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ENVIRONMENTAL AND SOCIAL **OF CITY** IMPACT ASSESSMENT GAS DISTRIBUTION (CGD) **PROJECT** IN CUDDALORE, NAGAPATTINAM, **AND THIRUVARUR DISTRICTS**, **TAMILNADU**



Client: Adani Gas Limited

ET-05666

Date: 27/12/2019

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INTRODUCTION

1.1 BACKGROUND

Adani Gas Ltd. ((hereinafter referred to as "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 in Cuddalore, Nagapattinam, and Thiruvarur districts in the state of Tamil Nadu in India.

AGL, is a Gujarat based and Bombay Stock Exchange listed company of Adani Group, an Indian multinational conglomerate headquartered in the Ahmedabad city of Gujarat. With a global footprint in developing and operating mines, the Group has diversified interests in natural resources, logistics, and energy and infrastructure businesses. The Group manages its major businesses through its three listed entities viz., Adani Enterprises Limited (AEL), Adani Power Limited (APL) and Adani Port and Special Economic Zones Limited (APSEZ).

Adani Group is one of the largest developers of ports, power plants, and infrastructure buildings in India. With the installed capacity of 10440 MW of thermal power plants and around 5000 km of overhead transmission line, Adani group is the leading independent private power producer in India. Fortune, India's largest edible oil brand is owned by the group. The company has combined market capitalisation in excess of US \$ 20 billion, a sales turnover of US \$ 9.4 billion. 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 13 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

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- 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. Udupi District- Karnataka
- 9. Cuddalore, Nagapattinam & Thiruvarur Districts- Tamil Nadu
- 10. Tiruppur District- Tamil Nadu
- 11. Bhilwara & Bundi Districts- Rajasthan
- 12. Chittorgarh (Other than Rawatbhata Taluka) & Udaipur Districts- Rajasthan
- 13. Balasore, Bhadrak & Mayurbhanj Districts- Odisha

AGL group has been granted authorization for laying, building, operating or expanding the CGD Network in Cuddalore, Nagappatanam, and Thiruvarur districts in the state of Tamil Nadu. 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 7,436 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, 28th September, 2018. Also the activities have to be completed as per the mentioned schedule in tenure of 8 contract years.

TUV SUD South Asia Pvt. Ltd. (TUV SUD) has been assigned by Adani Group for undertaking Environmental Impact Assessment (EIA) of its proposed City Gas Distribution (CGD) project at Cuddalore, Nagapattinam, and Thiruvarur districts in the state of Tamil Nadu in India.

1.2 PROJECT BRIEF

Adani group has been grant authorization for laying, building, operating or expanding the CGD Network in Cuddalore, Nagapattinam, and Thiruvarur districts in the state of Tamil Nadu. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 7436 square kilometers.

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	Table 1-1: Description of Work	
S.No	Description of Work	Numbers
1	Number of CNG stations (Online and daughter booster stations) to be	40
	installed within a contract years from the date of authorization	
2	Number of domestic piped natural gas connections to be achieved within 8 years from 13 th September, 2018	300089
3	Inch-km of steel pipeline to be laid within 8 years from 13 th September, 2018	839

Table 1-1: Description of Work

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, for the gas distribution throughout Cuddalore, Nagapattinam, and Thiruvarur districts in the state of Tamil Nadu in India

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 3rd October, 2018. The letter schedule D of the letter stated the year wise work program within the 8 contract year period. The purpose of the assignment is to evaluate the environmental and social impacts of the proposed project in line with the project and to implement mitigation measures and design an Environmental, Health, Safety and Social Management Plan to avoid adverse impacts during the project. The aim of the study is to assess whether the project to comply with the requirements of the above mentioned guidelines as necessitated by financial investors.

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

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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 TUV SUDS APPROACH & BRIEF METHODOLOGY FOR THE STUDY

The broad approach and methodology adopted for the project is described below:

- a) Identified and reviewed applicable local, state, and national environmental and social regulatory and institutional frameworks;
- b) Established environmental baseline conditions of the site and surrounding area through the following:
 - Detailed surveys to observe environmental and social characteristics of the project area in all three districts;
 - Discussions with the local community, project affected people, panchayats and identification key issues during planning, construction and operation phase of the project;
 - Primary baseline data collection of the site and study area with respect to water and soil quality, ambient air and noise quality and ecology mainly terrestrial flora & fauna and Avifauna in particular;
- c) Assessed the socio-economic environment through collation of secondary information of the site, supplemented by personal and group consultations with the local communities to understand community perception with regard to the project and its activities. The approach included:
 - Stakeholder identification;
 - Focussed group consultations with land owners, general community, and other impacted groups;
 - Field surveys and data compilation;
 - Group/Community Consultations: Group meetings and consultations with local and community representatives; and

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- d) Reviewed the current HR, Social, Environmental, Occupational Health and Safety Management System of AGL to understand its adequacy and efficacy with respect to the EHS&S requirements.
- e) Preparation of the EIA report.

The present Report has been prepared based upon the reconnaissance survey by TUV SUD team for preliminary assessment of the site done from 26st-28th December 2019. This survey included verification of location and site condition viz terrain & topography, soil & geology, vegetation cover in the project area and investigation in to environmental monitoring records of Ambient Air Quality, Noise levels, Surface water and groundwater, soil in study area of 10 km radius.

This report has been prepared based on detailed Environmental and Social Impact Assessment study as per IFC Performance Standards, Equator Principles, IFC's General EHS Guidelines and EHS Guidelines for Transmission Lines to assess the Environmental and Social Impact of the project.

1.5.1 AGENCIES CONTACTED

The following stakeholders were contacted during the EIA study:

- Project Proponents:
 - Representatives from AGL onsite
- Local Community:
 - o Residents Cuddalore, Nagappatanam, and Thiruvarur districts villages
 - PAP- Cuddalore, Nagappatanam, and Thiruvarur districts village

1.6 LIMITATIONS OF THE STUDY

The EIA report has been prepared based on the professional judgement to certain facts with resultant subjective interpretations. Professional judgments expressed herein are based on the facts which were available within the limits of the scope of work, information provided by the client or its representative, prevailing secondary data, budget and schedule.

The consultation undertaken during the site visit was based on the present understanding of the project and the project footprint. This assessment may slightly change in case of a change in the plant location as finalized at the time of study. The documents like land records, and management system were limited for review at the time of visit.

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Also, the consultations undertaken as part of the impact assessment were restricted to the stakeholders who were available during the site visit. Also, due to the large number of the villages within the study area and the limited time in which the assessment had to be completed, the EIA team undertook consultation in a sample of the villages with a focus for coverage of maximum number of stakeholder groups.

1.7 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 (Protection) Act. 1986. which regulates development Environment 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.

A recent notification by dated 7th November 2014 by MoEF&CC (Annexure-1) accorded general approval under the Forest (Conservation) Act, 1980 (FC Act) for underground laying of optical fibre cables, telephone lines, drinking water supply pipeline and CNG/ PNG pipelines along the petroleum pipelines within existing right of way not falling in National Parks and Wildlife Sanctuaries, without felling of trees, where the maximum size of the trench is not more than 2.00 meter depth and 1.00 meter width.

The present project does not fall under any notified area in the state of Tamil Nadu hence no clearance is required. The client need to intimate the project detail to the respective State Environment Impact Assessment Authority (SEIAA) following the procedure prescribed under the EIA Notification, 2006.

Also the stretches wherein pipeline is passing through the land 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 Indian railways, and land under the control of national or state highway – the client is advised to take permission from the authority.

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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 Gol, Forest, Ecology & Environment Department, CPCB, TNPCB	No
2.	Coastal Regulation Zone, Under the Environment Protection Act, 1986 a notification February, 1991, for regulation of activities in the coastal area by the Ministry of Environment and Forests (MoEF)	To maintain coastal ecological stability	As per the notification, the coastal land up to 500m from the High Tide Line (HTL) and a stage of 100m along banks of creeks, estuaries, backwater and rivers subject to tidal fluctuations, is called the Coastal Regulation Zone(CRZ). The above notification includes only the inter- tidal zone and land part of the coastal area and does not include the ocean part. The project does not fall within the above mentioned distances.	TNPCB	No. Not Applicable Only Intimation to TNPCB shall suffice
3.	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 Tamil Nadu (PWD)	Yes Application has been made
4.	The Railways Act, 1989	To manage safety of railways	For using land under the right of way basis for laying the CNG PNG pipeline	Indian Railways (IR)	Yes, Application has been made

Table 1-2: Applicability of all Act, Laws & Rules to the project

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S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
5.	The Control of National Highways (Land And Traffic) Act, 2002	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 has been made
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	Yes
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

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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	TNPCB	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.	TNPCB	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.	TNPCB	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.	TNPCB	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	TNPCB	Yes

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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	TNPCB	Yes
12.	Solid Waste Management Rules, 2016	Management and handling of solid waste	For disposal of solid waste generated during construction	TNPCB	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	TNPCB	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	TNPCB	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	TNPCB	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

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

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S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
21.	NOC from Gram Panchayat	As per Tamil Nadu state Government Policy, NOC is required from the Gram Panchayat.	Tamil Nadu Panchayats Act, 1958, Amended in 1994	Village Sarpanch	Application to village Panchayat falling in Thiruvaarur stretch has been made however application also needs to be submitted to Cuddalore and Nagapattianam Gram Panchayat

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S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
22.	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

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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

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> 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, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home 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).

1.8 STRUCTURE OF THE REPORT / CHAPTERISATION

The EIA Report will be chapterised under following heads:

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.

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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.

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2 PROJECT DESCRIPTION

2.1 DESCRIPTION OF THE CITY GAS DISTRIBUTION PIPELINE

Adani group has been grant authorization for laying, building, operating or expanding the CGD Network in Cuddalore, Nagappatanam, and Thiruvarur districts in the state of Tamil Nadu. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 7,436 square kilometers.

S.No	Description of Work	Numbers
1	Number of CNG stations (Online and daughter booster stations) to be	40
	installed within 8 contract years from the date of authorization	
2	Number of domestic piped natural gas connections to be achieved	300089
	within 8 years from 28 th September, 2018	
3	Inch-km of steel pipeline to be laid within 8 years from 28th September,	839
	2018	
4	Total Population	47,88,547
5	Total Geographical Area (Sq Km)	7,436
6	Total Household	11,93,290
7	No. of Charge Area	19

Table 2-1: Description of Work

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. 360 kms for the gas distribution throughout Cuddalore, Nagappatanam, and Thiruvarur district. The pipeline runs from Gail Tapoff point in Old town of Cuddalore (National Highway NH- 32) to terminal point at Thiruthuraipoondi in their 4-year strategic goal which is divided in three phases.

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The proposed project will provide 40 CNG stations and 01 LNG station throughout the project. There are total 19 charge areas for the entire project and 0.5 acre unrrigated farm land for one LNG station has been identified and acquired on willing buyer-willing seller mode in the old town of Cuddalore in the Cuddalore Industrial complex owned by State Industries Promotion Corporation of Tamil Nadu (SIPCOT).

Since the project does not lie in any notified protected forest no NOC and clearance is required to be obtained from TN forest department and MoEFCC, however intimation is to be sent to them detailing the project intent.

The project pipeline also does not fall in any of the coastal zone area hence no Coastal Regulation Zone (CRZ) clearance is required. The nearest pipeline starting point to the coast is at 650 metre in Nagapattinam at Tharangambadi.

One LNG station and the pipeline passes through Cuddalore Industrial Complex owned by State Industries Promotion Corporation of Tamil Nadu (SIPCOT) hence it is required to obtain permission from them. Pipeline passes along main district roads, state and national highway hence it is required to obtain clearance from the National Highway Authority of India (NHAI). It also crosses railway lines hence will be requiring clearance from Indian Railways.

The project may require permission from irrigation department and village panchayat if the pipe passes through any village or canal.

2.2 PROJECT IMPLEMENTATION SCHEDULE

A grant of authorization was signed on 28th September, 2018 by Petroleum and Natural Gas Regulatory Board (PNGRB) vide a letter of authorization to AGL group, which was accepted by them on 28th 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:

Implementation Schedule					
Approximate PNG		Approximate CNG Stations		Approximate Inch-km of steel	
Connections (Cumulative)		(Cumulative)		pipeline (Cumul	ative)
By the end of	% of work	By the end of	% of work	By the end of	% of work
contract year	program	contract year	program	contract year	program
1 st	NIL	1 st	NIL	1 st	5

Table 2-2: Project Implementation Schedule

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2 nd	10	2 nd	15	2 nd	20
3 rd	20	3 rd	30	3 rd	40
4 th	30	4 th	45	4 th	60
5 th	40	5 th	60	5 th	70
6 th	60	6 th	75	6 th	80
7 th	80	7 th	90	7 th	90
8 th	100	8 th	100	8 th	100

Client: Adani Gas Limited

Source: Adani Gas Limited

Adani group has been granted authorization for laying, building, operating or expanding the CGD Network in Cuddalore, Nagappatanam, andThiruvarur districts in the state of Tamil Nadu. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 7,436 square kilometers.

Adani has planned to lay 8" & 4" dia steel pipeline, approx. 360 kms for the gas distribution throughout Cuddalore, Nagappatanam, and Thiruvarur district. The pipeline runs from Gail Tapoff point in Old towm of Cuddalore (National Highway NH- 32) to terminal point at Thiruthuraipoondi in their 4-year strategic goal which is divided in three phases.

The project is still in conceptual stage and required regulatory permits are being obtained. No work has started yet on the any stage of the project.

Cuddalore district stretch runs from Gail Tap off point at Cuddalore old town where 0.5 acre unirrigated farm land has been identified and acquired. The details of pipeline loop and charge head is given in following table:

Charge Area ID	Name	Charge Area ID	Name		
CA 01	Chidambaram	CA 11	Sirkali		
CA 02	Cuddalore	CA 12	Tharangambadi		
CA 03	Kattumannarkoil	CA 13	Kodavasal		
CA 04	Kurinjipadi	CA 14	Mannargudi		
CA 05	Panruti	CA 15	Nannilam		
CA 06	Tittakudi	CA 16	Needamangalam		
CA 07	Veppur	CA 17	Thiruthuraipoondi		
CA 08	Virudhachalam	CA 18	Thiruvarur		
CA 09	Kuthalam	CA 19	Valangaiman		

Table 2-3: Details with Charge Area of the pipeline project

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CA 10	Mayiladuthurai

Table 2-4: Details of the loops and their length of the pipeline project

A Map Of Geographical Area Cuddalore, Nagapattinam and Thiruvarur Districts approved by PNGRB shows the following loops of the proposed pipeline routes:

Road	Approximate
	Distance
NH -32	12 km
SH- 9	34 km
MDR 200, MDR 816	50 km
NH-32, MDR 215	12 km
SH-532	57 km
SH-141, NH-38	30 km
SH- 64	30 km
SH- 64	12 km
SH-147, SH-150, SH 149	45 Km
SH- 202, SH-83, SH-202	24 km
SH-83, SH-202	20 km
	Road NH -32 SH- 9 MDR 200, MDR 816 NH-32, MDR 215 SH-532 SH-532 SH-141, NH-38 SH- 64 SH- 64 SH- 64 SH- 64 SH- 147, SH-150, SH 149 SH- 202, SH-83, SH-202 SH-83, SH-202

*MDR=Main District Road

Source: Primary Survey, TUV SUD

The proposed project was started in June-July 2019 and is expected to be completed in approximately 36 months from the date of approval environmental & other statutory clearances.

2.3 PIPELINE ROUTE & ACCESSIBILITY

Pipeline runs parallel along the various roads, and accessibility is not an issue. Project pipeline runs along major national and state highway connecting Cuddalore, Nagapattinam, and Thiruvarur districts. The route covers 77 villages in 13 talukas and 3 districts.

Table 2-5: List of villages, cities	a talukas and districts of	Tamil Nadu falling in the	project area
Tuble 2 0. Elst of Thinges, office	, talanas ana alstriots or	ranni Nada rannig in an	project area

S. No	City/ Village		Taluka	District	State
1	 Sellankuppam Thottapattu 	8. Annavalli 9. Tiyagavelli	Cuddalore		

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	3.	Varakalpattu	10.	Kodandaramapuram			
	4.	Karamanikuppam	11.	Ponnaiyankuppam			
	5.	Varakalpattu	12.	Alappakkam			
	6.	Ponnaiyankuppam	13.	Karaimedu			
	7.	Pachchyankuppam					
2	1.	Kilkavarapattu			Panruti		
3	1.	Eraiyur	2.	Kodikkalam	Tittakudi	Quddoloro	
4	1.	Sathiyavadi	4.	Pudukuraipettai	Virudhachal	Cuddalore	
	2.	Sathukudal	5.	Uthangal	am		
	3.	Virudhachalam	6.	Kuppanatham			
		Municipality	7.	Neyveli			
5	1.	Kurinjipadi	2.	Maruvay	Kurinjipadi		Tamil
			3.	Puvanikuppam			Nadu
	1.	B.Arunmozhidevan	7.	Keerapalayam	Chidambar		Nadu
	2.	B.Mutlur	8.	Veyyalur	am		
	3.	Miralur	9.	C.Thandeswaranall			
	4.	Siyappadi		ur			
	5.	Pinnalur	10	. C.Vakkaramari			
	6.	Periyapattu	11	. Nanjalur			
6	1.	Vanadarayanpettai	3.	Themmur	Kattumann		
	2.	Vadakkupalayam			arkoli		
	2.	Vadakkupalayam			arkoli		
7	2. 1.	Vadakkupalayam Edakudivasapathy I			Sirkali		
7 8	2. 1. 1.	Vadakkupalayam Edakudivasapathy I Mamakudi	5.	Kalahasthinathapur	Sirkali Tharangam		
7 8	2. 1. 1. 2.	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi	5.	Kalahasthinathapur am	Sirkali Tharangam badi		
7 8	2. 1. 1. 2. 3.	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur	5.	Kalahasthinathapur am Sembanarkoil	Sirkali Tharangam badi	Nagapatti	
7 8	2. 1. 1. 2. 3. 4.	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada	5.	Kalahasthinathapur am Sembanarkoil	Sirkali Tharangam badi	Nagapatti nam	
7 8 9	2. 1. 2. 3. 4.	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal	5. 6.	Kalahasthinathapur am Sembanarkoil Mudikondan	Sirkali Tharangam badi Kuthalam	Nagapatti nam	
7 8 9	2. 1. 2. 3. 4. 1. 2.	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal Pandaravadai	5. 6. 5. 6.	Kalahasthinathapur am Sembanarkoil Mudikondan Maharajapuram	Sirkali Tharangam badi Kuthalam	Nagapatti nam	
7 8 9	2. 1. 1. 2. 3. 4. 1. 2. 3.	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal Pandaravadai Nannilam	5. 6. 5. 6. 7.	Kalahasthinathapur am Sembanarkoil Mudikondan Maharajapuram Kollumangudi	Sirkali Tharangam badi Kuthalam	Nagapatti nam	
7 8 9	2. 1. 2. 3. 4. 1. 2. 3. 4.	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal Pandaravadai Nannilam Poongulam	5. 6. 5. 6. 7. 8.	Kalahasthinathapur am Sembanarkoil Mudikondan Maharajapuram Kollumangudi Keeranur	Arkoli Sirkali Tharangam badi Kuthalam	Nagapatti nam	
7 8 9 10	2. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4.	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal Pandaravadai Nannilam Poongulam Adiyakkamangalam	5. 6. 5. 6. 7. 8. 3.	Kalahasthinathapur am Sembanarkoil Mudikondan Maharajapuram Kollumangudi Keeranur Thiruvarur	Arkoli Sirkali Tharangam badi Kuthalam Thiruvarur	Nagapatti nam	
7 8 9 10	2. 1. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2.	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal Pandaravadai Nannilam Poongulam Adiyakkamangalam Perungudi	5. 6. 5. 6. 7. 8. 3.	Kalahasthinathapur am Sembanarkoil Mudikondan Maharajapuram Kollumangudi Keeranur Thiruvarur	Arkoli Sirkali Tharangam badi Kuthalam Thiruvarur	Nagapatti nam	
7 8 9 10 11	2. 1. 1. 2. 3. 4. 1. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 1. 1. 2. 3. 4. 1. 2. 3. 1. 2. 1. 1. 2. 1. 1. 2. 3. 1. 2. 1. 1. 2. 1. 1. 2. 1. 1. 2. 1. 1. 2. 1. 1. 2. 1. 1. 2. 1. 1. 2. 1. 1. 2. 1. 1. 2. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal Pandaravadai Nannilam Poongulam Adiyakkamangalam Perungudi Vengaramberaiyu	5. 6. 5. 6. 7. 8. 3. 2.	Kalahasthinathapur am Sembanarkoil Mudikondan Maharajapuram Kollumangudi Keeranur Thiruvarur	Arkoli Sirkali Tharangam badi Kuthalam Thiruvarur Needaman	Nagapatti nam	
7 8 9 10 11	2. 1. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 1. 1. 2. 1. 1. 2. 1. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 1. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 1. 1. 1. 2. 1. 1. 1. 2. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal Pandaravadai Nannilam Poongulam Adiyakkamangalam Perungudi Vengaramberaiyu	5. 6. 5. 6. 7. 8. 3. 2.	Kalahasthinathapur am Sembanarkoil Mudikondan Maharajapuram Kollumangudi Keeranur Thiruvarur Vakranallur	Arkoli Sirkali Tharangam badi Kuthalam Thiruvarur Needaman galam	Nagapatti nam Thiruvarur	
7 8 9 10 11 12	2. 1. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal Pandaravadai Nannilam Poongulam Adiyakkamangalam Perungudi Vengaramberaiyu Aravathur	5. 6. 5. 6. 7. 8. 3. 2. 4.	Kalahasthinathapur am Sembanarkoil Mudikondan Maharajapuram Kollumangudi Keeranur Thiruvarur Vakranallur Moonam Sethi	Arkoll Sirkali Tharangam badi Kuthalam Thiruvarur Needaman galam Mannargudi	Nagapatti nam	
7 8 9 10 11 12	2. 1. 1. 2. 3. 4. 1. 2. 3. 1. 2. 3. 4. 1. 2. 3. 4. 1. 2. 2. 1. 2. 3. 1. 2. 2. 1. 2. 2. 3. 1. 2. 2. 1. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2	Vadakkupalayam Edakudivasapathy I Mamakudi Tharangambadi Thirukkadaiyur Akkurpandaravada Kazhanivasal Pandaravadai Nannilam Poongulam Adiyakkamangalam Perungudi Vengaramberaiyu Aravathur Savala Karan	5. 6. 5. 6. 7. 8. 3. 2. 4. 5.	Kalahasthinathapur am Sembanarkoil Mudikondan Maharajapuram Kollumangudi Keeranur Thiruvarur Vakranallur Moonam Sethi Kottur Thottam	Arkoli Sirkali Tharangam badi Kuthalam Thiruvarur Needaman galam Mannargudi	Nagapatti nam	

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- Vilakkudi
 Rayanallur
 - ur i
- Edaiyur
 Pinnathur
- Kothamangalam
 Thiruthuraipoondi
- 7. Thillaivilagam

Thiruthurai

poondi

8. Alangadu

Source: Primary Survey, TUV SUD

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Figure 2-1: Location Map of Project Site

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Figure 2-2: Route Map for the pipeline in Cuddalore

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Figure 2-3: Route Map for the pipeline in Nagapattinam



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Figure 2-4: Route Map for the pipeline in Thiruvarur

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Source: Adani Gas Limited

Table 2-6: List of canals & Ponds falling in the pipeline route in the districts of Tamil Nadu

S.No	River/Canal/Rivulet	Project Phase
Cudda	alore	
1	Gadilam River	Orange Line
2	Natural Nala near Rajakuppam	Red line
3	Crossing Vadalur Ayan Eri Pond	Red line
4	Natural Nala near Kalaimangal Shobha	Red line
5	Natural Nala near Romanpuri Church	Red line
6	Manimuktha River	Red line
7	Rivulet near Alichikudi	
8	Perumal Lake River Canal	Green Line
9	Buckingham Canal	Green Line
10	Vellar River crossing	Violet Line
11	Pond near Vayalur	Violet Line
12	Pasimuthan Odai River	Violet Line

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13	Pazhaya Kollidam River	Violet Line	
14	Veeranam Lake	Violet Line	
Naga	Nagapattinam		
15	Creek near NSP Nagar Park	Orange Line	
16	Temple Pond in Vaitheesvarankovil	Orange Line	
17	Natural Nala crossing near Dharmathanapuram	Orange Line	
18	Natural Nala crossing near Alaveli	Orange Line	
19	Vallalar Koi Seva Temple Pond	Orange Line	
20	Water body near Kottupalayam	Violet Line	
21	Pond near Kaliyapannalur	Violet Line	
22	Rivulet crossing near Udayayarkoil Pathy	Violet Line	
23	Natural Nala crossing near Mangainallur Bus Stop	Deep Violet line	
24	Natural Nala crossing near Kumarmangalam Bus Stop	Deep Violet line	
25	Ponds near Pallivasal Bust Stop	Deep Violet line	
26	Rivulet near Poonthottam	Deep Violet line	
27	Rivulet near Mudikondam	Deep Violet line	
28	Natural Nala crossing near Nannilam	Deep Violet line	
Thiru	varur		
29	Natural Nala crossing in Purhupathur	Red Line	
30	Natural Nala crossing in Kaataatru Palam Bust Stop	Red Line	
31	Natural Nala crossing in Paandavaiyaru Bust Stop	Red Line	
32	Pond near Vengaramearaiyu	Red Line	
34	Natural Nala crossing in Keela Pananganttangudi Bust Stop	Red Line	
35	Natural Nala near Lakshamangudi	Red Line	
36	Natural Nala near Sithambur	Red Line	
37	Pon near Rajampalayam	Red Line	
38	Natural Nala and a Pond near Karuvakulam Bust Stop	Red Line	
39	Natural Nala and a Pond near Adichampuram Bust Stop	Red Line	
40	Natural Nala crossing in Vllakudi Palam Bust Stop	Red Line	
41	Thirukulam pond	Red Line	
42	Canal crossing in Thiruthuraipoondi	Orange Line	
43	Natural Nala crossing in Nadubalam	Orange Line	
44	Natural Nala crossing in Uppur	Orange Line	
45	Natural Nala crossing near Alangadu Bus Stand	Orange Line	
46	Pond near Muthupet	Orange Line	
47	Natural Nala crossing in Ariyalur	Blue Line	
48	Natural Nala crossing in Mangudi	Blue Line	
59	Natural Nala crossing in Kuruchumulai II	Blue Line	

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50	Natural Nala crossing in Thirukullar	Blue Line
51	Natural Nala crossing in Thirupathur Bus Stand	Blue Line
0		

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Source: Primary Survey, TUV SUD

 Table 2-7: List of Railway crossings in the pipeline route in the districts of Tamil Nadu

S.No	River/Canal/Rivulet	Project Phase	
Cudda	Cuddalore		
1	Pakkilipalayam	Orange Line	
2	KN Pettai Nagar	Orange Line	
3	Tirupadripuluyur	Orange Line	
4	Alapakkam Railway Station	Green Line	
5	Mayiladuthurai Railway Station	Yellow Line	
6	Peralm Railway Station	Violet line	
Nagapattinam			
7	Mayiladuthurai Railway Station	Yellow Line	
8	Peralm Railway Station	Violet line	
Thiruvarur			
9	Thiruthuraipoondi Railway Station	Red Line	
10	Thiruthuraipoondi Railway Station	Orange Line	
11	Nachikulam Railway Station	Orange Line	

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View of the 0.5 acre land procured for Charging Area proposed at Old Town Cuddalore

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2.4 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, 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).

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

Table 2-8: Applicable Standards & Codes

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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
0		

Source: Secondary Data Survey, TUV SUD

Table 2-9: 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

2.5 ASSOCIATED FACILITIES

2.5.1 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.

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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.

2.5.2 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.

2.5.3 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.

2.6 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.

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- 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.

S.No	Type of Crossing	Method of Crossing
1	National Highway	Conventional Trenching/ Horizontal Directional Drilling (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
0		

Table 2-10: Type of crossings required for various type of infrastructure

Source: PNRGB Notification, 2008

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- 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

2.6.1 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.

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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.

2.6.2 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.

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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 2-11: 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	1.5
	courses	
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

2.7 PROJECT REQUIREMENT

2.7.1 LAND

The land required for the project is only for CNG Stations and Tap off points. 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.

2.7.2 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.

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2.7.3 POWER REQUIREMENT

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

2.7.4 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. Further, one-time water shall be required for Hydro testing of pipeline. The water shall be sourced from tankers. 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.

2.7.5 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.

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3 ENVIRONMENTAL DESCRIPTION

3.1 STUDY AREA

This chapter summarises 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

The geomorphology of the Cuddalore coastal stretch includes the coastal plain with an average width of 6 kms. Its coastal landforms include strandlines, raised beaches, sand dunes,

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mangrove swamps and tidal flats with predominantly sandy beaches on the northern side and mangrove swamps on the South. Cuddalore has an average elevation of 6 m (20 ft). The land is completely flat with large deposits of black and alluvial soil inland and coarse sand near the seashore.

The entire area of Nagapattinam is a plain terrain with a gentle slope towards the east and the southeast. The maximum elevation is about 21m above mean sea level in the west. The coastline of Nagapattinam is straightened by south the bound longshore currents from the Kollidam river mouth to point Calimere.

Thiruvarur is It is a very small district with a total geographical area of 2097.09 Sq. Kms. This constitutes just 1.6% of the area of the State.

The entire district contains plain land only. Predominant soil types in the district are Sandy coastal alluvium and red loam. These types of soils are very fertile. Cauvery is the main river flowing in this district. Vennar, Vettar, Koraiyar, Paminiyar, Mullaiyar, Harichandra Nadi, Arasalar, Vanchiar, Nattar etc are some of the seasonal rivers flowing in this district. Canals extending to a length of around 612 Kms supported by the Cauvery system irrigate the entire district.

3.3 GEOMORPHOLOGY

Cuddalore

Major geomorphological units found in the study area are residual hills, structural hills, linear ridges,

The entire district can be broadly divided into following 3 zones. Western pediplains of entire area covered by Mangalur and Nallur blocks. This area is occupied by denudational landforms like shallow buried pediment, deep buried pediment and pediments.

Central part of the district is characterized by sedimentary high grounds, elevation >80 m of Cuddalore sandstone of Tertiary age. This zone occupies part of Virudhachalam, Kammapuram, Kurinjipadi, Cuddalore and Kattumannarkoil taluks. Rest of the area in the district is covered by eastern coastal plain, which predominantly occupied by the flood plain of fluvial origin formed under the influence of Penniyar, Vellar and Coleroon river systems. Marine sedimentary plain is noted all along the eastern coastal region. In between the marine sedimentary plain and fluvial flood plains, fluvio marine deposits are noted, which consists of sand dunes and back swamp areas.

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Nagapattinam

The present geomorphic set up in the district is the result of action of the major rivers with their distinct tributaries, oscillations in the sea level, tidal effects of Bay of Bengal and forces of wind. The landforms are delineated under erosional and depositional regime. The depositional regime comprises of a coastal plain under marine influence, a flood plain of fluvial regime with an intermixing section of both fluvial and marine influence. The entire area is a peneplained terrain with a gentle slope towards east and southeast. The maximum elevation is about 21 m above mean sea level in the west.

Thiruvarur

Thiruvarur district is a plain terrain with a gentle slope towards east in the northern and central parts and towards south in the southern part. The maximum surface elevation is about 30 m a msl in the western part of the district. The prominent geomorphic units identified in the district through interpretation of Satellite imagery are, 1. Deltaic plain, 2. Pediment and buried pediment 3. Natural levee- swale, 4. Lagoon/Backwater Coastal plain and 5. Beach and Beach ridges. Major part of the district including Valangaiman, Nannilam, Thiruvarur and part of Thiruthuraipoondi taluks is occupied by delta plain. Sedimentary high land having pediment and buried pediment and buried pediment landforms are observed in Mannargudi and Needamangalam taluks. Sedimentary plain consisting various landforms like natural levee, swale and marshy area, lagoon/Back water coastal plain and Beach ridges are seen in the southern part of the district.



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Figure 3-1 : Geomorhplogy Map of Cuddalore, Nagapattinam, and Muthupet Mangrove in Thiruvarur District

3.4 HYDROGEOLOGY

Cuddalore

Ground water occurs in all the geological formations ranging in age from Archaean to Recent which can be broadly classified into two hydrogeological units namely a) fissured and fractured formations b) porous formation.

Nagapattinam

The entire district covered by semi-consolidated formations consisting of sand, silt and clays. Ground water occurs under water table, semi-confined and confined conditions. The important aquifer systems in the district are i) Lower Miocene deeper aquifers and ii) Pliocene – Quaternary shallow aquifers.

Thiruvarur

The entire district is covered by semi-consolidated formations consisting of sand, silt and clays. Ground water occurs under water table, semi-confined and confined conditions. The important aquifer systems in the district are i) Lower Miocene deeper aquifers and ii) Pliocene Quaternary shallow aquifers

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Figure 3-2 : Hydrogeology Map of Cuddalore, Nagapattinam, and Thiruvarur District

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3.5 DEPTH TO WATER LEVELS

Cuddalore

In Cuddalore Ground water in this terrain is developed by means of dug wells, dug cum bore wells and bore wells/tube wells. The depth of the wells varies from 10 - 15 m bgl with yield varying from 25,000 to 1 lakh litres/day. The bore wells tap the fracture within 100 m bgl can yield up to 5 lps and can sustain a pumping of 4 - 8 hrs in a day. The quaternary formation occurs at shallow depth less than 30 m and is tapped by dug wells and filter points. The yield of the wells vary from less than 1 to 5 lps and can sustain a pumping of 6 - 8 hrs in a day.

Ground water development in 4 blocks viz. Kattumannarkoil, Keerapalayam, Kumaratchi and Portonova are moderate and categorized as Safe blocks. The remaining 10 blocks are semicritical stage. However, the ground water development in various parts of the district is more or less uniform. It is better to have some control on the ground water development and management of ground water in the semicritical blocks.

Nagapattinam

The estimation of ground water resources for the district has shown that 4 blocks are over exploited and one block is semi-critical

The estimation of ground water resources for the district has shown that 4 blocks are over exploited and one block is semi-critical. In Nagapattinam district, the bulk of rural water supply is from ground water by means of dug wells, hand pumps (filter point) and tube wells owned by individuals. The TWAD Board, an apex body for the rural and urban water supply in Tamil Nadu has provided water supply in rural and urban sectors from the ground water sources through the implementation of various schemes with the assistance of Govt. of India and with funds of State Govt. Drinking water is being supplied to Nagapattinam Municipality from a bore well at Odachcheri village, situated 15 km away from the town.

Thiruvarur

Development of ground water in the district is mainly through dug wells, filter points and Tube wells. Out of 10 blocks, one block is over exploited, one block is in critical category, two blocks are in semi-critical category, four blocks are in safe category and two blocks are totally saline. The gross ground water draft for irrigation in the district as on 31.03.2004 is of the order of 249.62 MCM whereas the draft for domestic and industrial water supply is computed as 18.4 MCM. Hence, the existing gross ground water draft for all uses in the district is of the order of 268.02 MCM. A quantum of 19.01 MCM has been allocated for domestic and industrial requirement for next 25 years as per norm.

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The depth to water levels during pre-monsoon and post-monsoon in Cuddalore, Nagapattinam, and Thiruvarur districts are given in **Figure 3-2**, **Figure 3-3**, and **Figure 3-4** respectively.



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

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Figure 3-4: Depth to Water Levels (Post-Monsoon)

3.6 GEOLOGY

The Cuddalore geology consist of argillaceous sandstone, pebble-bearing sandstones, mottled sandstone, ferruginous sandstone, grits and clay beds and lignite seams which occupied more than half of the study area.

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Nagapattinam District is underlain by crystalline metamorphic complex in the western parts of district and sedimentary tract in eastern side. An area of 4551 Sq.km is covered by crystalline rocks (63%)and 2671 Sq.km is Page 4 4 covered by sediments(37%).

Thiruvarur District is underlain by crystalline metamorphic complex in the western parts of district and sedimentary tract in eastern side. An area of 4551 Sq.km is covered by crystalline rocks (63%)and 2671 Sq.km is covered by sediments(37%).

3.7 WATER RESOURCES

3.7.1 SURFACE WATER

In Cuddalore for agricultural purpose maximum amount of available water resources are utilized through minor irrigation schemes. The surface flow in the rivers can be observed only during monsoon periods. The deficient monsoon rainfall has affected the flow of surface water into reservoirs, anicuts, lakes etc. Hence under these circumstances the agriculturists have to totally depend upon an alternative source i.e., Ground Water to meet their irrigation requirement.

In Cuddalore district, 593 tanks, 270 canals and one major reservoir serve as the main source for irrigation. Wellington reservoir is the major reservoir in Thittagudi taluk and Veeranam tank is the major irrigation source in Chidambaram and Kattumannarkudi taluks. In Cuddalore taluks Perumal Eri is the major surface irrigation source.

The Nagapattinam district is part of the composite east flowing river basin having Cauvery and Vennar sub basin. The district is drained by Kollidam and Cauvery in the north, Virasolanar, Uppanar in the central part and Arasalar, TirumalairajanAr, Vettar, Kedurai AR, Pandavai Ar, Vedaranyam canal and Harichandra Nadi in the southern part of the district. In Nagapattinam the river water is reported to be polluted by the effluents discharged into the river by several textile processing industries in the upstream.

In Thiruvaru the Vennar and Vettar rivers play an important role in draining the district. There are 13 irrigation canals branching from these rivers. There are 34 irrigation tanks, which serve as major source of irrigation the district. Out of 34 tanks in the district Mannargudi taluk accounts for 22, followed by Thiruthuraipoondii. Surface water canals are the major sources of irrigation water accounting for about 89 percentage of the area irrigated in the district, whereas

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dug wells and tube wells accounts for 11 percentages. The main source of irrigation in the district is canals. Canal irrigation is highest in the Mannargudi block, which is followed by Needamangalam block.



Figure 3-5 : Drainage Density Map of Cuddalore district

3.7.2 GROUND WATER

Cuddalore

As per the technical report on dynamic Ground Water Resources of Tamil Nadu as on March 2004, the district's Net Groundwater Availability is 156458.31 Ham, the gross draft for all users is 110841.93 Ham and Net Ground water Availability for further irrigation is 45561.68 Ham.

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Ground Water Draft:

Development of ground water in the district is mainly through dug wells, dug cum bore wells and bore wells/tube wells. The gross draft irrigation is 107124.76 Ham and gross draft for domestic and industrial purposes is 3717.18 Ham. The block wise gross draft for all use ranges from 644.61 (Portanova) to 16199.43 Ham (Cuddalore).

Stage of Ground Water Development:

The level of ground water development ranges from 10% to 90% all the 13 blocks in the district falls under safe to semi critical stage. Portonova, Keerapalayam and 9 Katturmannarkoil blocks have stage of development less than 70% while rest of the blocks have development between 70 to 90%.

Nagapattinam

The hydrogeological environment in the Nagapattinam district has been subjected to pollution considerably. The eastern part of the district being tail end of the canal system, and due to inferior quality of ground water, the agricultural prosperity in the eastern part attained a set back. The agricultural lands are brought under aquaculture use. The mushrooming and unregulated growth of aquaculture may lead to an alarming magnitude of pollution.

In the eastern part of the district near the coast, a ground water is saline. The fresh water pocket in the sand dune areas are used for drinking purposes. The discharge of untreated wastewaters of aquaculture farms and chemicals used for the growing prawns will also affect the shallow fresh water pockets.

Agriculture, which is the mainstay of the populace of the district, forms the chief socio economic base. The environmental hazards may arise in two kinds. (1) Due to the infiltration of irrigation water saturated with chemicals, insecticides, pesticides, fertilizers (2) the water of Cauvery is highly polluted with industrial effluents. The river water is reported to be polluted by the effluents discharged into the river by several textile processing industries in the upstream.

Thiruvarur

Development of ground water in the district is mainly through dug wells, filter points and Tube wells. Out of 10 blocks, one block is over exploited, one block is in critical category, two blocks are in semi-critical category, four blocks are in safe category and two blocks are totally saline. The gross ground water draft for irrigation in the district as on 31.03.2004 is of the order of 249.62 MCM where as the draft for domestic and industrial water supply is computed as 18.4 MCM. Hence, the existing gross ground water draft for all uses in the district is of the order of

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268.02 MCM. A quantum of 19.01 MCM has been allocated for domestic and industrial requirement for next 25 years as per norm.

Urban, Rural and industrial water supply schemes Tamil Nadu water supply and Drainage Board (TWAD) is providing drinking water supply to the urban and rural areas in the district. The water requirements of the habitations are met with through surface water sources or through various Mini water supply schemes or integrated water supply schemes utilizing the available ground water resources. A Quantum of 121.25 lakhs liters of protected water supply is made available for the population in the district. The average per capita water supply is around 47.33 Lpcd for the district. The Municipalities of Thiruvarur, Mannargudi and Koothanallur have the highest per capital consumption of 55 LPCD each, while the Town Panchayat of Muthupetai has 50 LPCD.

	lable	3-1: Ground Wa	ater Potential c	of the three Dis	stricts		
Block	Net annual groundwate r availability (ham)	Existing gross ground water draft for irrigation (ham)	Existing gross groundwate r draft for all uses (ham)	Provision for domestic & industrial water requireme nt supply to 2025 (ham)	Net annual ground water availabili ty for future irrigation develop ment (ham)	Stage of ground water developme nt (%)	Category
Cuddalore	156458.31	45561.68	110841.93		107124.7 6	10% to 90%	Safe- Critical
Nagapattinam	18343.12	21344.34	1922.21	21023.34		140%	Over Exploited
Thiruvarur	30112.23	24234.34	18345.2	18456.23	70234.22	90%	Semi Critical

Summarized block wise estimate of dynamic groundwater resources is given in Table 3-1.

Source: Groundwater Information Booklet, Cuddalore, Nagapattinam, and Thiruvarur District, Tamil Nadu

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3.8 CLIMATE

Cuddalore

The district has a hot tropical climate. The summer season, which is very oppressive, is from March to May. The southwest monsoon, which follows, lasts till September. October to December constitutes northeast monsoon season. January to February is the comparatively cooler period.

Nagapattinam

The temperatures various from 40.6 to 19.3° C with sharp fall in night temperatures during monsoon period. The relative humidity ranges from 70 – 77% and it is high during the period of October to November.

Thiruvarur

The district has a hot tropical climate the summer season, which is very oppressive, is from March to about the end of May. The humidity is generally high in the coastal region throughout the year and exceeds 70 percentages during period from August to May. It is much drier towards the interior of the district.

3.8.1 TEMPRATURE

As per the Indian Meteorological Department, Cuddalore (1981-2010) the mean annual daily maximum and minimum temperature recorded is 29 °C and 22 °C. The district experiences the highest temperature during the month of May whereas the lowest temperature during the month of January.

Table 3-2: Temperature details of IMD Cuddalore (1981 - 2010)

Months	Max. Temp.(⁰C)	Min. Temp. (ºC)	Months	Max. Temp.(ºC)	Min. Temp. (ºC)
January	29.7	21.0	July	35.5	26.4
February	31.7	21.1	August	34.0	25.6
March	31.6	25.5	September	34.1	25.8
April	34.6	26.1	October	32.8	24.3
Мау	37.2	27.1	November	30.3	23.3
June	36.8	26.0	December	29.0	22.0

Source: Climatological Normals (1981-2010)

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3.8.2 RAINFALL

Cuddalore

The annual normal rainfall for the period (1901- 2000) ranges from 1050 - 1400 mm. The normal annual rainfall over the district varies from about 1050 mm to about 1400 mm. It is the minimum around Vriddhachalam (1051.3 mm). It gradually increases and reaches a maximum around Chidambaram (1402.6 mm) and Portonovo (1347.1).

Nagapattinam

The district receives rainfall under the influence of both southwest and northeast monsoon. A good part of the rainfall occurs as very intensive storms resulting mainly from cyclones generated in the Bay of Bengal especially during northeast monsoon. The district receives rainfall almost throughout the year. Rainfall data analysed (period 1901-70) shows the normal annual rainfall of the district is 1230 mm.

The rainfall pattern in the district shows interesting features. Annual rainfall, which is 1500 mm at Vedaranyam, the southeast corner of the district, rapidly decreases to about 1100 mm towards west of the district. The district enjoys humid and tropical climate with hot summers, significant to mild winters and moderate to heavy rainfall.

Thiruvarur

The district receives rainfall from both southeast and northeast monsoons. The normal annual rainfall in the district ranges from 1100 to 1260 mm. It gradually increases towards east and south and attains a maximum around Thiruvarur in the eastern part. It is observed that the chances of receiving normal annual rainfall vary from 40 percentages at Needamangalam to 51 percentages at Thiruthuraipoondi. These changes are the highest (50-55 percentage) in a small area around Thiruthuraipoondi in the eastern part. In the rest of the district these chances are in the range 40-50 percentages.

The observations of rainfall for Cuddalore, Nagapattinam, and Thiruvarur 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 3-3: Rainfall details of Cuddalore District (5 years)												
Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018	30	13	11	16	46	38	85	144	121	247	329	172
Source: India Metrological Department												

Source: India Metrological Department

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Table 3-4: Rainfall details of Thiruvarur District (5 years)												
Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018	46	13	16	35	41	28	63	97	86	206	317	230
0												

Source: India Metrological Department

3.8.3 WIND

The average annual wind speed observed at IMD Cuddalore is 4.3 m/s. Table below gives the monthly values of the wind speed at IMD Cuddalore. The wind-rose diagram for Cuddalore, Nagapattinam, and Thiruvarur 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 3-5: Wind Speed (IMD Gurgaon)

Month		Month	Wind Speed (m/s)
January	4.1	July	4.7
February	3.8	August	5.0
March	3.6	September	4.1
April	4.4	October	2.9
May	5.6	November	3.7
June	5.5	December	4.5

Source: Climatological Normals (1981-2010)

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Wind Rose Diagram of Cuddalore



• 0 to 5 km/h [10m] • 5 to 10 km/h [10m] • 10 to 15 km/h [10m] • 15 to 20 km/h [10m] • 20 to 25 km/h [10m] • 25 to 30 km/h [10m] Wind Rose Diagram of Nagapattinam



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Wind Rose Diagram of Thiruvarur



Source: Climatological Normals (1981-2010

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Figure 3-6: 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

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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 II, i.e the least active seismic zone. The IS code assigns zone factor of 0.16 for Zone II. The project under the Cuddalore, Nagapattinam, and Thiruvarur Districts of Tamil Nadu hence lies in seismic zone II (Least Damage Risk Zone (MSK VI) as shown in Figure 3-7 below.



Figure 3-7: Geological Map of India with Seismic Zonation showing Project Site

Source: Maps of India, Secondary Research, TUV SUD

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3.9 **BIOLOGICAL ENVIRONMENT**

3.9.1 FOREST AREA/ RESERVED FOREST/ NATIONAL PARKS & SANCTAURIES

Forest Cover of the State is 26,345 sq.km which is 20.26% of the State's geographical area. In terms of forest canopy density classes, the State has 2,993 sq.km (28.23 % of GA) very dense forest, 10,469 sq.km (8.04% of GA)moderately dense forest and open forest and 12,883 sq.km (9.90 % of GA) respectively. Figure 3-8 presents the Forest Cover Map of Tamil Nadu state. Comparative details between the Project Districts & State forest Cover have been presented in below

District / State	Area in Km ²				% of	
	Geographical	Very Dense	Moderately	Open	Total	Geographical
	Area	Forest	Dense	Forest		Area
			Forest			
Cuddalore	3677.810				1415	38.48
Nagapattinam	2715.83				46.33	1.70
Thiruvarur	2097.97				24.52	1.11

Table 3-6: Forest Cover in Project District and Tamil Nadu

Source: India State of Forest Report, 2017

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Figure 3-8: Forest Cover Map of Tamil Nadu State showing project location

Source: The Tamil Nadu Forest Department

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Ecological studies are one of the important aspects of Environmental and Social Impact Assessment (ESIA) with a view to conserve biodiversity. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprise of both plant and animal communities, which interact not only within and between themselves but also with the biotic components viz. physical and chemical components of the environment. Generally, biological communities are good indicators of climatic and edaphic factors. Studies on biological aspects of ecosystems are important for safety of flora and fauna. The biological environment includes terrestrial and aquatic ecosystems.

This section of report describes, the methodology adopted for secondary data collection, diversity of higher flora and fauna recorded through primary field studies and the secondary data sourced from published scientific literature, habitat profile and ecosystem services profile and nearest designated areas of the project site.

Primary and Secondary Survey

The primary surveys were undertaken to identify the ecological features of the area with particular reference to identify and quantify any sensitive ecological communities in the study area within 10 km radius of the proposed project. Secondary surveys Literature surveys were conducted to identify Rare, Endangered, Endemic and Threatened species (REET) and/or habitats within the study area. The reference has been taken from The Wildlife (Protection) Act, 1972 and Red Data Book.

GPS point	Latitude	Longitude	Remarks	Distance
F1	11°25'14.49"N	79°47'35.18"E	Pichavaram Mangrove Forest	13 Km from
				Chidambaram Loop
F2	10°21'5.27"N	79°35'45.34"E	Muthupet Mangrove Forest	10 km from
				Muthupet loop
				termination point
F3	11°47'17.53"N	78°42'2.45"E	Lower Kalarayan Hill Forest	65 Km

Table 3-7: GPS	6 coordinates	of the critical	habitats	around	the project	site:
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Figure 3-9: Map showing Sampling points of the eco-sensitive habitats identified in the proposed

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alem Tami Nadu Tiruchirappali Thanjavu Nagapatlinam

Table 3-8: GPS coordinates of Ecologically Sensitive Receptors and Habitats in Study Area

Ecological sensitive habitat	Direction and Distance from the project site.
National Parks/ Wildlife Sanctuary/ Biosphere reserves/ Elephant Reserve/ Any Other Reserve	Lower Kalarayan Hill Forest, 65 Km NW
Reserved Forests	Nil
Wildlife Corridors & Routes	No notified wildlife corridors are present in 10 km vicinity.
Wetlands / Water bodies	Numerous ponds, canals, riverines, and natural nalas in vicinity of pipelines however no wetlands in vicinity
Ramsar Site	NIL

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Important Bird Habitats	Nil		
Breeding/nesting areas of endangered	Not present		
species			
Mangroves	Two		
	Pichavaram Mangrove Forest, 13 Km to		
	east from Chidambaram Loop		
	Muthupet Mangrove Forest, 10 Km from		
	Muthupet loop Terminaton point on South		

Figure 3-10: Map of the areas of ecological sensitivity in the project districts



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3.9.2 FLORA

The dry tropical vegetation is observed within the study area. The experimental finding of the pre monsoon season shows the dominance of **grasse** like Cyanodondactylon followed by Parthenium hysterophorus, Croton sparsiflorus and trees like Acacia nilotica, Azadirachta indica, Annona squamosa, Delonix regia, Ficus benghalensis within the study area. List of flora reported/observed in the study area is given in Table 3-9

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Sr. No.	Scientific Name	Family Name	Vernacular Name (Tamil)	Common Name	IUCN Red List
1	Acacia auriculoformis	Fabaceae	Kaththisayukku	Ear Leaf Acacia	NA
2.	Acacia nilotica	Fabaceae	Karuvelamaram	Babul	NA
3.	Albezia lebbeck	Fabaceae	Siris	Lebbek Tree	NA
4.	Alstonia scholaris	Apocynaceae	Elilappalai	Blackboard Tree	LC
5.	Annona squamosa	Annonaceae	Atta	Sugar Apple	NA
6.	Anthocephalus chinensis	Rubiaceae	Vellai	Kadam	NA
7.	Azharditica indica	Meliaceae	Vembu, Neem	Indian Ipecac	NA
8.	Bambusa arundinacea	Gramineae	Mullumungil	Bamboo	NA
9.	Bauhinia variegata	Fabaceae/Leguminosae	Shemmandarai	Camel's Foot Tree	LC
10	Borassus flabellifer	Aracaceae	Nungu	Palmyra Palm	NA
11.	Cassia hirsuta	Fabaceae	Malaiyavarai	-	NA
12	Citrus aurantifolia	Rutaceae	Yelumicham	Key Lime	NA
13.	Delonix regia	Caesalpiniaceae	Mayaram	Flame Tree, Royal Poinciana	LC
14.	Emblica officinalis	Phyllanthaceae	Nelli	Indian Gooseberry	NA
15	Ficus benghalensis	Moraceae	Mayarum	Banyan	NA
16	Ficus religiosa	Moraceae	Arasu	Bodhi Tree	NA
17.	Garuga pinnata	Burseraceae.	Arunelli		NA
18	Lantana camara	Verbenaceae	Unnichedi	Big-Sage	NA
19	Mangifera indica	Anacardiaceae	Maangai	Mango	DD
20.	Parthenium histerophorus	Asteraceae	Carrot Grass	Bhajpa Grass	NA
21.	Phoenix sylvestris	Arecaceae	Lcham	Sugar Date Palm	NA
22	Psidium guajava	Myrtaceae	Коууа	Guava	NA

Table 3-9: List of Flora within the project Area

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LC-Least Concern, DD-Data deficient, CR-Critically Endangered, VU-Vulnerable, NE-Not Evaluated, NA Not assessed, EN- Endangered, NT-Near Threatened, EW- Extinct in the Wild

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3.9.3 FAUNA

Sr. No.	Scientific Name Fami	y Name	Vernacular Con Name (Tamil)	nmon Name IU(CN Red List
Amphib	ians				
1.	Bufo melanostictus	Bufonidae	Thavakalam	Toad	LC
2.	Hyla arborea	Hylidae	Mara Thavakalai	Tree frog	LC
3.	Rana cyanophlyctis	Ranidae	Thavakalai	Frog	LC
4.	Rana tigrina	Ranidae	Thavakalai	Frog	LC
Mamma	ls	•		•	
5.	Bandicota bengalensis	Muridae	Parchaelli	Bandicoot	LC
6.	Cynopterus sphinx	Pteropodidae	Vavaal.	Fruit bat	LC
7.	Funambulus palmaram	Sciuridae	Anil	Squirrel	LC
8.	Herpestes edwardii	Herpestidae	Keeripillai	Mongoose	LC
9.	Rattus norvegicus	Muridae	Eli	Field mouse	LC
10.	Rattus rattus	Muridae	Eli	House rat	LC
Reptiles		ł	•	•	•
11.	Bangarus spp.	Elapidae	Kattuviriyan.	Krait	NA
12.	Calotex versicolor	Agamidae	Onan	Garden lizard	NA
13.	Chameleon zeylanicus	Chamaeleonidae	antacam	Indian	LC
14.	Lycodon aulicus	Colubridae	Sang vin	Common wolf snake	NA
15.	Ealpidae	Elapidae	Rattle	Indian Rattle snake	NA
16.	Eryx johnii	Boidae	Errattathalaiyan	Indian sand boa	NA
Butterfli	es				
17.	Hypolimnas bolina	Nymphalidae	-	Great egg fly	NA
18.	Junoria almana	Nymphalidae	Shindilakodi	Peacock pansy	NA

LC-Least Concern, DD-Data deficient, CR-Critically Endangered, VU-Vulnerable, NE-Not Evaluated, NA Not assessed, EN- Endangered, NT-Near Threatened, EW- Extinct in the Wild

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3.9.4 **BIRDS**

SI.No	Sciencific Name	Common Name	Vernacular Name(Tamil)	IUCN Redlist
1.	Corvus splendus	Common Crow	Kakka	LC
2.	Lonchura straita	Spotted munia	Munia	LC
3.	Cuculus varus	Cuckoo	Kuyil	LC
4.	Eudynamis scolopaceus	Koel	Koel	LC
5.	Psittacula krameri	Weaver bird	Killi	LC
6.	Adreoli grayii	Parrakeet	Kokku	LC
7.	Porphyra prophyra	Purple swamphen	Neelakokku	NA
8.	Surniculus lugubris	Drongo cuckoo	Karichankuyil	LC
9.	Alcedo coerulescens	Small Blue kingfisher	Meenkotti	LC
10.	Merops orienbtalis	Green Bea Eater	PachaiPanchurutaan	LC
11.	Egretta garzetta	Little egret	Chinnakokku	LC
12.	Bubulcus ibis	Cattle egret	Unnikokku	LC
13.	Fulica sp.	Rallideae	NeerKozhi	NA
14.	Amaurornis phoenicurus	Rallideae	NeerKozhi	LC
15.	Hydrophasianus .C.	Jacanideae	Tamaraiillaikolli	NA
16.	Coracius benghalensis	Indian Roller	Neelkant	LC
17.	Psilopogon haemacephalus	Megalimideae	ChemmarbuKukkuruvan	LC

LC-Least Concern, DD-Data deficient, CR-Critically Endangered, VU-Vulnerable, NE-Not Evaluated, NA-Not assessed, EN- Endangered, NT-Near Threatened, EW- Extinct in the Wild

3.9.5 LIST OF ZOOPLANKTONS

Sr.	Zooplankton
No.	
1	Acartiadanae
2	Acartiaclause
3	Macrosetellagracilis
4	Labidoceraacuta
5	Acartiaerythraea

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6	Metis jousseaumei
7	Microsetellarosea
8	Monostyla bulla
9	Oithonabrevicornis
10	Copepod nauplius
11	Microsetella norvegica
12	Bivalveveliger
13	Oithonarigida
14	Copiliavitrea
15	Favela species
16	Oithonabrevicornis
17	Corycaeusdanae
18	Oncaeavenusta
19	Euterpinaacutifrons
20	Brachionucalyciflorus
21	Calannsfinmarchicns
22	Brachionusurceolaris
23	Paracalanusparvus
24	Paracalanusparvus
25	Gastropodveliger
26	Globigerinaspecies
27	Tintinnopsis species

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 Cuddalore, Nagapattinam, and Thiruvarur;

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• 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 CUDDALORE, NAGAPATTINAM, & THIRUVARUR DISTRICT PROFILE

Cuddalore District is located in the southern Indian state of Tamil Nadu. Cuddalore district has three divisions, ten taluks, thirty two fircaks, and 905 revenue villages in revenue administration. This district has 13 panchayat unions and 683 village panchayats as rural development administration. In urban it has five Municipalities and 18 town panchayat. This District consists of nine legislative and two parliamentary constituencies. Total Geographical area of the district is 3678 Sq.km with coastal line of 68Km. stretching. Five major rivers are running in this district. The district has some small deposits of lignite that helps in production of electricity etc. The district is also one of the most robust fishing areas in the state of Tamil Nadu, and home to a large number of fisher population. Agriculture and industries are also main profession of this district peoples. Jackfruits and Cashew nuts are also famous in this district. World famous sugar and chocolates are being manufactured in this district.

Nagapattinam districtwas carved out by bifurcating the composite Thanjavur district on 18.10.1991. This district has traditionally been referred to as East Thanjavur and Paddy granary of South India Nagapattinam District lies on the shores of the Bay of Bengal between Northern Latitude 10.10' and 11.20' East Longtitute 79.15' and 79.50' This is peninsular delta District surrounded by Bay of Bengal on the East, Palk Straint on the South and land on the West and Northern Side. This District is predominantly, A Coastal District having a large coast line of 141 kilometres. This District has a numerous places of historical importance. Nagapattinam is an old Port Town. Nagapattinam District is having an area of 2715.83 Sq. Kms in its fold. The District Headquaters is Nagapattinam. This district is enveloping 11 Panchayat Unions, 4 Municipalties, 8 Town Panchayats on its Development Side. On the Revenue Side, it is housing 2 Revenue divisions with 4 and 3 Taluks respectively and 523 revenueVillages. Decades back to Sangamage, NAGAPATTINAM district was ruled over by Chola Kings and by Pandiyas for a short while.

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Thiruvarur was a part of Thanjavur district till 1991 and Nagapattinam district until 1997; it became the headquarters of Thiruvarur district when it was carved out of Nagapattinam district in 1997. The Odambokki river passes through the centre of the town.[2] Thiruvarur covers an area of 10.47 km2 (4.04 sq mi) and had a population of 58,301 as of 2011.[3] It is administered by a first grade municipality. The town is a part of the Cauvery delta region and agriculture is the major occupation. Roadways are the major means of transportation with a total of 94.06 km (58.45 mi) of district roads including three national highways passing through the town.

3.10.2 VILLAGES FALLING UNDER STUDY AREA

There are 77 villages along the proposed pipeline route, in which most of the settlements are ribbon developed along the main route. The main city/villages through which the proposed pipeline passes are given below in Table 3-10 below.

S.	City/ Village		Taluka	District	State
No					
1	 Sellankuppam Thottapattu 	8. Annavalli 9. Tivagavelli	Cuddalore		
	3. Varakalpattu	10. Kodandaramapuram			
	4. Karamanikuppam	11. Ponnaiyankuppam			
	5. Varakalpattu	12. Alappakkam			
	6. Ponnaiyankuppam	13. Karaimedu			
	7. Pachchyankuppam				
2	2. Kilkavarapattu		Panruti		
3	3. Eraiyur	4. Kodikkalam	Tittakudi	Qualitations	
4	8. Sathiyavadi	11. Pudukuraipettai	Virudhachal	Cuddalore	
	9. Sathukudal	12. Uthangal	am		
	10. Virudhachalam	13. Kuppanatham			
	Municipality	14. Neyveli			
5	1. Kurinjipadi	2. Maruvay	Kurinjipadi		Tamil
		3. Puvanikuppam			Nadu
	1. B.Arunmozhidevan	7. Keerapalayam	Chidambar		, lada
	2. B.Mutlur	8. Veyyalur	am		
	3. Miralur	9. C.Thandeswaranall			
	4. Siyappadi	ur			
	5. Pinnalur	10. C.Vakkaramari			
	Periyapattu	11. Nanjalur			

Table 3-10: Villages Falling in Study Area

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6	1.	Vanadarayanpettai	3.	Themmur	Kattumann		
	2.	Vadakkupalayam			arkoil		
7	1.	Edakudivasapathy I			Sirkali		
8	1.	Mamakudi	5.	Kalahasthinathapur	Tharangam		
	2.	Tharangambadi		am	badi		
	3.	Thirukkadaiyur	6.	Sembanarkoil		Nagapatti	
	4.	Akkurpandaravada				nam	
9	1.	Kazhanivasal	5.	Mudikondan	Kuthalam		
	2.	Pandaravadai	6.	Maharajapuram			
	3.	Nannilam	7.	Kollumangudi			
	4.	Poongulam	8.	Keeranur			
10	1.	Adiyakkamangalam	3.	Thiruvarur	Thiruvarur		
	2.	Perungudi					
11	1.	Vengaramberaiyu	2.	Vakranallur	Needaman		
					galam	Thiruvarur	
12	1.	Aravathur	4.	Moonam Sethi	Mannargudi		
	2.	Savala Karan	5.	Kottur Thottam			
	3.	Mudal Sethi	6.	Kottur			
13	1.	Vilakkudi	5.	Edaiyur	Thiruthurai		
	2.	Rayanallur	6.	Pinnathur	poondi		
	3.	Kothamangalam	7.	Thillaivilagam			
	4.	Thiruthuraipoondi	8.	Alangadu			

Source: TUV SUD Primary Survey

3.10.3 DEMOGRAPHIC DETAILS

Cuddalore

An official Census 2011 detail of Cuddalore, a district of Tamil Nadu has been released by Directorate of Census Operations in Tamil Nadu. Enumeration of key persons was also done by census officials in Cuddalore District of Tamil Nadu.

In 2011, Cuddalore had population of 2,605,914 of which male and female were 1,311,697 and 1,294,217 respectively. In 2001 census, Cuddalore had a population of 2,285,395 of which males were 1,150,908 and remaining 1,134,487 were females. Cuddalore District population constituted 3.61 percent of total Maharashtra population. In 2001 census, this figure for Cuddalore District was at 3.66 percent of Maharashtra population.

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There was change of 14.02 percent in the population compared to population as per 2001. In the previous census of India 2001, Cuddalore District recorded increase of 7.66 percent to its population compared to 1991.

Cuddalore District Density 2011

The initial provisional data released by census India 2011, shows that density of Cuddalore district for 2011 is 704 people per sq. km. In 2001, Cuddalore district density was at 617 people per sq. km. Cuddalore district administers 3,703 square kilometers of areas.

Cuddalore Literacy Rate 2011

Average literacy rate of Cuddalore in 2011 were 78.04 compared to 71.01 of 2001. If things are looked out at gender wise, male and female literacy were 85.93 and 70.14 respectively. For 2001 census, same figures stood at 81.64 and 60.27 in Cuddalore District. Total literate in Cuddalore District were 1,815,281 of which male and female were 1,000,322 and 814,959 respectively. In 2001, Cuddalore District had 1,420,488 in its district.

Cuddalore Sex Ratio 2011

With regards to Sex Ratio in Cuddalore, it stood at 987 per 1000 male compared to 2001 census figure of 986. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 896 girls per 1000 boys compared to figure of 957 girls per 1000 boys of 2001 census data.

Nagapattinam

An official Census 2011 detail of Nagapattinam, a district of Tamil Nadu has been released by Directorate of Census Operations in Tamil Nadu. Enumeration of key persons was also done by census officials in Nagapattinam District of Tamil Nadu.

In 2011, Nagapattinam had population of 1,616,450 of which male and female were 798,127 and 818,323 respectively. In 2001 census, Nagapattinam had a population of 1,488,839 of which males were 739,074 and remaining 749,765 were females. Nagapattinam District population constituted 2.24 percent of total Maharashtra population. In 2001 census, this figure for Nagapattinam District was at 2.39 percent of Maharashtra population.

There was change of 8.57 percent in the population compared to population as per 2001. In the previous census of India 2001, Nagapattinam District recorded increase of 8.07 percent to its population compared to 1991.

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Nagapattinam District Density 2011

The initial provisional data released by census India 2011, shows that density of Nagapattinam district for 2011 is 629 people per sq. km. In 2001, Nagapattinam district density was at 616 people per sq. km. Nagapattinam district administers 2,569 square kilometers of areas.

Nagapattinam Literacy Rate 2011

Average literacy rate of Nagapattinam in 2011 were 83.59 compared to 76.34 of 2001. If things are looked out at gender wise, male and female literacy were 89.79 and 77.58 respectively. For 2001 census, same figures stood at 84.89 and 67.96 in Nagapattinam District. Total literate in Nagapattinam District were 1,213,008 of which male and female were 640,916 and 572,092 respectively. In 2001, Nagapattinam District had 996,580 in its district.

Nagapattinam Sex Ratio 2011

With regards to Sex Ratio in Nagapattinam, it stood at 1025 per 1000 male compared to 2001 census figure of 1014. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 959 girls per 1000 boys compared to figure of 963 girls per 1000 boys of 2001 census data.

Thiruvarur

In 2011, Thiruvarur had population of 1,264,277 of which male and female were 626,693 and 637,584 respectively. In 2001 census, Thiruvarur had a population of 1,169,474 of which males were 580,784 and remaining 588,690 were females. Thiruvarur District population constituted 1.75 percent of total Maharashtra population. In 2001 census, this figure for Thiruvarur District was at 1.87 percent of Maharashtra population. As per the religious census of 2011, Thiruvarur had 84.38% Hindus, 14.13% Muslims, 1.39% Christians, 0.02% Sikhs, 0.01% Buddhists, 0.02% Jains, 0.05% following other religions and 0.01% following no religion or did not indicate any religious preference.

There was change of 8.11 percent in the population compared to population as per 2001. In the previous census of India 2001, Thiruvarur District recorded increase of 6.31 percent to its population compared to 1991.

Thiruvarur Literacy Rate 2011

Average literacy rate of Thiruvarur in 2011 were 82.86 compared to 76.58 of 2001. If things are looked out at gender wise, male and female literacy were 89.13 and 76.72 respectively. For 2001 census, same figures stood at 85.43 and 67.90 in Thiruvarur District. Total literate in

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Thiruvarur District were 946,471 of which male and female were 503,085 and 443,386 respectively. In 2001, Thiruvarur District had 788,302 in its district.

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Thiruvarur Sex Ratio 2011

With regards to Sex Ratio in Thiruvarur, it stood at 1017 per 1000 male compared to 2001 census figure of 1014. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 958 girls per 1000 boys compared to figure of 970 girls per 1000 boys of 2001 census data.

Table 3-11: Demographic Profile of Project Districts				
Cuddalore /Description	2011	2001		
Population	26.06 Lakhs	22.85 Lakhs		
Actual Population	2,605,914	2,285,395		
Male	1,311,697	1,150,908		
Female	1,294,217	1,134,487		
Population Growth	14.02%	7.66%		
Area Sq. Km	3,703	3,703		
Density/km2	704	617		
Proportion to Tamil Nadu Population	3.61%	3.66%		
Sex Ratio (Per 1000)	987	986		
Child Sex Ratio (0-6 Age)	896	957		
Average Literacy	78.04	71.01		
Male Literacy	85.93	81.64		
Female Literacy	70.14	60.27		
Total Child Population (0-6 Age)	279,950	284,964		
Male Population (0-6 Age)	147,644	145,645		
Female Population (0-6 Age)	132,306	139,319		
Literates	1,815,281	1,420,488		
Male Literates	1,000,322	820,726		
Female Literates	814,959	599,762		
Child Proportion (0-6 Age)	10.74%	12.47%		
Boys Proportion (0-6 Age)	11.26%	12.65%		
Girls Proportion (0-6 Age)	10.22%	12.28%		

Nagapattinam/ Description	2011	2001
Population	16.16 Lakhs	14.89 Lakhs
Actual Population	1,616,450	1,488,839

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Table 3-11: Demographic Profile of Project Districts

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Male	798,127	739,074
Female	818,323	749,765
Population Growth	8.57%	8.07%
Area Sq. Km	2,569	2,569
Density/km2	629	616
Proportion to Tamil Nadu Population	2.24%	2.39%
Sex Ratio (Per 1000)	1025	1014
Child Sex Ratio (0-6 Age)	959	963
Average Literacy	83.59	76.34
Male Literacy	89.79	84.89
Female Literacy	77.58	67.96
Total Child Population (0-6 Age)	165,245	183,346
Male Population (0-6 Age)	84,335	93,396
Female Population (0-6 Age)	80,910	89,950
Literates	1,213,008	996,580
Male Literates	640,916	548,142
Female Literates	572,092	448,438
Child Proportion (0-6 Age)	10.22%	12.31%
Boys Proportion (0-6 Age)	10.57%	12.64%
Girls Proportion (0-6 Age)	9.89%	12.00%

Thiruvarur/ Description	2011	2001
Population	12.64 Lakhs	11.69 Lakhs
Actual Population	1,264,277	1,169,474
Male	626,693	580,784
Female	637,584	588,690
Population Growth	8.11%	6.31%
Area Sq. Km	2,274	2,274
Density/km2	556	492
Proportion to Tamil Nadu Population	1.75%	1.87%
Sex Ratio (Per 1000)	1017	1014
Child Sex Ratio (0-6 Age)	958	970
Average Literacy	82.86	76.58
Male Literacy	89.13	85.43
Female Literacy	76.72	67.90
Total Child Population (0-6 Age)	121,973	140,099
Male Population (0-6 Age)	62,280	71,115
Female Population (0-6 Age)	59,693	68,984

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946,471	788,302
503,085	435,421
443,386	352,881
9.65%	11.98%
9.94%	12.24%
9.36%	11.72%
	946,471 503,085 443,386 9.65% 9.94% 9.36%

Source: Census of India

Religion wise Demography details

The religion-wise demography profile indicates that maximum population belongs to Hindus (~90%) followed by Muslims (~8.00%) in all three districts. The details of religion-wise demography status o are given below in Table 3-12.

Fable 3-12: Religion-wise demographic Profile as per Census data, 2011							
District/ Cuddalore	Total	Percentage					
Hindu	2,391,675	91.78 %					
Muslims	123,749	4.75 %					
Christian	83,334	3.20 %					
Sikh	401	0.02 %					
Buddhist	236	0.01 %					
Jain	1,280	0.05 %					
Others	138	0.01 %					
Not Stated	5,101	0.20 %					

District/ Nagapattinam	Total	Percentage
Hindu	1,435,072	88.78 %
Muslims	128,617	7.96 %
Christian	47,579	2.94 %
Sikh	184	0.01 %
Buddhist	450	0.03 %
Jain	963	0.06 %
Others	110	0.01 %
Not Stated	3,475	0.21 %

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District/Thiruvarur	Total	Percentage
Hindu	1,132,785	89.60 %
Muslims	96,092	7.60 %
Christian	33,192	2.63 %
Sikh	258	0.02 %
Buddhist	151	0.01 %
Jain	279	0.02 %
Others	64	0.01 %
Not Stated	1,456	0.12 %

Source: Census of India, 2011

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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.

	Physical				Biolog	gical	Soci Econo	o- mic	
	Ambient Air Quality	Ground/Surface Water (Quantity/Quality)	Ambient Noise	Land (Land use, Topography, drainage, soil)	Flora	Fauna	Livelihood and Occupation	Infrastructure	Health & Safety
	Aug	mentation	of Fa	cilities					

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

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Construction Phase										
Civil and mechanical works	0	•	0	0	0	0	0	0		
Movement of vehicles	0		0			0		0	0	
Hydro testing									0	
Waste generation, handling and				0					0	
disposal										
	Operation Phase									
Operation of pumps and	0	0	0							
compressors										
Storage of Gas/ Crude	0									
Cleaning & maintenance		0		0						
Movement of vehicles	0		0			0		0	0	
Waste generation, handling and		0		0						
disposal										
	La	ying of Nev	w Pipe	eline						
		Constructio	n Pha	se						
Preparation of Right of way	0		0	0		0	0	0	0	
Pipe laying	0			0					0	
Chemical use/handling		0		0						
Movement of vehicles	0		0			0		0	0	
Hydro testing										
Waste generation, handling and		0							8	
disposal				0						
Leakage from Pipeline	0									
		Operation	Phase)						
Operation of compressors	0		0							
Cleaning & maintenance		0		0						
Waste generation, handling and			0							
disposal										
Movement of vehicles	0		•			0		0		
		CNG Sta	tions							
		Constructio	n Pha	se				1		
Civil and mechanical works	0		0	0	0		0		0	
Movement of vehicles	•	•	0			0			0	
Waste generation, handling and	0	•		0	0			0	0	
disposal										
		Operation	Phase	9						
Leakage due to corrosion,	0	0								

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equipment failure, accidents,					
human error and as a result of					
third party interference					

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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.

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- 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

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- 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

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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.

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- 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.

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- 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.

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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.

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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)

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- 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

- 6. 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.

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- 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; and
- Prevent unauthorised or unintentional intrusion to protected areas through fencing or flagging

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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.

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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.

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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 Cuddalore, Nagapattinam, and Thiruvarur. 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.

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Figure 5-1: Photographs taken during the stakeholder consultations Stakeholder Consultation in Thiruvarur District



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Stakeholder Consultation in a residential Area in Cuddalore District

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Stakeholder Consultation in a residential Area in Nagapattinam District



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Stakeholder Consultation in a Commercial Area in Thiruvarur District

Representatives of AGL

S.No.	Name	Project Site/Corporate Office	Department
1	Mr. Anup Gutta	Project Site	Project
2	Mr. Venkatesh	Project Site	Project

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Discussions with Local Inhabitants Village 1

Name of the village	:	Arasakuli	Date	: 28th Dec 2019
Panchayat	:	Arasakuli	Tehsil/Taluka	: Virudhachalam
District	:	Cuddalore		

Participants:

S.No.	Name	Village	Occupation	Land ownership/Local Inhabitants in vicinity of Project Site
1	Edwin	Arasakuli	Student	
2	Rajamma	Arasakuli	Housewife	
3	Govind	Arasakuli	Service	

Sr.No.	Questions	Responses
1	Total population of the area:	2070
2	Average Household Size:	5-6
3	Literacy rate:	70.38%
4	Caste/tribe details:	Schedule Tribe (ST) constitutes 9.42 % while Schedule
		Caste (SC) were 7.34 % of total population in Arasakuli
		village. No tribes.
5	Religion:	70 % Hindu, 10% Muslim, 10% Christian
6	Ethnic Group	South Asians
7	Major Occupation:	Farming, Service
8	Crops Grown:	Rice
9	Land Holding details:	1-5 Acres
10	Type and number of livestock	Cows, Bulls
	per household:	
11	BPL Holders/Other	20%
	government scheme:	
12	Educational facilities:	High School
13	Transport facilities:	State Bus
14	Health care facilities:	Hospital
15	Water Supply facilities:	Tap and handpump
16	Electricity facilities:	24 Hrs
17	Role of Women:	Household work
18	Veterinary facility	Yes
19	Fertilizer shop	Yes

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20	Fair price shop	Yes
21	NGO working in the area	None
22	Government scheme	MNREGA
23	Cultural Site	None

Summary of Responses received from locals residing in area

Questions	Summary of responses received from affected parties
What is the present mode of cooking	Fuelwood/ LPG
(Fuelwood/ LPG/Kerosene Stove)	
Is there any piped gas supply in the vicinity?	No
Any apprehensions/concerns/odour/safety	Yes, about fire and explosion safety and illegal connection and
issues w.r.t. present project in the area	theft. Suggests that a demo to be given to the village about the
	safety aspects of gas pipeline
Are people contended with fuel switchover	Yes, very much willing
from present mode to Piped Gas Supply?	
Are the people contended with the present	No
upcoming project in the area?	
Have any of the locals objected so far/raised	No
Grievance related to similar projects/proposed	
project?	
What is the general perception about CGD	Very positive
projects?	
Other projects nearby or any other industry	Neyweli Mining and Powerplant

Summary of Responses received from land sellers (near to Tap Off Station in case of Pvt. Land Parcel)

Questions	Summary of responses received from affected parties
What is the Land Use of the project site?	Non irrigated farm land. For several last year no crop has been grown on it amd is currently a fallow land.
Has any land from local villages been acquired for the project?	No
Are the land disbursers contended with the remuneration received?	Yes
Have any of the land owners who sold their land for the project gone landless?	No

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What is the general perception about CGD Projects?	Positive
Other projects nearby or any other	The CGD project is coming in the major towns of the three districts.
industry	There are no other gas distribution project in the districts.

Discussions with Local Inhabitants Village 2						
Name of the village	:	Kottur		Date	: 28th Dec 2019	
Panchayat	•	Kottur) (Tehsil/Taluka	: Sirkali	
District		:	Nagapattinam)		
Participants:						

Sr. No.	Name	Village	Occupation	Land ownership/Local Inhabitants in vicinity of Project Site
1	Alwyn Pathavil	Arasakuli	Labourer	
2	Jerolim	Arasakuli	Housewife	

Sr. No.	Questions	Responses
1	Total population of the area:	1036
2	Average Household Size:	5-6
3	Literacy rate:	76.38%
4	Caste/tribe details:	Most of the villagers are from Schedule Caste (SC).
		Schedule Caste (SC) constitutes 62.16 % of total population
		in Kattur village. The village Kattur currently doesn't have any
		Schedule Tribe (ST) population. No tribes.
5	Religion:	60 % Hindu, 10% Muslim, 20% Christian
6	Ethnic Group	South Asians
7	Major Occupation:	Farming, Service
8	Crops Grown:	Rice
9	Land Holding details:	1-5 Acres
10	Type and number of livestock	Cows, Bulls
	per household:	
11	BPL Holders/Other	20%
	government scheme:	
12	Educational facilities:	High School

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13	Transport facilities:	State Bus
14	Health care facilities:	Hospital
15	Water Supply facilities:	Tap and handpump
16	Electricity facilities:	24 Hrs
17	Role of Women:	Household work
18	Veterinary facility	Yes
19	Fertilizer shop	Yes
20	Fair price shop	Yes
21	NGO working in the area	None
22	Government scheme	MNREGA
23	Cultural Site	None

Summary of Responses received from locals residing in area

Questions	Summary of responses received from affected parties
What is the present mode of cooking (Fuelwood/ LPG/Kerosene Stove)	Fuelwood/ LPG
Is there any piped gas supply in the vicinity?	No
Any apprehensions/concerns/odour/safety	Yes, about fire and explosion safety and illegal connection and
issues w.r.t. present project in the area	theft. Suggests that a demo to be given to the village about the
	safety aspects of gas pipeline
Are people contended with fuel switchover	Yes, very much willing
from present mode to Piped Gas Supply?	
Are the people contended with the present	No
upcoming project in the area?	
Have any of the locals objected so far/raised	No
Grievance related to similar projects/proposed	
project?	
What is the general perception about CGD projects?	Very positive
Other projects nearby or any other industry	None

Source: TUVSUD Primary Survey

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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.

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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.

Currently the project is in conceptual stage and pipeline route are still being assessed and finalized.

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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

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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 help 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 40 CNG stations and 01 LNG station throughout the project route due to which the local community can easily access the cheapest way for their transportation.

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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.

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8.2 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 · 	 Review and approval of the contractors Transport management plan, Pollution Prevention Management Plan, detailed construction method statements and Reinstatement Plan 	AGL	Pre-construction
	 Identification of areas of particularly sensitive receptors (e.g., villages or crops) 	 Identification of areas of particularly sensitive receptors (e.g., villages or crops) 	 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	

Table 8-1: Environment Management Plan

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			•	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 . 	•	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

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	 Optimization of plant running time (where appropriate) 	 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 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 	 Selection of appropriate routes for vehicles using public road network and project access roads - Provision of environmental training for vehicle drivers and equipment operators - 	 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

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			•	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 . 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 	•	Review and approval of the contractors Transport management plan, 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.	AGL	• Pre-construction
	 Implement workforce education with respect to minimising disruptive activities. Incorporate into the project 	•	Routine monitoring, documentation and review of application of mitigation measures	Contractors	 Throughout Construction Period 	

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	induction training. Implementation of camp rules including restrictions on noisy activities 	 induction training- Implementation of camp rules including restrictions on noisy 	•	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	 Water Pollution Disposal of liquid wastes/water (Hydro test 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 	 Risk assessment to be undertaken before any chemical additives are used in hydro test water Controlled discharge of water to reduce soil erosion Testing and treatment of water before discharge Responsible disposal of waste water; no disposal of 	•	Review and approval of the contractors Pollution Prevention Management Plan, Procurement and Supply Management Plan, Waste Management Plan, Infrastructure and Services Management Plan and detailed construction method statements	AGL	 Pre-construction
		•	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

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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 	•	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
	 abstractions · Monitoring of water levels in wetlands Ensure appropriate consolidation of backfill · Implementation of erosion control measures 	•	Routine monitoring, documentation and review of application of mitigation measures Spot checks on the contractor's performance	AGL	Throughout Construction Period Throughout Construction Period
	 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 completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction

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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	•	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
 owners/land occupiers/land users · Include provisions for drainage/irrigation 	•	Routine monitoring, documentation and review of application of mitigation measures	Contractor	Throughout Construction Period		
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	•	Review and approval of the contractors Infrastructure and Services Management Plan, Community Liaison Management Plan, Reinstatement Plan and detailed construction method	AGL	Pre-construction

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	the project	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 pre-construction assessments and development of mitigation actions for sensitive sites 	AGL	 Pre-construction
Disposal of trench-water 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

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Sediment release	 Avoid open cut river clossings release 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

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			•	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 	•	Review and approval of the contractors Procurement and Supply Management Plan and Waste Management Plan	AGL	 Pre-construction
p	procedures	•	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

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		•	Routine monitoring, documentation and review of application of mitigation measures Spot checks on the	Contractor	Throughout Construction Period Throughout
			contractor's performance		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 hazardous materials (e.g. lubrication fluids, oils, paints, diesel etc.).	 Development and implementation of specific 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 	•	Review and approval of the contractors Pollution Prevention Management Plan, Employment and Training Management Plan, Transport Management Plan, Procurement and Supply Management Plan, Waste Management Plan, Emergency Response plan, and construction method statements	AGL	• Pre-construction
	response training Rapid	•	Recording and regular review	Contractor	Throughout Construction Pariod
	response in event of spillage	_	Pouting monitoring	Contractor	
		•	documentation and review of	Contractor	Construction Period

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			training, procurement, storage and waste management processes		
	•	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 Community liaison to discourage local use of ROW as road Common access routes to be used for pipeline 	•	Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan, Community Liaison Management Plan and Community Safety Management Plan	Contractor	Throughout Construction Period
	were practical Traffic movements to be preceded by an assessment of ground conditions	•	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

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Soil compaction	 Protection of soil storage areas from vehicle movements . Protection of soil surface in areas of soft ground . 	 Review and approval of the contractor's management plans, detailed construction method statements and Reinstatement Plan 	AGL	 Pre-construction
	 Provision of appropriate drainage and regular regrading 	 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
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 	Contractor	 Throughout Construction Period

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				measures		
			•	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	•	Review and approval of the contractor's management plans, detailed construction method statements and Reinstatement Plan	AGL	 Pre-construction
		and/or the establishment of nursery crops should be	•	Routine monitoring, documentation and review of	Contractor	 Throughout Construction Period

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		carried out • • Ensure appropriate segregation, storage, management and reinstatement of topsoil	•	application of mitigation measures 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 . Ensure that any potential subsoil disposal sites and 	•	Review and approval of the contractors Waste Management Plan, Reinstatement Plan and detailed construction method statements	AGL	 Pre-construction
		disposal plans are subject to	•	Routine monitoring,	Contractor	Throughout

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	an environmental review prior to their adoption		documentation and review of application of mitigation measures		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 contaminated land	 Avoid construction in areas of known or suspected contamination as far as is practical . Ensure that where contaminated land is encountered it is effectively 	•	Review and approval of the contractors Pollution Prevention Management Plan, Waste Management Plan, Reinstatement Plan and detailed construction method statements	AGL	Pre-construction
	managed	•	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	AGL	Pre-construction

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			mitigation actions		
	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 . 	 Review and approval of the contractors Pollution Prevention Management Plan, Emergency Response Plan, Waste Management Plan and detailed construction method statements 	AGL	Pre-construction
		 Storage of drilling muds in bunded area . Avoid use of toxic chemicals in drilling fluid 	 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
Ecology	Loss of habitat	 Development and implementation of: - Environmental management plans- Construction method 	Review and approval of the contractor's management plans, detailed construction method statements and reinstatement plan	AGL	 Pre-construction
		statements (including	Routine monitoring, documentation and review of	Contractor	 Throughout Construction Period

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	clearance)Transport Management	application of mitigation measures		
	 (including route selection) Reinstatement Plan Additional ecological surveys and translocation programmes 	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	AGL	 Throughout

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				performance			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	Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan and Employment and Training Management Plan	AGL	•	Pre-construction
		•	equipment operators · Control of operational speeds and operating times · Maintenance of vehicles and	Routine monitoring, documentation and review of traffic management and training processes	Contractor	•	Throughout construction period
			plant	Collection and review of incident and near miss data	Contractor	•	Throughout construction period

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		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 . Institute temporary traffic control, where necessary . Undertake community 	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 Routine monitoring,	AGL	 Pre-construction Throughout
	consultation	documentation and review of application of mitigation measures		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	Contractor	 Throughout construction period

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		community liaison processes		
		 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. • 	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.
		Implementation of community safety measures (fencing		

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		 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
Health and Safety	Community Safety	 Spot monitoring of health and safety incidence rates for community members and full review of any serious incidents. Spot monitoring of community traffic safety meetings AGL Monthly Two to three times in first four months and if training is seen as acceptable, 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 safetyAGLMonthly for first three months. If implementation of measures during construction as outlined in 'Implementation of general construction mitigation measures', General ConstructionAGLMonthly for first three months. If implementation of proceeding appropriately, reduce

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	Impacts section above.		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	

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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:

S.	Component	Location	Parameters	Frequency
No				
		Construction F	hase	
1	Stack emission	Stacks attached to	Stack monitoring for	Once in a month
	characteristics	emission sources	PM, SOX, NOX and HC	
2	Ambient air quality	Nearest Residential	Ambient air quality	Once in a month
2		Areas and busy	narameters as per	
		commercial		
		locations	DM2 5 SOX NOV CO	
2	Cround water quality	Doint upod for	PIVIZ.3,30X, NOX, CO	Once in a month
3	Ground water quality	Point used for		Once in a month
	(used as source of	drinking water	180:10500	
	domestic water)			-
4	Effluent quality	Discharge header of	According to general	As per
		hydrotested pipeline/ tank	discharge standards	requirement
5	Waste (including	Construction sites	Quantity/ volume	Once in a day
	hazardous)	and camps	generated and	,
			disposed	
6	Equipment noise levels	1 m from DG set	dB(A)	Once in a month
7	Ambient noise levels	Nearest residential	Ambient noise levels	Once in a month
		areas/ Silent zones	(Leqday & Leqnight)	
		etc		
Operation Phase				
8	Greenbelt development		Plant density, health,	Once in 6 months
			growth and survival rate	
9	Waste (including	At CNG stations	Quantity/ volume	Once in a month
	hazardous)		generated and	

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

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

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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 no impact along any stretch as the pipeline route is not falling near any sensitive ecological 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.

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• 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.

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- 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 land use 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 any ecological senisitive 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.

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• 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

The Environmental Impact Assessment study for the proposed city gas distribution project in Cuddalore, Nagapattinam, and Thiruvarur districts of Tamil Nadu state has been aimed to identify and evaluate potential environmental impacts associated with all aspects of the proposed project. The conclusion and recommendations of this study are result of on-site inspections, the evaluation of impacts identified by specialists, and the process of stakeholder consultation.

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

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the implementation of the mitigation measures and EMP, the proposed activities of AGL will have negligible impact on environment and will improve economy of the nation.

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Annexures

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Annexure 1: AGL QHSE Policy

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	adani	
	Gas	
QUALITY, HEAL	TH, SAFETY & ENVIRONM	ENT POLICY
Ve, at ADANI GAS LIMITE ation with efficient, envir	ED (AGL) engaged in providing e onment friendly, safe & cost effe	energy solution to the octive fuel.
Safety first in everything	we do at AGL" is an integral part	t of AGL culture
GL firmly believes that a	ll types of injuries, illness & incid	dents are preventable.
Ve at AGL are committed	to ensure continuity of natural	gas supply & reliability
of services to the custo	mers and also committed to d	lemonstrate continual
mprovement in our Qualit	y, Occupational Health, Safety &	Environmental (QHSE)
nanagement performance	e by:	
Assessing needs & expe	ctations of Interested Parties an	d satisfying them with
continual improvement e	effort;	
Continual Improvement	by reviewing and monitoring Org	ganizational Context &
Strategic Direction by us	se of process approach and risk b	ased thinking;
Adopt and implement th	ne best available technology and	d systems from design
to the delivery of gas to	customers and also the work p	ractices to reduce the
QHSE risks as low as r	easonably practicable and mi	nimize the impact on
environment; public and	assets	
 Integrate QHSE aspects 	in all our business processes;	athor coquirements
 Pro-actively comply w 	ith all applicable legislation of	oot Systems and CGD
Establish, review and s	trengthen our QHSE Managem	ent Systems and COD
network integrity in an o	for collution prevention, waste a	woidance an prevention
• Institutionalize practices	s for politicion prevención, woste e	
Echapoling the compete	ancies and commitment of emplo	ovees through suitable
	vement and motivation	,
We shall make this policy	available to all our stakeholders.	
we shall make this policy		()C
te: 05-11-2018		Suresh P Mangla

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Annexure 2: Geographical Area and project detail

SUD

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