

# Executive Summary

## Project Background

Rising oil fuel consumption, limited productivity and lack of refining capacity in Pakistan has forced the Government of Pakistan (GOP) to create a National Policy designed to explore less expensive, more readily available and more environmental friendly fossil fuel resources.

Natural gas is one such supplementary fuel that is much more affordable and environment friendly than imported oil. Therefore, Pakistan's dependency on natural gas is increasing with time. Natural gas has emerged as the largest source of fuel in the energy sector of Pakistan, providing nearly 50 percent of total energy consumption.

However, demand for natural gas exceeds supply by approximately 30 percent. The actual demand and supply gap was 650 mmscfd in 2007, and is projected to increase to 3,709 mmscfd by the year 2020. Pakistan's policy is to develop all available options for environmentally friendly sources of energy to keep pace with economic growth. As indigenous sources of natural gas are limited, Pakistan is investing in Liquefied Natural Gas as an economically viable option. Importation of LNG is the most cost effective and environmentally friendly way of meeting the country's growing energy needs.

## Proponent Details

Associated Group (AG), headquartered in Lahore, Pakistan, is actively engaged in the Energy Sector, primarily in the LPG business in Pakistan. AG was founded by the late Mr Z. Z. Ahmed, former Deputy Inspector General of Pakistan Police, in 1965. Today, the company continues under the executive management of Mr. Iqbal Z. Ahmed.

Jamshoro Joint Venture Limited (JJVL) is the company's flagship operation, producing over 450 tons of LPG daily. AG is also involved in LPG marketing and transportation, Power Generation, Coal Mining, Real Estate, Media and Publishing, and Business Consultancy Services.

## Pakistan GasPort Ltd., Overview

Pakistan Gasport Limited (PGPL) is the project Sponsor.

PGPL is a venture of JJVL and US partner Walters Power International. PGPL recently secured approvals from the Government of Pakistan to establish the country's first LNG import terminal at Port Qasim (PQA), Karachi, Pakistan. The project will construct a mooring and offloading jetty within PQA. A Floating Storage and Regasification Unit (FSRU) vessel will be permanently moored to the jetty. The FSRU is a typical LNG transport ship with onboard LNG storage tanks. The FSRU is outfitted with equipment to regasify the LNG to natural gas (RLNG). RLNG will be delivered via subsea pipeline to the nation's natural gas pipeline system and on to end users of the gas. The FSRU will be periodically resupplied with LNG transported by LNG tanker from supply sources in the Persian Gulf area. The project's market opportunity is the sale of RLNG to industrial and electric power generation concerns in Pakistan. The concept is for current users of Heavy Fuel Oil (HFO) to fuel switch to RLNG based on pricing designed to undercut HFO pricing. Benefits to consumers of RLNG include reduced operating & maintenance expense, higher operating efficiencies, reduced fuel cost, and significantly reduced air emissions.

PGPL has signed an Implementation Agreement with PQA on a Build, Own, Transfer (BOT) basis with a lease for 30 years, renewable for subsequent periods.

## Alternative Project Locations

Primary alternative siting options include an offshore terminal linked to shore by a subsea pipeline. This was rejected primarily due to significantly higher costs of an offshore terminal, need for an onshore LNG storage tank farm, and the added risk of exposure to the open seas and heavy weather. Other locations in the PQA area were rejected due to exposure to main shipping channels or proximity to population centers or industrial/commercial facilities.

The operations of the LNG jetty include harboring, berthing, unloading, storage, re-gasification and transmission of RLNG to onshore customers via an established natural gas pipeline network. The selected site offers the best balance of positive attributes for siting the PGPL import terminal.

The location of the PGPL LNG import terminal was selected based on aerial and boat surveys of the PQA area including extensive number of visits to the site and evaluation of the site via an extensive engineering-oriented feasibility study. The proposed PGPL site was selected from a number of locations in the PQA area taking into account the bathymetry of the seabed, marine weather conditions, distance from populated and industrial/commercial areas, protection from the open sea, avoidance of sensitive environmental concerns such as mangroves, proximity to the national gas pipeline grid, as well as on-shore topography where the subsea pipeline comes ashore..

The project is also located in an area which provides infrastructure, accessibility and functionality as required for efficient operation of the project. A number of sites were examined in the coastal waters of Port Qasim for locating the proposed LNG terminal.

The selected location is just north of Qutub Point in Kadiro Creek, which links the PQA navigation channel with Korangi Creek in Port Qasim. Coordinates of the jetty are at 24°47'25"N, 67°13'37"E.

- The selected site is secluded and considerably distant from the navigational channel while also providing for good approach and maneuverability of LNG transport ships.
- The configuration and arrangement of berthing (storage and cargo) is in naturally aligned with the creek.
- The proposed site considers minimal disturbance to sensitive ecosystems, especially nearby mangroves, and other aquatic flora and fauna.
- Minimum dredging will be required for the preparation of the approach channel, docking area, and turning basin which must be provided for safe and effective maneuverability of LNG transport ships.

## Alternatives to LNG

PGPL has advocated the procurement of environment friendly natural gas to meet a significant portion of Pakistan's future needs by importing LNG. The GOP is already importing high sulphur furnace and residual oil to

meet the primary fuel needs of the nation's industries and electric power generation sectors. However, RFO is under increasingly short supply as globally, oil refineries add additional capacity to extract higher value products from the oil stream. As a result, RFO is expected to become increasingly costly as supplies are outstripped by demand. In addition, RFO is costly for industry to transport, store and use as it requires higher operating and maintenance costs, results in reduced efficiency and takes a heavy toll in air pollution and related health effects. Importing natural gas from international sources by means of LNG carriers has a number of benefits, including reduced costs over imported fuel oil, safety and security in handling, storage and transportation greatly enhanced air quality and health benefits locally and regionally.

## Project Description

The LNG import terminal is specifically designed to accommodate the basic features of the terminal, including jetty operations, subsea pipeline header on the jetty platform, subsea pipeline to transport RLNG to the existing natural gas pipeline grid, permanent mooring of the FSRU vessel and berthing of LNG resupply transport vessels.

The FSUR, which can store up to 125,000 cubic meters of LNG, will be resupplied on average once per week. The PGPL terminal will handle approximately 400 million cubic feet of RLNG per day (500 MCFD maximum), or about 3 million metric tonnes of LNG per year.

Operatively, LNG is simply natural gas that has been cryogenically reduced by 600:1 in volume from its normal gaseous state. Major suppliers are located about 1.5 days sail from the terminal in the Persian Gulf area. LNG supplies are loaded onto LNG transport ships and transported to the PGPL LNG terminal. Upon arrival, the LNG transport ships are guided to the unloading facility by tugs that will align the ship in double berthing position to the FSRU. Standard LNG unloading arms will connect the transport vessel to the FSRU for unloading the LNG cargo. Once on board, the FSRU is equipped with a process to re-gasify the LNG back into standard natural gas. Upon leaving the re-gas process on the FSRU, the RLNG passes into a 30" diameter, 4.5km subsea pipeline which connects onshore to the nation's natural gas pipeline system, and is then transported to customers. All project components are located within the jurisdiction of Port Qasim Authority.

## Process Control System

The Process Control System is comprised of the following:

- Pressure Control Station
- Export Gas Heating
- Metering Station
- Vapor Compressor

## Utilities

Utility systems for the PGPL terminal facility will include the following:

- Electrical power will be generated onboard the FSRU using the ships steam/electric generating system. The system includes use of 'boil-off' gas from the FSRU's LNG storage tanks to produce steam driving steam turbine generators. The system generates 100% of electric power required by the terminal and process steam as needed for the Regasification process
- Fire fighting water will be supplied by a seawater pumping facility located on the jetty
- Potable water will be produced on the FSRU by a potable water generation system
- The FSRU will have onboard housing and dining facilities for its operational staff
- Minimal workshop and repair facilities will be provided on the FSRU
- Nitrogen, used to purge LNG and RLNG unloading arms and LNG storage tanks for fire control purposes will be produced on the FSRU by a self-contained nitrogen generation system.
- Instrument air and utility process air will be produced on the FSRU by an air compression and drying system
- Oily water separation and slop oil storage will be maintained onboard the FSRU for disposal by contractors in the PQA area.
- All waste material, sanitary and solid, will be retained

onboard the FSRU and disposed of by local contractors. No waste material will be discharged or disposed of into the sea.

- As onboard Odorant Injection Package would inject ethyl mercaptan consistent with requirements for natural gas.
- Onshore, the project will have a fenced area of approximately 5 acres, a guardhouse and small office. This area will house the RLNG meter and pipeline interconnection into the national gas pipeline grid. Utilities will be supplied from local sources.
- The sanitary sewage from the office and guard house be collected and treated in a septic tank. The sludge from the tank will be removed by local contractors. The effluent from the septic tank will be discharged into a soak pit or septic drain field as required by local regulations.

## Dredging

The approach channel and turning basin will be dredged to >12.5m Chart Datum (CD) with the berth (FSRU mooring pocket) dredged to >15.0m CD. Dredging will include about a 200m berthing pocket for the FSRU, a 450m diameter turning circle for maneuvering the LNG transport ships, and about an 800m approach to the PGPL terminal from PQA's main navigable channel into Korangi Creek.

The project estimates the need to remove approximately 3.5 million cubic yards of material which will be transported to an infill site selected by PQA. The site will be created by means of building a 3.5 km coffer dam approximately 5 km west of the terminal. The area was selected due to its proximity as well as its isolation from other residential, industrial or commercial activity. The dam will be lined to minimize sedimentation into the sea from deposited material.

## Risk Mitigation

The Project will adopt these risk management measures.

- Element of Safety in the Design of Project Facilities
- Storage and Carrier Vessel design and construction

- Double Hull System acting as Containment System
- Pressure and Temperature control systems
- Propulsion System
- Ballast Tanks
- Ship Safety Systems
- Fire Protection

## Legislation Pertaining to Project

Section 12 of Pakistan Environmental Protection Act (PEPA) 1997 states that any project involving construction activities or any change in the physical environment is subject to compliance with Pakistan's Environmental Protection Agency requirements, as implemented by the Sindh Environmental Protection Agency. According to PEPA Review of IEE / EIA Regulations 2000, PGPL's project falls under Schedule II, Port and Development involving gross ship displacements greater than 500 tons.

In compliance with these requirements, PGPL conducted a full environmental impact assessment (EIA) of the project, which was submitted to the Sindh EPA, which issued approvals for the project in 2009. Subsequently, PGPL has applied to the US Overseas Private Investment Corporation for project financing of the project.

Per OPIC requirements, this Environmental and Social Impact Assessment was conducted in full compliance with applicable International Finance Corporation standards and guidelines.

Other important legislation and policy requirements followed in the study include:

- Port Qasim Authority Act, 2002
- National Environmental Quality Standards 2000
- Forest Act 1927
- Ports Act 1908 and Pakistan Territorial Waters and Maritime Zone
- LNG Policy 2006 of GoP
- Code of Federal Regulations (USA)
- National Fire Protection Association

- European Standards
- National Conservation Strategy 1992
- Biodiversity Action Plan
- Maritime Policy of Pakistan 2002

In addition to above national regulatory requirements, international standards and guidelines applicable to LNG shipping and LNG terminals were also considered while preparing this report.

## Baseline of the Region

This ESIA study has been conducted in full compliance with IFC standards and guidelines. The following highlights the major study areas contained in the full report.

### Climate

Climatic condition of Port Qasim and its adjoining area is moderated by the presence of sea. Temperature and rainfall are comparable to Karachi City. Temperatures occasionally exceed 40 degrees C. in summer and fall to 10 degrees C. in winter.

In general, relative humidity is about 60-65%, while wind speeds are from 1 to 10 m/s.

### Ambient air quality

Ambient air quality monitoring conducted by SUPARCO at the project site indicates that concentration of all major pollutants including NO<sub>x</sub>, SO<sub>2</sub>, CO and PM<sub>10</sub> as well as noise levels are within the limits as specified by IFC standards. Continuous monitoring was carried out for 24 hours and air dispersion models developed confirming baseline observations.

### Geology

The information, as per Geological Survey of Pakistan, reveals that the project site and its adjoining areas belongs to the middle and upper tertiary formations which are fresh and slightly weathered, as compared to recent and sub-recent shoreline deposits. These deposits derive from Gaj / Manchar formations of lower Miocene to Middle Miocene / Upper Miocene to Pliocene age. The Gaj formation consists of mostly limestone with subordinate

shale and sandstone. The limestone is sandy and extremely fossiliferous. This formation overlies Nari for which consists of harder limestone beds and shale.

## Seismicity

Pakistan's Unified Building Code has categorized Karachi and its adjoining area as 2B zoning as has the Geological Survey of Pakistan.

## Flora and Fauna

Terrestrial flora is rarely found in the area due to non-availability of fresh water. The presence of saline or brackish water supports vegetation such as mangroves and other marine flora. Clusters of mangroves were identified in the project area. *Avicenna marina* is most abundant and dominant specie of the mangrove family found in the area. Published records indicate the presence of juvenile shrimps and fishes in the Korangi Creek area. There are no endangered species within the limits of the project site. The marine environment of the area between the shoreline and the project site in Kadiro creek is highly degraded. It has lost most of its biodiversity due to industrial and agricultural pollution entering the creek system in PQA, and high salinity values due to excessive diversion and overuse of the Indus River, which seldom now flows to the sea. As such most of the marine flora and fauna in the project area, including the mangroves, are stressed.

## Land use and Development

PQA has administrative control over the 4,900 ha of land above the water line and 64,000 ha of mangrove forests, mud flats and creeks. Major land use in the PQA area near includes industrial facilities and typical port features. Installations of Fauji Oil Terminal Company (FOTCO) are at a distance of 10-12 km to the proposed LNG terminal. Several companies involved with the import and storage of molasses operate on a 70 ha some 5 km east of the project area.

## Socioeconomic profile of the Project Area

Socioeconomic studies have been carried out through direct observations and semi-structured interviews. Three

target areas were identified namely the small settlements of Goth Ali Mohammad and Rehdi Goth and housing facilities for staff of the Korangi fish harbor and small boat building businesses in the area of the Korangi fish harbor. Goth Ali Mohammad is about 1 km to the NW of, while Rehdi Goth is about 3 km East of, the proposed LNG land terminal facility. Goth Ali Mohammad is at a distance of 4 km to the NE and Rehdi Goth 3 km to the North of PGPL's LNG jetty.

The total population in the overall study area is between 25,000 and 30,000, although no one lives within 3 km of the LNG jetty or 1 km from the onshore pipeline interconnection terminal. Most people in the study area are dependent up fishing activity in and around the shore waters. The remaining inhabitants are largely involved in day labor, self-employment and services, with very few operating businesses. The socioeconomic status of the locals is very basic, with few amenities.

Literacy ratio in affected villages throughout the study area is about 12%. The most significant environmental issues in these settlements is lack of sanitation and health facilities.

There is no group of people in the area of the project who are indigenous or are socially or culturally distinct from the existing dominant society nor is the project expected to cause displacement of any population. Some members of the local population, especially local fishermen, may be affected by the project however as transient environmental issues such as dredging may temporarily affect their lifestyle and livelihood.

## Local Community Impact Mitigation

Anticipating the project will create impacts in some measure on the local community, the project has committed to a programmatic and on-going system to identify, evaluate and compensate any loss of livelihood, loss of assets, or similar impacts suffered by anyone using or living in the project area. The project has adopted a system of community outreach to open communications and dialogue with the local communities on project activities, educate them as to the project's grievance procedures and compensation plans, and work to provide jobs and economic opportunity to local residents as detailed in Chapter 6 of this ESIA. As an example of the project's commitment to the local community, PGPL has

undertaken a study to determine fishing pressure from local fisherman in the project area. The study will detail how much usage the area receives, to fully assess impacts resulting from project activities and to provide compensation to those impacted by the project. As a result of project outreach programs, and the concerns expressed by the local community about potential project impacts, the Pakistan Fisher folk, a local community advocacy organization, will be consulted in all studies and programs related to fishing in the local area.

## Project Siting

A number of different sites under PQA's jurisdiction was examined in the Port Qasim area for locating the proposed LNG terminal.

PQA provided guidelines based on its mission to develop the port facility in an efficient and environmentally benign manner. PQA and PGPL both agreed, based on the particular requirements of PQA and the project, to recommend the site in the Kadiro-Korangi Creek. Following aspects have been taken into account while selecting the recommended location of PGPL's LNG terminal:

- Siting of LNG terminal in sheltered locations, remote from other industrial, commercial and populated areas.
- The Location is so chosen as to reduce the risk of passing ships impacting the berthed FSRU and LNG transport vessels.
- Siting the terminal in a position that reduces the possibility of large ships passing near the jetty.
- Providing adequate backup area for maneuvering LNG transport ships. Stringent international practices impose a safety and security exclusion zones around LNG vessels while in transit and during the berthing operation. These zones are astern, ahead and on either side. The following LNG safety and security zones are applied by US, European and Far East LNG terminals:
  - US (enforced by the US Coast Guard):
  - Ahead: 1.5-3km Astern: 0.5-1.5km

- Port and starboard: 500 meters
- European & Far East Terminals:
- Ahead: > 800 meters
- Astern: > 800 meters
- Port and starboard: typically the channel width

## Other Safety Considerations

The location of the jetty is in a sheltered area remote from other port users where other ships do not pose a collision risk and where a release of LNG or gas vapor will not affect the local community. The Project is conducting a Quantitative Risk Assessment (QRA) to determine the effects of a catastrophic release of LNG as a liquid and as a vapor, which poses the threat of explosion or fire. As LNG is non toxic and quickly evaporates, vapor, and specifically ignition of the vapor, is the major focus of the QRA. LNG is quite safe to handle under normal circumstances, and as it is not stored under pressure is not in itself explosive. Only upon release and conversion to its vapor phase is it potentially explosive, and even then only within a narrow band of ratio of air:vapor mix. International standards suggest that minimal danger from fire or explosion exists to anyone or anything located beyond 1.6km from the source of an LNG derived explosion or fire. While no one lives within the range of concern (nearest inhabitants are approximately 3 km distant), the project has undertaken a Hazard Identification program that will lead to a full QRA developed in the final engineering design stage. The major settlements, habitations, industrial and commercial facilities in the study area are all outside of the safety and security zones for LNG terminals as recommended by PQA and international US and European guidelines including SIGTTO.

## Ambient Noise Levels

LNG terminal construction and associated activities onshore and off may have possible impact on ambient noise levels. In particular, work such as pile driving, dredging, drilling, earthworks, etc. as well plant noise from compressors and similar machinery, would contribute to noise. The duration of the construction work is anticipated not to exceed over 18 months and impacts will be moderated due to lack of residential, industrial or commercial areas close to the project.

It is anticipated that on site noise levels during the construction phase will not exceed the average noise of 85 dB(A) at 7.5m. Ear plugs would be provided to construction workers to be worn as protective measures.

Other activities during construction that can be a source of noise is the movement and operation of heavy construction equipment, excavation and fill operation for grading, pipeline cutting, welding, installation etc. The noise would be confined to the local surroundings and the impact will be of temporary nature.

The operations of LNG cargo unloading, storage and regasification are low impact activities. Noise emissions during project operation are expected to be much lower and generally derived from facility opera such as pumps, engines, other on-site machinery, and from marine vessels unloading LNG at the jetty. The power generators and electric supply units are enclosed in the FSRU and would not be a significant noise source.

## Air Quality

Construction and operation of the Project is expected to result in emissions into the atmosphere that may affect air quality. The effects on air quality are likely to arise during construction from dust generated at the onshore construction site and during operation from fugitive emissions of natural gas from venting and accidental leakage.

The main impact regarding fugitive emissions of dust is a nuisance effect mainly caused by certain construction activities.

Further, emissions from construction equipment are another source of pollution. The air contaminants emitted during construction may include nitrogen oxides and carbon monoxide due to operation of construction equipment. However the significance is low as these emissions are very limited and are rapidly dispersed due high wind velocity prevailing on the shores.

Project operations, including LNG storage, vaporizers used in regasification, marine vessels and vehicle traffic, will also generate fugitive emissions of natural gas, methane, particulate matter, combustion gases and GHGs (primarily carbon dioxide. Air modeling under various scenarios suggests that in case of accidental release of LNG vapor from the project the impact would be insignificant.

Adequate and proper maintenance of all pumps, valves and pipelines must be ensured to limit any fugitive natural gas emissions within acceptable limits.

The steam/electric power plant onboard the FSRU will produce about 220,000 tons/year of CO<sub>2</sub>, a recognized greenhouse gas. On the other hand, substituting RLNG for RFO as boiler fuel yields vastly improved air quality and health benefits, well beyond the modest additional contribution to background CO<sub>2</sub> levels from the FSRU power plant.

## Maritime Navigation

During construction of the LNG Jetty, there may be occasional temporary obstruction to navigation during maneuvering of the floating construction equipment (piling barges). This will however be coordinated with PQA to minimize disruption. As the proposed Jetty is located on the confluence of Kadero and Phitti Creeks, well separated away from the main navigation channel, obstruction to shipping during routine construction operations should be minimal.

No impact on navigation in the main channel of the port is expected to project operations. The Port Authority will regulate the traffic channel according to regulations. Hence no Mitigation measures are required.

## Geology, Geomorphology and Hydrogeology

Dredging for the approach channel, turning basin and berthing pocket and disposal of spoil in the areas designated by Port Qasim will result in a temporary negative impact on the channel geomorphology but this will be transitory and relatively insignificant.

The site is located in a seismically moderate hazard zone, 2B and design of all facilities shall be based accordingly.

Dredging associated with the project will create approximately 3.0 million cubic meters of spoil material to be disposed of behind a 3.5km cofferdam built for the purpose as required and as located by PQA. The resulting fill material will eventually create usable land adjacent to the existing shore line approximately 4.5 km west of the jetty location. During construction of the cofferdam, barges will undertake construction activities, thereby minimally affecting local turbidity as the cofferdam is

placed. After completion, the dam will receive a synthetic liner to reduce or eliminate passage of sediments from spoils placed behind the dam. Impacts from placing spoils behind the cofferdam are considered minimal, as the spoil material is very similar to the mudflats and sediments existing behind the cofferdam.

## Hydrological Impacts

The construction of the project does not interfere with the natural drainage of the area. The soil proposed to be used as fill is granular and fill slopes on the creek side will be protected against erosion by pitching. However, during construction, some spillage of fill mater waste on to the foreshore areas may be unavoidable. Careful construction operation will limit it to minimum with no significant

## Sediment Quality

Sediment contamination could have been of concern because the disturbance caused by dredging / excavation / reclamation or construct work would have released contaminants into the water column either in solution or re-suspension of particulate matter. However, since the sediment does not fall into a contaminated category, the disturbance caused due to construction work is not expected to have an adverse on water quality of the surrounding environment or potential toxic effects on aquatic biota due to the bioavailability of any contaminants. No term mitigation measures are required as the construction of the LNG terminal; dredging and laying of the subsea pipeline are short term processes with no long term adverse effects.

## Effects of Disposal of Dredge Spoil on Water Quality

The construction of the LNG terminal facility, in particular the jetty, the subsea pipeline and dredging activities will result in short term increases in the suspend loading of the creek system, which could affect local flora and fauna, and therefore local fishermen. Dredgers will be equipped with suction devices to minimize the spread of fugitive sediments in the water column. Based on 20 years of continuous study of the effects of dredging in the PQA, the effects of additional sediments suspended in the water column are short lived and not a significant source of disruption except in the immediate local area. Benthic

organisms quickly repopulate the dredged areas, and fish in the affected water column typically move to clearer water until the sediments settle, then return.

The sediment quality survey of the area adjacent to the proposed LNG Jetty indicates that the site area is not contaminated to any significant level, therefore the bioavailability of any contaminants are not high, and no mitigation measures are therefore required.

## Spillages of Construction Materials and Piling Wastes

During the construction of LNG terminal it is possible that construction materials could either be released accidentally or dumped intention into the marine environment. Although materials like rock, concrete, plastics, etc. are relatively inert, other materials such as metals, etc. can cause deleterious effects on the water quality.

Other than a large scale accidental spill of fuels or other mechanical fluids, the impact of an individual event is likely to be small and not significantly adverse.

No impact on ground or submarine soil or water is anticipated.

## Drainage from the Berth and Storage Areas

The LNG terminal will not handle water or soil pollutants. The storm water runoff from storage areas and berth will be relatively lacking in contaminant discharge other than windblown dust and some traces of oils. Runoff from the jetty and similar built surfaces will be allowed to flow through a series of catch pits leading to drains that discharge directly to the water.

As the rainfall in the area is scarce, the runoff from the onshore facilities would be minimal. In addition, it is planned to regularly sweep the areas to remove the littered/spilled solid wastes and dust.

No mitigation measures are required as far as the proposed LNG terminal is concerned.

## Oil Spills

Spillage of oil and other hydrocarbon-based fuels, such as diesel, or untreated oily slops or ballast water has marked pollution effecting the quality of water and creating

damage to the aquatic environment & ecosystems. In enclosed channels such as at PQA the breakdown of fuel spilled into the water can cause marine faunal mortality.

## Discharges from the Septic Tank

Incident of discharge of untreated sewage into the creeks could have potentially adverse effects on water quality. Any impact would be influenced principally by the effluent quality and quantity, and the extent of dispersion around the point of discharge. For example, discharge of raw sewage with a high BOD to low energy in sheltered water could cause localized oxygen depletion.

The industries in Port Qasim area are required to treat their industrial waste and sewage and discharge the treated effluent meeting EPA's NEQS. The LNG terminal will have only domestic sewage from its offices which shall be collected and treated in a septic tank. Wastes from the FSRU will be collected by contractors and appropriately treated and disposed of.

No mitigation measures other than treatment of effluent in septic tanks before its discharge into PQA sewerage system or infiltration into the soil through a septic tank drain field is required.

## Discharges of Ships' Wastes

The discharge of ships' wastes into the main channel & onto port waters could cause the contamination of water and sediments. Secondary impacts could arise, such as the degradation of fisheries and marine habitats. MARPOL 73/78 seeks to prevent the discharge of polluting substances from ships into the marine environment. MARPOL 73/78 contains several annexes with restrictions on the discharge of waste from the ships, including those calling on the LNG terminal. All LNG transport ships will be required to follow MARPOL guidelines and standards.

## Terrestrial Ecology

The construction of the proposed LNG Terminal, storage area and subsea pipeline will not result in significant damage to the ecosystem which is only sparsely vegetated with a few plant species, each of which is prevalent in the Karachi region. It is estimated that the onshore ecology will be minimally affected, if at all. Some land will be used for construction of onshore facilities, but no unique habitat

exists on the site.

## Mangroves

For the construction of the subsea delivery pipeline and LNG jetty, the project design is intended to avoid impacting mangroves. No mangrove plants will be removed at the locations along the alignment of the subsea pipeline. The proposed routing of the pipeline and construction design ensures that no major damage to this important asset is caused. The technique employed for laying the pipeline underneath the sea bed is environment friendly, causing minimal disturbance to the ecology particularly relating to mangroves and benthos. For construction of the jetty, access to the work area will primarily be by barge, so no roads, laydown areas or similar use of surface lands are required. A condition of the project approval from SEPA is that any single mangrove disturbed during construction of the project will be required to be replaced ten-fold. The project is committed to exercise great care to avoid impacts to nearby mangroves.

## Marine Ecology

The impact of dredging within the project area includes suppression of species variety, population density and biomass as well as differences in species composition compared with the surrounding deposits. Generally, there will be no suppression of species diversity, population density or biomass benthic macro fauna outside the immediate boundaries of the dredged sites.

The impact of dredging and reclamation for the proposed LNG Jetty will have very localized impacts on the macro fauna near the site. Moreover, re-colonization by most species will occur after the construction of proposed LNG Jetty when the stable environment will prevail.

There are a number of mitigation measures which can be implemented in order to reduce the significance of this potential impact. These are given below (a combination of most practical measures will be adopted):

- For use of dredged spoil for reclamation, build coffer dam to retrain the dredged material which is especially designed to strain water without releasing significant sediment load back into the marine ecosystem using a geo textile barrier.

- Reduce overspill as far as practically possible
- Ensure that the discharge pipe is located at a suitable location within the coffer dam.
- Use an efficient trailing suction hopper dredger, wherever possible.

As no endangered species are reported to exist in the area, the impact from construction on the marine ecology will therefore be local, small and temporary.

Other impacts on marine ecology associated with dredging operation:

- Removal of benthos
- Smothering of benthos
- Release of contaminants
- Noise disturbance to marine fauna.

The excavation of the area for pipeline laying, dredging, and depositing dredge material behind the cofferdam will impact the habitat of the proposed site and the benthos of the Kadero Creek. To avoid significant impacts, proper care must be taken during construction. There will be inevitable removal of some benthic species at the construction sites. Some of the species could be important in themselves or as a source of food for other marine fauna including of the adjoining area. It is a natural phenomenon that after the construction phase is over the species from adjacent areas will recolonize at the site. The exact composition of species in terms of abundance and distribution may not recolonize in the area initially but with the passage of time and stability in the ecology of the area, the habitat may become similar in nature as prior to the construction by long lived species. Since the pipeline laying is a short term activity, the impact may not be very significant because the severity of impact is dependent on the amount of sediment in suspension, sediment size distribution and the current movement in the operation area. It is anticipated that the turbidity thus caused will not have significant impact.

The operational activity involves shipping traffic, and off loading LNG at jetty. The Jetty and the LPG storage facility have been designed keeping in view the standard international safety specification for handling LPG. All necessary control measures have been incorporated ensure that no fugitive emissions enter the marine

ecosystem. The nature of the project is such that it will have no significant impact on marine ecology. The liquid effluents from the offices will be treated to meet EPA standards and will have no potential for pollution of the habitats occupied by juvenile fish and other commercially important species. The potential threat to the fish is from the untreated industrial and municipal sewage being discharged into the creeks. The operation of LPG Terminal will have no impact on the marine ecology of the area.

The proposed LNG Jetty project area is not known to contain any rare or endangered species and the terminal / jetty is not expected to disturb the ecology of the core area significantly. The project is also not expected to release any pollutants during normal operations. Its location and operation is not expected to affect the breeding habitats of marine animals or migratory paths of any bird species. No adverse impacts anticipated on the marine life during operation. The only probability of degrading the ecosystem will be collision of ships, boats or tanker oil spill due to tanker accident. However, the ecological impact would be confined to the ecosystem around the spill zone and the effects would dissipate after a short period.

No mitigation measures would be required during operation. However the proponent has developed a contingency plan to combat oil spills in case of emergency. PGPL will maintain an in-house capability to fight medium size oil spills due to accidents, and in addition is a participant in Spill Contingency Planning developed by and in implementation at Port Qasim.

## Environmental Management Plan

EMP has been developed by the consultant for the construction and operating phases of the LNG project. It forms an integral part of post EIA study environmental monitoring and auditing of the project. This EMP outlines contents of construction and operational phases both. It constitute document for use in the field by the contractor(s) and their person construction as well as by the personnel of PGPL during operations. Its construction contractor, through its engineering and environmental consulting team, is responsible for implementing the EMP thus striving for continual improvement in the LNG jetty activities and its operation in a healthy port environment.

## Objectives of EMP

The purpose of the EMP is to:

- outline environmental protection measures to be followed during construction of jetty / pipeline and operations of the facilities by PGPL such as the storage vessel, pipeline, jetty, etc
- ensure that commitments to minimize environmental effects are met
- document environmental concerns and appropriate protection measures
- provide concise and clear instructions to Project personnel such PGPL staff and contractors regarding procedures for protecting the environment and minimizing environmental impact
- provide a reference document for personnel when planning and/or conducting specific activities
- provide contingency plans for accidental events
- communicate changes in the program through the revision process and
- Provide a reference to applicable legislative requirements.
- **disposal of water** pertinent to the planning, design, construction, operation and maintenance of the PGPL's facilities.
- **Materials management:** Those services and activities which support the avoidance, resource recovery (e.g. reuse and recycling) and environmentally responsible disposal of solid and liquid waste materials.
- **Planning, design and development:** The planning, design and development of the PGPL's built form and associated infrastructure.
- **Pollution prevention:** Those aspects of planning and management which support minimization of air and water pollution and contamination of land resulting from daily routine activities.
- **Transport:** Programs, projects, systems and procedures which promote and support walking, cycling and public transport.
- **Biodiversity and open space:** Those aspects of management and maintenance which support conservation and enhancement of biodiversity and environmentally sustainable use of open space across PGPL and other properties.

## Scope of EMP

The scope of the EMP includes the following functional areas:

- **Management systems:** Those systems employed in the management of the PGPL's operational activities. It will include financial engagement and supervision of contractors purchasing policies,
- **Knowledge systems:** Those processes which build knowledge and capacity on environmental issues, principles and sustainable behavior. It will include training communications campaigns links with operational departments, etc.
- **Energy management:** The energy-related aspects of the planning, design, construction, operation and maintenance of the PGPL's facilities.
- **Water management:** Aspects of supply, usage and
- Barge and Supply Ship operations
- Water course crossing
- Wastewater and Storm water management
- Hydrostatic testing
- Noise and Air emissions
- Erosion protection requirements
- Cleanup and Revegetation
- Waste management plan
- Environmental Monitor / Inspector
- Contingencies planning > accidents and malfunctions

## Standard Operation Procedures

SOPs have been formulated and incorporated in the EMP to serve as guidelines for various activities carried out during the operations project. The SOPs developed are:

- Environmental compliance

## Conclusion

The LNG project shall be a unique development that is primarily introduced into the region to augment the current energy resources in order to sustain affordable and eco-friendly fuel resources. Environmental considerations have been given to in the site selection and the impacts due to the construction and operation of the project have been extensively identified, adequately addressed and mitigated in a comprehensive manner. The issue of safety and the element of risk involved in the operation of the LNG terminal have been fully incorporated in the design and operations of the project.

There are no significant adverse impacts on the physical environment or ecology as adequate mitigation measures have been suggested that are effectively introduced in order to minimize the predicted impacts.

Socioeconomic impacts on micro scale may be of some concern however welfare of the local community has been addressed adequately by the project in its policy to provide communications, public outreach, grievance procedures, compensation for adverse effects on livelihood or assets, and its commitment to provide employment and business support to the local community. On macro scale, the impact is highly positive as the project will reduce the deficit in energy sector which in turn boost the economy of the region.

It is envisaged that the current commitment of the proponent to ensuring and enhancing the quality of life in and around the project area through implementation of a sound environmental management plan specifically developed for the project will mitigate any likely adverse impacts.