Waste Management Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of procurement and waste management processes	Contractor	• Throughout Construction Period

			• Spot checks on procurement and waste management processes	AGL	• Throughout Construction Period
	Railway Crossing	• Mitigation measures to be formulated in conjunction with local railway department	• Review and approval of the contractors Transport management plan, Infrastructure and Services Management Plan, Community Liaison Management Plan, Community Safety Management Plan and Procurement and Supply Management Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Throughout Construction Period
	Potential for accidental spillage of	• Development and implementation of specific	• Review and approval of the contractors Pollution Prevention Management Plan,	AGL	• Pre-construction

	hazardous materials (e.g. lubrication fluids, oils, paints, diesel etc.).	procedures for hazardous materials management • Minimisation of acquisition and storage of hazardous materials Training of personnel in safe use & handling of hazardous materials • Provision of appropriate spill response equipment and spill response training Rapid response in event of spillage	Employment and Training Management Plan, Transport Management Plan, Procurement and Supply Management Plan, Waste Management Plan, Emergency Response plan, and construction method statements		
			• Recording and regular review of incidents and near misses	Contractor	• Throughout Construction Period
			• Routine monitoring, documentation and review of training, procurement, storage and waste management processes	Contractor	• Throughout Construction Period
			• Spot checks on contractor performance and record keeping Routine review of incident and near miss data.	AGL	• Throughout Construction Period
	Disturbance of land surface & vegetation	• Vehicle movements confined to defined access routes • Provision of environmental training to drivers and plant operators	• Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan, Community Liaison Management Plan and	Contractor	• Throughout Construction Period

		• Community liaison to discourage local use of ROW as road Common access routes to be used for pipeline were practical Traffic movements to be preceded by an assessment of ground conditions	Community Safety Management Plan		
			• Routine monitoring, documentation and review of traffic management and community liaison processes	Contractor	• Throughout Construction Period
			• Spot checks on traffic management, training and community liaison processes. • Routine review of access route condition and adherence to defined access routes.	AGL	• Throughout Construction Period
	Soil compaction	• Protection of soil storage areas from vehicle movements · • Protection of soil surface in areas of soft ground · • Provision of appropriate drainage and regular regrading	• Review and approval of the contractor's management plans, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development	AGL	• Pre-construction

			of mitigation actions for sensitive sites		
	Soil erosion	• Implementation of erosion control measures · • Compaction of soil stack surface to minimize erosion · • Preparation & implementation of approved crossing methods	• Review and approval of the contractors Pollution Prevention Management Plan, Reinstatement Plan and detailed construction method statements (with specific attention to those concerning river crossings)	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
	Loss of soil structure and fertility	• Ensure appropriate segregation, storage, management and reinstatement of stripped soil	• Review and approval of the contractor's management plans, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction

			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Loss of viability of soil seed bank	• Undertake an environmental review of the route to identify areas where preconstruction seed collection, harvesting of seeds from surrounding areas and/or the establishment of nursery crops should be carried out · • Ensure appropriate segregation, storage, management and reinstatement of topsoil	• Review and approval of the contractor's management plans, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
	Modified topography	• Ensure that reinstatement is sympathetic to existing contours	• Review and approval of the contractors Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction

			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Disposal of surplus subsoil	• Ensure that the generation of surplus soil is minimised and that disposal is conducted appropriately ·	• Review and approval of the contractors Waste Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
		• Ensure that any potential subsoil disposal sites and disposal plans are subject to an environmental review prior to their adoption	• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary additional assessments and development of appropriate mitigation actions	AGL	• Pre-construction
	Disturbance of known/unknown	• Avoid construction in areas of known or suspected	• Review and approval of the contractors Pollution Prevention Management Plan,	AGL	• Pre-construction

	contaminated land	contamination as far as is practical · • Ensure that where contaminated land is encountered it is effectively managed	Waste Management Plan, Reinstatement Plan and detailed construction method statements		
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary additional assessments and development of appropriate mitigation actions	AGL	• Pre-construction
	Potential for drilling fluid breakout/spillage (During HDD)	• Adequate geotechnical survey work conducted during design · • Risk assessment to be undertaken before drilling in vicinity of sensitive surface waters · • Storage of drilling muds in bunded area ·	• Review and approval of the contractors Pollution Prevention Management Plan, Emergency Response Plan, Waste Management Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period

		• Avoid use of toxic chemicals in drilling fluid	• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
Ecology	Loss of habitat	Development and implementation of: · • Environmental management plans· • Construction method statements (including clearance) • Transport Management (including route selection) • Reinstatement Plan Additional ecological surveys and translocation programmes	Review and approval of the contractor's management plans, detailed construction method statements and reinstatement plan	AGL	• Pre-construction
			Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
			Routine monitoring of species translocation programmes	AGL	Pre-construction and during

					construction in sensitive areas
	Impeded movement of wild animals, and domestic herds	• Ensure that gaps are left in soil stacks at strategic locations · • Leave gaps in welded strings at critical locations to allow passage of domestic herds · • Minimise interval between welding and ditching	Review and approval of the contractors Community Liaison Management Plan, Infrastructure and Services Management Plan, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction
			Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout construction period
			Spot checks on the contractor's performance	AGL	• Throughout construction period
	Public & animal safety	• Erection of warning barriers where significant risk to public and livestock exists · • Installation of soft plugs in ditch with sloped edges to allow animal egress	Review and approval of the contractors Community Safety Management Plan, Infrastructure and Services Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout construction period
			Spot checks on the contractor's performance	AGL	• Throughout construction period

Social	Vehicle Movements	• Selection of appropriate routes for vehicles using public road network and project access roads · • Provision of environmental training for vehicle drivers and equipment operators · • Control of operational speeds and operating times · • Maintenance of vehicles and plant	Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan and Employment and Training Management Plan	AGL	• Pre-construction
			Routine monitoring, documentation and review of traffic management and training processes	Contractor	• Throughout construction period
			Collection and review of incident and near miss data	Contractor	• Throughout construction period
			Spot checks on procurement and waste management processes Routine review of incident and near miss reports	AGL	• Throughout construction period
	Partial road closure	• Use non-open trench crossing techniques for major roads · • Minimise duration of closure of roads and provide temporary access where necessary · • Use steel plates across trench to maintain access ·	Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan, Community Safety Management Plan, Community Liaison Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction

		• Institute temporary traffic control, where necessary · • Undertake community consultation	Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout construction period
			Spot checks on the contractor's performance	AGL	• Throughout construction period
	Loss of boundaries	• Reinstatement of boundaries following construction · • Ensure consultation with landowners, occupiers and users	Review and approval of the contractors Infrastructure and Services Management Plan, Community Liaison Management Plan and Reinstatement Plan	Contractor	• Throughout construction period
			Routine monitoring, documentation and review of traffic management and community liaison processes	Contractor	• Throughout construction period
			• Spot checks on community liaison processes. • Routine review of access route condition and adherence to defined access routes.	AGL	• Throughout construction period
	Grievance Redressal Mechanism	Community Grievance Process	Spot follow up of complaints recorded in complaints register to assess whether process has been carried out correctly.	AGL	• Monthly during Construction period

		Implementation of general construction mitigation measures	Spot checks at ROW, construction sites and affected communities to ensure mitigation measures are being implemented. This will look specifically at: · • Implementation of measures to avoid disruption to infrastructural services such as telecoms, electricity, gas and water. · • Implementation of community safety measures (fencing near residential areas, fencing on public trench crossings, warning lights and warning signs at open areas of trench). • Suitable diversions are in place where necessary · • Dust and noise mitigation measures are in place · • Alternative water sources are provided as appropriate	AGL	Monthly for first 3 months. If implementation of mitigation measures is proceeding appropriately, reduce monitoring to bimonthly with review of written activity reports submitted on a weekly basis.
Health and Safety		Community Safety	• Spot monitoring of health and safety incidence rates for community members and full review of any serious incidents.	AGL	Monthly Two to three times in first four months and if training is seen as acceptable,

			• Spot monitoring of community traffic safety meetings		revert to once every six months. If training is not of sufficient quality, then continue at two to three every four months.
		General Safety Measures during	Spot monitoring of implementation of safety measures during construction as outlined in 'Implementation of general construction mitigation measures', General Construction Impacts section above.	AGL	Monthly for first three months. If implementation of mitigation measures is proceeding appropriately, reduce monitoring to bimonthly with review of written activity reports submitted on a weekly basis
		Health and safety training	Monitor HR records to ensure training is provided to all workers and spot monitor all courses (general health and safety, safe driving training, job specific health and safety) provided to ensure training is adequate	AGL	

8.3 MONITORING SCHEDULE

The objectives of monitoring are:

- To check effectiveness of mitigation measures
- To evaluate the adequacy of Environmental Impact Assessment
- To assess status of compliance to legal requirements
- To assess if the Environmental Management Plan needs revisions/ updating.

The proposed environmental monitoring program during both construction and operation phases of the project are given in Table below:

Table 8-2: Environment Monitoring program- Construction & Operation Phase

S. No	Component	Location	Parameters	Frequency
Construction Phase				
1	Stack emission characteristics	Stacks attached to emission sources (e.g. DG sets)	Stack monitoring for PM, SOx, NOx and HC	Once in a month
2	Ambient air quality	Nearest Residential Areas, and busy commercial locations	Ambient air quality parameters as per NAAQS viz. PM10, PM2.5,SOx, NOx, CO	Once in a month
3	Ground water quality (used as source of domestic water)	Point used for drinking water	Parameters listed in ISO:10500	Once in a month
4	Effluent quality	Discharge header of hydrotested pipeline/ tank	According to general discharge standards	As per requirement
5	Waste (including hazardous)	Construction sites and camps	Quantity/ volume generated and disposed	Once in a day
6	Equipment noise levels	1 m from DG set	dB(A)	Once in a month
7	Ambient noise levels	Nearest residential areas/ Silent zones etc	Ambient noise levels (Leqday & Leqnight)	Once in a month
Operation Phase				
8	Greenbelt development		Plant density, health, growth and survival rate	Once in 6 months
9	Waste (including hazardous)	At CNG stations	Quantity/ volume generated and	Once in a month

			disposed at new CNG facilities	
10	Effluent quality	At CNG stations	Monitoring of treated water from outlets of ETP & STP	Once in 6 months

9 SUMMARY & CONCLUSIONS

9.1 SUMMARY OF IMPACTS

Among the pipeline lifecycle stages of construction and operations, due to temporary nature of the pipeline laying/construction, most impacts are likely to be short term and reversible in nature. The impacts that shall be most significant and of primary concern are summarized in the subsequent sections.

9.2 IMPACT DUE TO PIPELINE ROUTE SELECTION

The proposed pipeline route has been so selected such that there are:

- Shortest length of the pipeline between source and destination points
- Avoidance of sensitive areas such as national parks, sanctuaries and wildlife corridors
- Minimum impact to reserve forests and other sensitive areas
- Minimum number of water crossings
- Minimum impact to the environment
- Avoidance of populated areas/ industrial area
- Easy access to the route during construction, operation and maintenance of the pipeline.

9.3 IMPACTS DURING CONSTRUCTION OF PIPELINE

- There will be minor impact along Nuh-Ferozpur Jhirka Section (Phase III) as the pipeline route is falling near to Aravalli Hills area.
- Earth work excavation, embankment formation, transport of construction materials, handling, laying and jointing of pipelines - These activities would cause a general increase in levels of dust and suspended particulate matter in the ambient air. However, this increase in concentration would be of temporary nature and localized.
- Movement of vehicles for transportation of construction material – These activities would cause a marginal increase in the levels of oxides of nitrogen, carbon monoxide and hydrocarbons.
- Impact from sediments being washed into the water bodies while the pipeline is laid across them. The pipeline will not be laid in rainy season, which will avoid adverse impacts on water body.
- Drinking water for base camps will be made available through local supply system. The domestic sewage from the construction camps will be either disposed off into the local sewage system and if required, will be treated in soak-pits and septic tanks.

- Water consumption during hydro-testing of pipeline - Efficient use of water will be made to reuse test water in different test sections. Water will be tapped from different sources along the pipeline route, without unduly disturbing its normal users.
- At major crossings, Horizontal Directional Drilling (HDD) method will be deployed so there will be no disturbance to the natural water flow or cause any pollution to the water body. Hence there will not be any obstruction/damage to fishing, recreational and navigation activities. The pipeline will be laid at a minimum depth of 2.5 meter below the bed level of water crossings.
- The pipeline will be buried all along its length hence impact on landuse pattern will be marginal and reversible.
- Some quantity of earth excavated for pipeline laying will become surplus after installation of the pipeline and may be required for disposal.
- However, as this excess of earth will be taken to low lying area for filling purpose, the aesthetics of the pipeline RoU and soil quality will not be affected.
- Noise Generation - The major human settlements are along the pipeline route where the noise levels due to construction activities are estimated to be around 70-90 dB(A). Such onetime exposure is not expected to last for more than few weeks and shall not exceed the stipulated standards. The pipeline laying work would be done in night only as there is lots of traffic in day time and creates disturbance to the locals.
- Selection of the pipeline route has been done in such a way that eco-sensitive areas which may be affected during the construction of the pipeline are minimised.

9.4 IMPACTS DURING OPEARTION OF PIPELINE

- No impact on Aravalli Hills area is envisaged during operation
- No air emissions will be generated during the operation phase.
- The compressing station enroute will be kept in a built-in-area that will reduce the noise level to minimum. The incremental noise level in the nearest village due to the proposed operations will be minimal.
- There will be no significant impact on ecological environment during the operational phase of the project.
- The probability of leakage will be significantly reduced by adoption of appropriate safety measures and SCADA system.
- The probability of leak from a pipeline is remote. Pipeline will be buried minimum 1.5 m in the cross-country section and 2.5 meter below the bed level at major crossings.

9.5 MITIGATION AND ENVIRONMENTAL MANAGEMENT PLAN

General

The mitigation measures to reduce environmental impacts, described in this EIA, can be divided into the following categories:

- Those which can be regarded as good working practice.
- Project decisions taken by AGL with environmental protection in mind.
- Such measures are designed to avoid, eliminate or reduce potential impacts that may occur to the environment in the course of the proposed activities.

Post Monitoring Program

The implementation of mitigation measures during construction and operation phases will be monitored. The monitoring plan would provide for periodic revision, if necessary in light of the baseline status to indicate progress in project implementation and changing environmental conditions so as to provide a basis for evaluation of project impacts. The post monitoring program would include the following:

- Approved means of leak detection would be employed as per the provisions of Schedule I -E of PNGRB Regulations, 2008 and as per ASME B 31.8, Appendix - M.
- Regular and adequate patrolling of pipeline particularly at crossing locations and settlements.
- Monitoring of pressure, coating conditions and cathodic protection

9.6 CONCLUSIONS

There will be a beneficial effect from pipeline project that will directly and indirectly boost the living standards of the people, save foreign exchange and with increase in industrial activities, create more jobs in the local economy. Thus, it can be concluded on a positive note that after the implementation of the mitigation measures and EMP, the proposed activities of RGPL will have negligible impact on environment and will improve economy of the nation.