Azeri, Chirag, Gunashli Full Field Development Produced Water Disposal Project (ACG FFD PWD)

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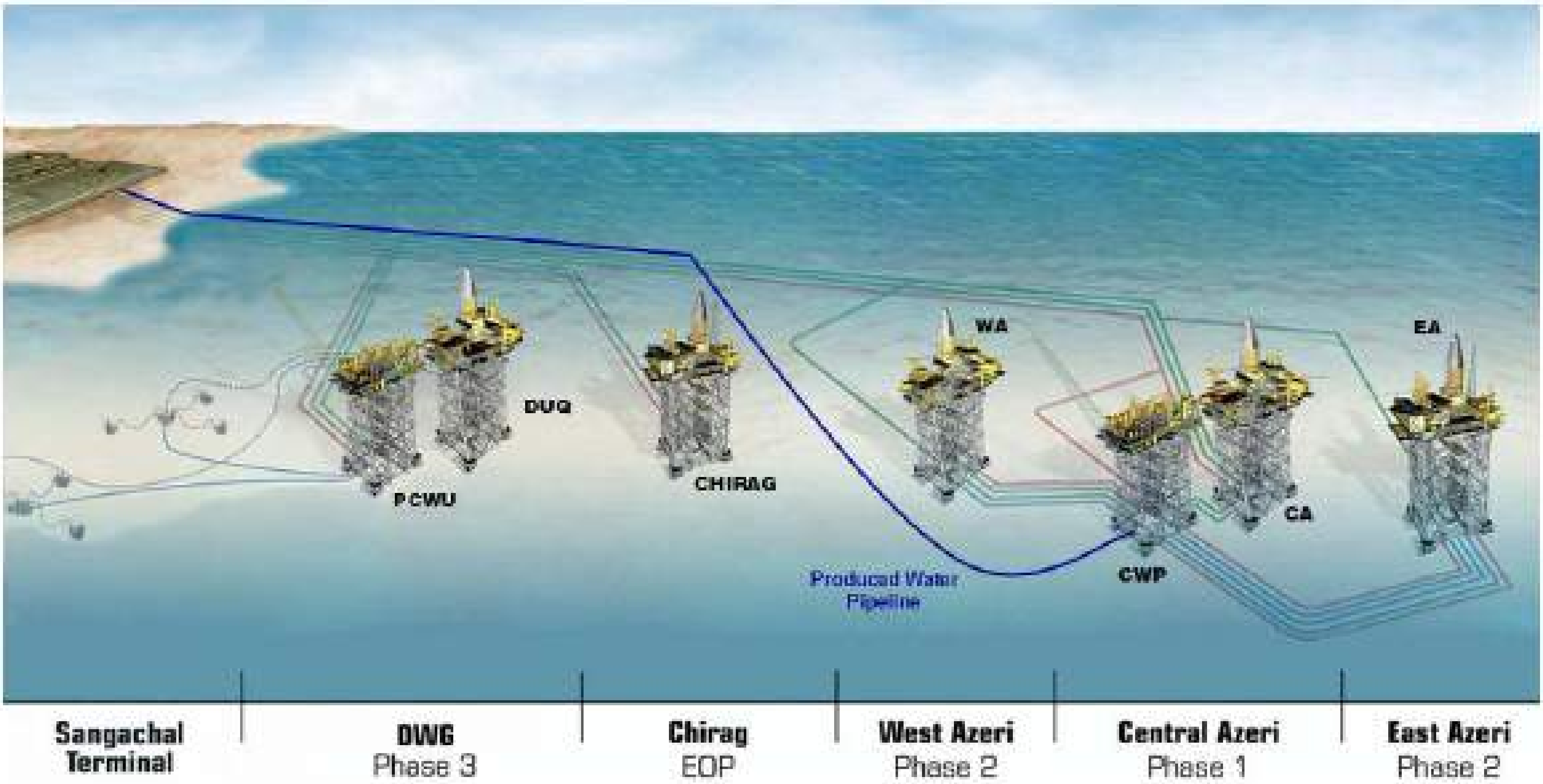

Environmental and Socio-economic Impact Assessment

Final Report
January 2007

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GLOSSARY

Aarhus Convention
The UN Economic Commission for Europe Convention on Access to Information, Public Participation in Decision Making, and Access to Justice in Environmental Matters was established in Aarhus, Denmark, in 1998. It requires that the Azerbaijan government ensure the universal availability of environmental information to the public. It also requires the Azerbaijan government to give the public the chance to participate in environmental decision-making over a wide range of economic activities, and to provide avenues through which members of public may appeal decisions they feel are not adequately considered. This convention was updated by the Kiev Protocol of 2003, and the Almaty Amendment of May 2005.

Abandonment fund
Money set aside for closure and clean-up of oil wells, as well as restoration of the adjacent environment. The abandonment fund set aside for ACG FFD will be inherited and administered by SOCAR after the term of the PSA finishes in 2024.

Abra Ovata
A mollusc that was introduced to the Caspian Sea by Soviet authorities in the 1940s to supplement the food supply of sturgeon (benthic feeding fish).

Absheron Ridge
A complex asymmetrical subsea ridge oriented northwest-southeast that is an extension of the Absheron peninsula upon which the ACG Contract Area oil drilling platforms are built.

Acartia Tonsa
A *copepod* (zooplankton) that invaded the Caspian Sea via bilge water collected by ships in the Mediterranean Sea that later passed through the Volga-Don Canal.

Azeri, Chirag, and Gunashli (ACG) Phase 1
The first phase of the full ACG field development involved the placement of a platform complex within the central part of the Azeri oil field (Northing 4433320 Easting 9530150 Pulkovo 1942 Grid), installation of a 30-inch offshore pipeline of over 190 km length, and construction of an onshore terminal for the processing of oil and gas. The offshore platform complex included two platforms connected by bridge: the production, drilling, and quarters (PDQ) platform; and the compression and water injection platform (CWP). The ESIA for this project was completed in February 2002 (by URS Corporation Ltd.), and the construction was scheduled for completion in late 2004. Production is estimated to peak around 2008.

ACG Phase 2
The second phase of the full ACG field development involved the placement of platform complexes within the western and eastern portions of the Azeri oil field, expansion of the CWP platform at Central Azeri (Phase 1 facility), installation of a second offshore 30-inch pipeline of over 190 km length, and the addition of onshore processing facilities for processing the additional volumes produced by the Phase 2 wells. The ESIA for this project was completed in late 2002, and construction was scheduled for completion in March 2006 for the West Azeri platform (date of first oil) and January 2007 for the East Azeri platform. Production is estimated to peak in 2014 for the West Azeri well, and 2015 for the East Azeri well.

ACG Phase 3
The third phase of the full ACG field development involved the placement of a platform complex within the Deepwater Gunashli (or western Chirag) field, drilling of a main well and two flanking well complexes (connected to the main well platform by subsea umbilical), an offshore spur pipeline connecting to both the Phase 1 and Phase 2 30-inch mainlines, and a further expansion of the onshore terminal to handle the additional oil and gas in preparation for its export. The ESIA for this project was completed in October 2004 (by URS Corporation Ltd.), and the construction was scheduled for completion in early 2008. Production is estimated to peak around 2010.

Acute toxicity
The property of a substance that has a toxic effect on a living organism exposed to a lethal dose over a short period relative to the lifespan of the organism.

Admiralty
Refers, in the context of this report, to the Admiralty of the former Soviet navy, which produced navigation charts of the Caspian Sea still in use today.

AFS Convention
The International Convention on the Control of Harmful Anti-Fouling Systems on Ships was established by the International Maritime Organisation (IMO) in October 2001. It is not yet in force, but once it has reached the threshold of 25 nations ratifying it with greater than 25 percent of total world shipping tonnage, it will require, with respect to this project, that the Azerbaijan government prohibit the use of organotin compounds as anti-fouling biocides on the hull of ships flying its flag or making use of its port or offshore facilities.

Aggregates Management Environmental Focus
That portion of the Contractor Implementation Plans and Procedures (CIPP) that details the approaches and methods employed for environmentally responsible storage, use, and disposal of gravel and crushed rock.

Alien species / Introduced species
A species that has not evolved naturally within, or is not native to, the environment it inhabits..

American Petroleum Institute (API)
The largest petroleum industry trade association in the world is also the foremost authority on petroleum industry standards and practices. API Gravity is a reference system for the density of crude oil and constituent hydrocarbons.

Amphipod
A small crustacean of the order *Amphipoda* having a laterally compressed body with no carapace (often described as “shrimp-like”).

Anode
The negative contact from which electrons flow out of to return to the circuit. Literally, the path through which the electrons ascend out of is an electrolyte solution. The other charged electrode in the same cell or device is the cathode.

Annelid
Any of various worms or wormlike animals of the phylum *Annelida* characterised by an elongated, cylindrical and segmented body (includes earthworms and leeches).

Anthropogenic
Effects or processes that are derived from human activity.

Appraise
In the BP Capital Value Process, within this first stage a wide range of project concepts are identified and considered in terms of their feasibility. Recommended options based on this first stage of analysis are passed into the second, or Select, stage.

Aquifer
An underground layer of water-bearing permeable rock or unconsolidated material (gravel, sand, silt, or clay) from which groundwater can be extracted.

Aromatic hydrocarbons
The group of hydrocarbon molecules that incorporate one or more planar sets of six carbon atoms. Also called arenes, the group includes: Benzene, Toluene, Ethylene, Xylene, etc. Can be Monocyclic (MAHs) or Polycyclic (PAHs).

Arsenic
A highly poisonous metalloid that has high acute and long-term toxicity to aquatic life, as well as high acute and moderate long-term toxicity to birds, and terrestrial animals. Where soil content is high, plant growth and crops may be reduced. It is a persistent pollutant that will bioaccumulate in fish and shellfish. Arsenic can sublimate when exposed, or burned within industrial processes; once in gaseous form, it can settle into the soil or water. Elemental arsenic is not water soluble, but many of its compounds are, and occur naturally in groundwater. (CAS 7440-38-2)

Asian Development Outlook (ADO)
A branch of the Asian Development Bank (ADB) that assesses economic trends and prospects in the developing countries of Asia.

Azerbaijan Business Unit (AzBU)
A corporate unit within BP that operates under a number of Production Sharing Agreements (PSAs) and a Host Government Agreement (HGA) made with the government of Azerbaijan. In the Republic of Georgia and Turkey, the AzBU also operates under HGAs specifically covering export pipelines and terminals.

Azerbaijan Strategic Performance Unit (AzSPU)
A corporate unit within BP that organizes business unit activities along strategic lines. SPUs operate under the direct supervision of their respective executive committee (ExCo).

AzPetrol
Retail Petroleum Company maintaining a petroleum receiving facility on Sangachal Bay south of the pipeline landfall location. Tankers servicing the AzPetrol Sangachal facility routinely cross the pipeline route on their way to dock.

Azeri Chirag Gunashli (ACG) Contract Area
Refers to International Contract (Production Sharing Agreement) No. 1 signed between the government of Azerbaijan and representatives of the Azerbaijan International Operating Company (AIOC) on September 20, 1994 (ratified on December 2 and coming into effect December 12 of the same year). BP maintains operational control of wells and infrastructure inside and leading out of the ACG Contract Area.

Back Ridge Province
A province assigned in the ACG Contract Area Baseline Survey (1996) to that part of the Contract Area north of the crest of the Absheron Ridge. It is characterized by gentle slopes to the northeast that may be either rough and irregular (with gas seeps and other gas-charged sediments), or smooth and featureless.

Baltic Sea Vertical Datum
The contour of 0 m vertical elevation recognized within Azerbaijan, taken from the mean lower low water line of the Baltic Sea near the Pulkovo Observatory (located in St. Petersburg, Russia).

Barium
This metallic material is a key component of barite, which is used as a weighting element in drilling fluids. Barite contains barium sulphate, which does not dissolve, nor bioaccumulates.

Barrels
The traditional English and American unit of measure of oil volume (originating in early Pennsylvanian oil fields), standardized in 1866 to equal 159 litres (0.159 m^3) or approximately 35 imperial gallons (42 US gallons).

Basel Convention
The Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal was established in Basel, Switzerland, in 1989 (brought into force in 1992). It requires that the Azerbaijan government ensure minimum generation of hazardous waste, adequate disposal facilities for wastes that are generated, and effective management of hazardous waste (minimizing threats to human health and the environment).

Beach haul
The act of pulling pipeline from the nearest location in which the pipelaying barge (PLBG) can anchor offshore (in this case, 1.2 km out) to the location where the offshore pipeline ties in with the onshore pipeline at the landfall site.

Benthos
Organisms attached to or resting on the bottom sediments and those which bore or burrow into the sediments.

Berm (also finger pier)
For this project, this is a jetty installed at a right angle to the shoreline to approximately 3 m depth.

Bern Convention
The Convention on the Conservation of European Wildlife and Natural Habitats was established in Bern, Switzerland, in 1982. This international treaty establishes the coastline of Azerbaijan as an area of special conservation interest (ASCI) within a European Emerald Network of similar areas. As such, the impact of the ACG FFD PWD project on the coast must be assessed in terms of this treaty.

Best Practicable Environmental Option (BPEO)
An evaluation procedure adopted by Great Britain in January 1976 with the goal of managing wastes and other environmental implications of project options, along with safety and cost considerations. The Royal Commission on Environmental Pollution writes: "The BPEO procedure establishes for a given set of objectives the option that provides the most benefits or the least damage to the environment as a whole, at acceptable cost, in the long term as well as in the short term."

Biochemical Oxygen Demand (BOD)
The amount of oxygen required by aerobic microorganisms to biodegrade the organic matter in a sample of water, such as that polluted by sewage. It is used as an indicator of the quality of a water body.

Biocides
A chemical agent that can be added to fluids for the purpose of preventing or limiting growth of bacteria or other living organisms.

Biodegradable
Susceptible to breakdown into simpler compounds by microorganisms in the soil, water, and atmosphere. Biodegradation often converts toxic organic compounds into non- or less toxic substances.

Biological Treatment
A treatment option for produced water where bacteria are introduced into produced water to consume its organic components. The bacteria produce carbon dioxide gas and sludge from the organic components it consumes. This is not a stand-alone treatment of produced water and would require additional treatment before release. The option is not considered viable as the sludge would have be disposed into an appropriate landfill by truck (posing a potential hazard to traffic and workers), control of its disposal would have to be passed along to a third party (landfill management) which poses a risk if mismanaged, and public perception of threats to wildlife from discharge of treated water would pose a risk to company reputation.

Biomass
The dry or wet weight of organisms inhabiting a particular ecotope, usually expressed in grams or kilograms per unit area. Often used comparatively to determine the environmental health of an area.

Biotope
An area that is uniform in environmental conditions providing habitat for a specific assemblage of animal and plant life.

Bivalve
A marine or freshwater mollusc belonging to the class *Bivalva*. They have a laterally compressed body and a shell consisting of two hinged parts that are more or less symmetrical (includes scallops, clams, oysters, and mussels). They feed by siphoning and filtering small particles from water, and can be attached to surfaces or buried in sand or sediments.

Black water
Sanitary sewage wastewater and associated solids. Must be treated to national and international standards before any discharge.

Blend water
Water used for dilution of saline Produced Water.

BP Capital Value Process (CVP)
The assessment process whereby BP identifies the most justified option for a project; this is closely aligned with the steps of engineering design. The steps used in this process include: appraise, select, define, execute, and operate.

Brackish
Saltier than freshwater, but not as salty as seawater (for many brackish water bodies, the surface water salinity varies considerably, both over distances and over time). The precise range is between 0.5 and 30.0 parts per thousand (‰)

Brownfield
Under definition used in the United Kingdom, brownfield lands are any previously developed land to be used for future development, irrespective of the presence of contaminants. Under the definition used in the United States, brownfield lands are abandoned or otherwise under-used industrial or commercial sites where future development is complicated by real or perceived environmental contamination.

Bund
A wall or dyke around storage tanks to contain the contents in case of rupture or spillage.

Cadmium
A relatively rare, soft, bluish-white, transition metal, this element and its compounds are highly toxic even in low concentrations and will bioaccumulate in organisms and ecosystems making it highly persistent. It is highly toxic to aquatic life. No data exists for its toxicity to plants, birds, or terrestrial animals. However, it is classified a probable carcinogen, and has been known to produce cancer in test animals.

Carbon Dioxide (CO_2)
A 'greenhouse' gas suspected of contributing to climate change.
(CAS 124-38-9)

Carbon Monoxide (CO)
A gas suspected of contributing indirectly to climate change by enhancing ozone production near the earth's surface. Highly toxic to humans, and able to enhance photochemical smog formation. (CAS 630-08-0)

Cathodic Protection (CP)
A technique used to control corrosion of a submerged metal surface by making that surface the cathode of a localized electrochemical cell. This is done by the placement of a nearby galvanic or sacrificial anode source with a higher electrochemical potential. This anode eventually wears away and must be replaced.

Cement
Used to set casing in the well bore and seal off unproductive formations and cavities. It is also used as a coating to add weight to submarine pipelines.

Central Waste Accumulation Area (CWAA)
A designated waste collection facility serving a specific area; also may include facilities for incineration or disposal of hazardous substances.

Chemical Oxygen Demand (COD)
An indirect measure of the amount of organic pollutants in water, determined by the amount of oxygen consumed by such pollutants per litre of aqueous solution.

Chemical Treatment Skid
A treatment system that injects chemicals into water to reduce contaminants within the stream and optimise the processes for which the water will be used.

CHEMMAP
A 3-dimension chemical discharge model designed to predict trajectory, fate, impacts, and biological effects of a variety of chemical substances, used in this ESIA to predict the results of a Produced Water spill in both nearshore and offshore regimes. The modelling software is produced by Applied Sciences Associates (ASA), Inc. (http://www.chemmap.com/).

Chromium
A naturally occurring, steel-gray, hard metal with a high melting point no odour or taste. Chromium (III) occurs in nature and may be found at low background levels everywhere. Chromium metal and chromium (III) compounds are not usually considered health hazards, but chromium III has a known moderate acute toxicity within aquatic life.

Chromium (VI) (hexavalent chromium) is released by industrial processes and can be toxic if orally ingested or inhaled. Most chromium (VI) compounds are irritating to eyes, skin and mucous membranes. Chronic exposure to chromium (VI) compounds can cause permanent eye injury and is an established human carcinogen.

Chromium will bioaccumulate in organisms (e.g. accumulates in fish) and ecosystems

Combustion emissions
Air pollutants that result from incineration of materials or gasses (typically fossil fuels).

Commissioning
Preparatory work, servicing etc. usually on newly installed equipment and all testing prior to full production.

Communicable Diseases Awareness and Prevention Social Focus
That portion of the Contractor Implementation Plans and Procedures (CIPP) that details the minimum standards for education and safe practices in the prevention of the spread of communicable diseases among contractor employees and the communities near the project site.

Compression and Water-injection Platform (CWP)
One of two platforms at the Central Azeri platform complex in the ACG Contract Area. It is dedicated to injection of produced water into the ACG reservoir.

Consequence
The resultant effect (positive or negative) of an activity's interaction with the legal, natural and/or socio-economic environments

Consortium
With respect to this project, this is a joint venture enterprise used by the oil industry as a vehicle for joint operations where a distinct local legal entity and joint staffing are required.

Contract Area
Area of the sea that has been sub-divided and licensed/leased to a company or group of companies for exploration and production of hydrocarbons.

Contractor Control Plans (CCP)
A description originated by an owner company of the mechanisms that allow the company to ensure that its contractors fulfill their contractual commitments and implement mitigation actions for which they are responsible.

Contractor Implementation Plans and Procedures (CIPP)
A description originated by the contractor to describe the measures by which they will implement their contractual commitments and mitigation measures for which they are responsible.

Convention on Climate Change (UNFCCC) and Kyoto Protocol
The UN Conference on Environment and Development Framework Convention on Climate Change was established at the Earth Summit held in Rio de Janeiro in 1992. The Kyoto Protocol modified this Convention, providing for established limits to greenhouse gas (GHG) emissions among industrialised (Annex I) and developed (Annex II) countries. The Convention defines Azerbaijan as a developing country, which is not subject to the emissions restrictions of the treaty. However, at the same time, it cannot sell emission credits to other countries until it volunteers to become an Annex I country.

Convention on the International Trade in Endangered Species (CITES)
The Convention on the International Trade in Endangered Species of Wild Flora and Fauna was drafted at a World Conservation Union (at the time called the International Union for the Conservation of Nature and Natural Resources, or IUCN) meeting in Nairobi, Kenya, in 1963. It was established as treaty in Washington, DC, in 1973 (set in force in 1975). The convention requires that the Azerbaijan government prohibit the international trade of endangered wildlife and flora endemic to its environment. This convention was updated by the Bonn Amendment of 1979, and the Gabarone Amendment of 1983.

Copepod
Small crustacea, represented by a large number of of mainly planktonic marine and freshwater species.

Copper
Copper is a reddish-coloured metal, with a high electrical and thermal conductivity. Copper is naturally occurring in rocks, soils and sediments and is an essential nutrient to all higher plants and animals. In animals, it is found primarily in the bloodstream, as a cofactor in various enzymes, and in copper-based pigments. In sufficent amounts, copper can be poisonous or even fatal to organisms.

Copper (II) compounds are toxic to aquatic life (toxicity is affected by water softening, alkalinity, and pH). Copper will bioaccumulate in fish tissues. It is less toxic in soil than in water, and is released into the atmosphere as particulate emissions from extraction and manufacturing industrial processes.

Corrosion
The eating away of metal by chemical or electrochemical action. The rusting and pitting of pipelines, steel tanks, and other metal structures is caused by a complex electrochemical action in which the metallic surface of the structure acts as an anode (see Cathodic Protection).

Corrosion inhibitors
Chemical compounds that, when added in small concentration, stops or slows down corrosion of metals and alloys.

Cost
In the BP Capital Value Select Process, this is the analysis of the initial expenditure and operating costs over the life of the field or project. This includes capital expenditure estimates, the cost of manufacture, construction, and installation.

Cover
The depth of the outside of the top of a pipe from the final grade of the ground surface.

Crude oil
An unrefined mixture of naturally occurring hydrocarbons with varying densities and properties.

Ctenophore
Any of various marine animals of the phylum *Ctenophora*, having transparent, gelatinous bodies bearing eight rows of comb-like cilia used for swimming. Also known as comb jellyfish.

Cuttings
The fragments of rock dislodged by the bit and brought to the surface in the mud. These are reinjected into the reservoir at the Central Azeri platform.

Cumulative impact
Environmental and/or socio-economic aspects that may not on their own constitute a significant impact but when combined with impacts from past, present or reasonably foreseeable future activities associated with this and/or other projects, can result in larger and more significance impact(s).

Decommissioning
Shutdown of the pipeline with system cleaning and dismantling of any facilities. This will be detailed one year before the overall project completes production of 70 percent of identified reserves.

Define
In the BP Capital Value Process, within this third stage the finalised option (the option not rejected in either Appraise or Select stages) is developed to provide technical definition, cost, project schedules, and funding for the proposed project. Once this stage is completed, the project is passed into the fourth, or Execute, stage.

Demulsifier
A chemical used to break down crude-oil water emulsions. The chemical reduces the surface tension of the film of oil surrounding the droplets of water. The water then settles to the bottom of the tank (oil is generally lighter than water).

Diatom
Any microscopic one-celled or colonial algae of the class *Bacillariophyceae*, having cell walls of silica consisting of two interlocking symmetrical valves.

Dibenzothiophene
Also called DBT, this is a lightweight PAH consisting of two benzene rings connected to a sulphur atom found within crude oil. It is much more persistent than many other PAHs (in one study, DBT was found 10 years after its introduction to a soil sample). Acute toxicity is rare for humans, fish, or terrestrial animals as a result of exposure to low levels of any PAH, and the greatest danger posed by this compound is in long-term exposure; it is a possible carcinogen. (CAS 132-65-0)

Dispersion modelling
A mathematical simulation usually performed on a computer that shows how pollutants will disperse in an ambient medium.

Dissolved Gas Flotation (DGF)
An oil separation process where fuel gas is introduced to a tank of produced water. Oil and oil-coated solids within the water mixture will collect onto the fuel oil and rise to the top of the water.

Downhole injection
Injection of material down a well.

Downtime
A period when any equipment is unserviceable or out of operation for maintenance.

Draught
The depth of the bottom of a ship below the waterline. May be extended by heaving (up-and-down motion of the ship from interaction with waves), pitch (rotation of the ship about its transverse axis), and squat (an induced local depression in the sea surface caused by the motion of the ship).

Ecotoxicity
The effect of toxins as measured in terms of environmental exposure (usually determined through a tiered effects process or analysis).

EC_{50} (Median Effective Concentration)
The concentration of a chemical at which 50% of the test population exhibits a defined response to that chemical.

Effluent
Liquid waste products emitted by an operation or process.

Electrostatic Coalescer
An electrical devise that uses water's conductive qualities to extract it from other non-conductive fluids, such as crude oil; both water and crude oil are allowed to coalesce, or mass together, separately. Traditional coalescers are used toward the end of the separation process, as produced water in large quantities often forms a bridge between electrodes and shorts out the process.

Emission Factor
An average emission rate for a given pollutant from a given source, relative to units of activity. This is measured using real time data collected over a specific period.

Enhanced Offshore Separation
A treatment option to remove produced water from product at each of the production wells so that the water content in the product is low enough for other disposal options to become feasible. Water separated at the platforms (by either an electrostatic coalescer or a vessel internal electrostatic coalescer – VIEC) would be reintroduced directly by injection to the offshore reservoir.

Environmental and Socio-economic Impact Assessment (ESIA)
Systematic review of the environmental or socio-economic effects a proposed project may have on its surrounding environment.

Environmental aspect
An element of an organisation's activities, products or services that can interact with the environment.

Environmental Issues Identification (ENVIID) Workshop
A meeting where experts and concerned individuals meet and compile a list of all potential effects that could result from the execution of a project, identifying significant environmental impacts and key issues for further consideration.

Environmental Assessment (EA)
In the BP Capital Value Select Process, this is the analysis of the environmental and socio-economic standards set for the project. This should include not only the direct impacts, but also perceptions that may introduce risks to company reputation.

Environmental impact
Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.

Environmental Management System (EMS)
System established to manage an organisation's processes and resultant environmental impacts (one exists for BP's Azerbaijan Business Unit).

Environmental Risk Assessment (ERA)
An examination of risks resulting from technologies, practices, processes, and industrial activities that may pose a threat to ecosystems, fauna, and humans. This is predominantly a scientific activity that critically reviews available data to identify, determine the validity of, and quantify risks associated with a potential threat for the purpose of effectively managing them within a project.

Environmental and Social Management System (ESMS)
System established to manage an organisation's processes and resultant environmental impacts (one exists for the ACG Full Field Development project).

Environmental receptors
Any of various organisms that are directly or indirectly affected by environmental impact.

Environmental Statement
Formal document presenting the findings of an ESIA process for a proposed project.

EPA 16
A group of 16 PAHs designated by the U.S. Environmental Protection Agency as priority pollutants. These include the following:

- acenapthene
- acenaphthylene
- anthracene
- benz[a]anthracene
- benzo[b]fluoranthene
- benzo[k]fluoranthene
- benzo[g,h,i]perylene
- chrysene
- dibenz[a,h]anthracene
- fluoranthene
- fluorine
- indenol[1,2,3-co]pyrene
- naphthalene
- phenanthrene and
- pyrene [CAS 129-00-0].

The justification behind selecting these as priority pollutants was that these had the highest carcinogenic effects among the 120 known PAHs.

Espoo Convention
The UN Economic Commission for Europe Convention on Environmental Impact Assessment in a Transboundary Context was established in Espoo, Finland, in 1991. It requires that the Azerbaijan government notify countries that might be subject to potential transboundary environmental impacts (particularly in the event of a disaster) of a project it approves before it is constructed.

Evaporation pond
A process used for produced water disposal where contaminated water is collected in a pond and allowed to evaporate naturally. The option is not considered viable as the pond sludge must be disposed periodically as hazardous waste, wildlife may become exposed to toxic levels of salt and chemicals through use of the pond, local evaporation rates are not large enough to dispose the required quantity of produced water without use of an extensive-sized pond, residency time may lead to unpleasant odours for nearby residents, and water may escape from the pond through leakage or a storm event.

Execute
In the BP Capital Value Process, within this fourth stage the detailed engineering occurs on the final option, providing design, cost details, and schedule generally defined during the third, or Define, stage. Construction work takes place prior to the fifth, or Operate, stage.

Export pumps
With respect to this project, export pumps are pumps used to extract Produced Water from storage facilities into the pipeline that eventually leads to reinjection back into the reservoir below the ACG Contract Area. The use of three electrically driven centrifugal pumps allows for flows that are in excess and below peak flow conditions within the pipeline, and allows for routine maintenance of export pumps without interruption of Produced Water flow within the pipeline.

Fauna Management Environmental Focus
That portion of the Contractor Implementation Plans and Procedures (CIPP) that details the minimum effort required by the contractor to prevent

impacts to critical fauna in the vicinity of the project during construction activity.

Fetch
The distance over water at which wind acts in the creation of coastal waves. This affects longshore drift, coastal erosion, and in enclosed bodies of water such as the Caspian Sea, localised sea swelling (such as what is seen in Khazri and Gilavar wind events at Baku).

Flow Meter Totaliser
A device used to measure the rate of fluid flow and provide a total flow volume for a given period.

Fluvial
Of or relating to rivers or streams or produced by the action of a river or stream.

Footprint
The impact/impression on the seabed or land from a facility.

Formation
A rock deposit or structure of homogenous origin and appearance.

Fugitive emissions
Very small chronic escape of gas and liquids from equipment and pipework.

Garadag Executive Power
The executive branch of the district government with jurisdiction in the Garadag District of the Baku *Sahar* or Municipality (location of the Sangachal Terminal, situated southwest of the built up area of Baku).

Gastropod
Any of the various mollusks of the class *Gastropoda* such as the snail; they characteristically have a single, usually coiled shell or no shell at all, a ventral muscular foot for locomotion, and eyes and feelers located on a distinct head.

Gilavar wind
Gale-force coastal winds that blow from the south in the vicinity of the Absheron Peninsula. These usually occur ahead of clear (winter) or hot (summer) weather, and may change the Caspian sea level elevation in the vicinity of Baku and Sangachal Bay.

Grey water
Wastewater generated from the drainage of used shower water, sink water, and laundry water. May be discharged directly into seawater without treatment, according to MARPOL standards.

Grounding
The running aground of a ship, or the bumping of a ship on the seabed or on seabed obstacles (such as a pipeline).

Habitat
An area where particular animal or plant species and assemblages are found, defined by environmental parameters.

Halocarbons
Chemical compounds where one or more carbon atoms are linked covalently to one or more halogen atoms (fluorine, chlorine, bromine, or iodine). Commonly used as solvents, pesticides, refrigerants, fire-resistant oils, elastomers, adhesives and sealants, electrical insulation, and plastics.

Harmonised Offshore Chemical Notification Format (HOCNF)
A format used for communicating an inventory of chemicals kept at an offshore site (such as an oil rig). The HOCNF has been in use in European Union countries since 2002, and is regulated under the terms of the OSPAR Treaty. UK-based companies are using an amended form of the traditional OCNS to meet the standards of the HOCNF.

Hazard
The potential to cause harm, including ill health or injury; damage to property, plant, products or the environment; production losses or increased liabilities.

Health, Safety, and Environmental (HSE) Management Plan
A description of the means of achieving health, safety and environmental objectives.

Health, Safety, and Environmental (HSE) Management System
The company structure, responsibilities, practices, procedures, processes and resources for implementing health, safety and environmental management.

Hook-up and Commissioning (HUC)
The phase that follows offshore development (pipeline) installation during which all connections and services are made operable and commissioned (started up).

Hot work
Work performed on heated apparati (such as an operating production facility). These require special procedures to ensure worker safety and safe uninterrupted operation of the facility.

Hydrocarbon
Organic chemical compounds of hydrogen and carbon atoms. There are a vast number of these compounds and they form the basis of all petroleum products. They may exist as gases, liquids or solids, examples being methane, hexane and asphalt.

Hydrostatic testing/Hydrotest
The checking of the integrity of a container (e.g. tank or pipe) by filling it with water under pressure and testing for any loss of pressure.

Induced Gas Flotation (IGF)
A water separation device that passes air bubbles through an oil-water mixture in order to induce the lighter oil to the top of the water column. It is then skimmed off and returned into the system for further processing.

Inert Gas
A gas that does not chemically react under normal circumstances. These are used to flood compartments when there is fire or imminent danger of fire.

Injection well
A well used to introduce fluids into a reservoir, usually for enhanced recovery.

Integrated Control and Safety System (ICSS)
A computer-enhanced system that provides operational control of a complex system.

Integrated Environmental Monitoring Programme (IEMP)
A programme by which all existing environmental monitoring related to the ACG FFD is coordinated and rationalised in a cost-effective and practicable manner, with the intent of ensuring regulatory compliance, effective environmental management, and corporate reputation are addressed. The programme serves as a basis for design of future individual studies that will provide accurate, defensible, and interpretable data that reflects ongoing changes to environmental conditions, can withstand international and national scrutiny, demonstrate the effectiveness of BP Environmental Policy, and provide the means to compare BP activities with predictions set forth in its ESIAs and other source documents.

Internally Displaced People (IDP)
Individuals who have been forced to leave their home for reasons such as natural disasters or war, which have not crossed an international boundary.

Iron
The most abundant metal on earth, iron is usually beneficial to life, but typically forms toxic compounds when in excess. In humans, excess iron can cause liver and kidney damage. Some compounds are carcinogenic. (CAS 7439-89-6)

Khazri wind
Gale-force coastal winds that blow from the north in the vicinity of the Absheron Peninsula. These are cool (summer) or cold (winter) winds that can reach 40 m/s (mid-range Category 1 hurricane speeds on the Saffir-Simpson scale), and may change the Caspian sea level elevation in the vicinity of Baku. (Name of the wind is derived from the ancient city of Khazar, near present-day Astrakhan, Russia.)

Kiev (SEA) Protocol to the Espoo Convention
The May 2003 modification to the UN Economic Commission for Europe Convention on Environmental Impact Assessment in a Transboundary Context (also called the Strategic Environmental Assessment Protocol) will require, once in force, that the Azerbaijan government review all official draft plans and programmes. It also provides for extensive public participation in evaluation of these draft plans and programmes.

Landfall
The beach location where pipelines cross the Caspian Mean Lower Low Water (MLLW) contour on their way between Sangachal Terminal and their respective offshore installation (located near Northing 4451150 Easting 9371420 Pulkovo 1942 Grid).

Larvae
A juvenile form of animal that develops into a different form.

LC_{50} (Median Lethal Concentration)
The concentration of a chemical measured in a standard test for its toxicity where 50 percent of a test population is killed within a specific time period.

Lead
A soft, heavy, and toxic metal, lead is bluish white when freshly cut but tarnishes to dull gray when exposed to air. The metal has poor electrical conductivity and is highly resistant to corrosion.

Lead is a poisonous metal that can damage nervous connections (especially in young children) and cause blood and brain disorders. In the environment lead can mean death to fauna, and slowed growth to flora. Soft water can increase lead toxicity for both flora and fauna. Long-term exposure for fauna to non-lethal doses of lead will shorten lifespans, decrease reproductive health, and cause both appearance and behavior changes. It is highly persistent in water and may be bioaccumulated. Lead compounds can change with exposure to sunlight, air, and water, but lead will stay in soil, dust, and sediment for many years.

Lessons learned
Case studies involving mistakes made in similar situations to a given project, performed with the intent of avoiding those same mistakes in the future.

Liquid hydrocyclone
A devise that uses centrifugal motion to increase the gravitational forces applied toward separation of oil (generally of a lighter specific gravity) from water.

Littoral
The part of the shore that is under water at high tide and exposed when the tide is low. Also known as the intertidal zone.

London Dumping Convention
The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (also called LC72) was established in London, UK, in 1972. It requires that the Azerbaijan government regulate the dumping of waste materials from ships in the Caspian Sea. Regulated material are either black-listed (prohibited from being dumped) or grey-listed (requires special care in being dumped).

Lowest Observable Effect Concentration (LOEC)
The smallest amount of a substance that may cause an adverse alteration of function, growth, development, or life span on a target organism.

Low Pressure Separator (LPS)
The existing method for separating processed water from product in the ACG field.

Macro Porous Polymer Extraction (MPPE)
A process for extracting a target fluid from a stream by passing the stream through a filter consisting of macro porous polymer beads which contain an extraction fluid inside.

Mammal
A class of warm-blooded vertebrates, *Mammalia*, having mammary glands in the female.

MARPOL (1973/1978)
The Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships (1973) was established by the International Maritime Organisation (IMO) in 1978, and came into force in 1983. It requires, with respect to this project, that the Azerbaijan government regulate protective measures aimed at prevention, control, and reduction of potentially unplanned discharges of Produced Water (particularly under Annex I, Prevention of Pollution from Oil).

Mat/Mattress
A structure to support and protect the lay down head and pig launcher/receiver during installation and pre-commissioning activities and also to provide any additional dropped object protection to the pipeline and tie-in spool arrangement.

Maximum Permissible Concentrations (MPC)
The regulatory value defining the greatest concentration of a chemical that if inhaled daily would result (given current understanding) in no appreciable harm to the person breathing it.

MPC also refers to the greatest acceptable environmental concentration (usually in water) for specified purposes (such as fisheries protection)

Mechanical filtration
Passage of fluid through a filter in order to remove undissolved sediment.

Mercury
A heavy, silvery transition metal, mercury is one of five elements that are liquid at or near standard room temperature. Mercury is an extremely rare element in the earth's crust but enters the environment as a pollutant from various industries.

The metal is toxic to aquatic life and is highly persistent in water. In the environment mercury and its compounds will often form into methylmercury through chemical oxidation or bacteriological processes. Methylmercury is a highly toxic organic compound of mercury and will remain at toxic levels within the environment for many years.

Fish and shellfish have a natural tendency to concentrate mercury in their bodies often in the form of methylmercury. Bioaccumulation rates are such that fish-tissue concentrations of mercury increase over time. The metal is also subject to biomagnification. This is where species of fish that are high on the food chain contain higher concentrations of mercury than others due to feeding on fish with high fish-tissue concentrations.

Methane (CH_4)
A gas suspected of contributing indirectly to climate change by enhancing ozone production near the earth's surface. Poisonous at high concentrations, and able to enhance photochemical smog formation.

Milli Mejlis
The national parliament of Azerbaijan (unicameral with 125 deputies serving for 5-year terms).

Mitigation
Process that would make a negative consequence less severe.

Montreal Protocol
The Montreal Protocol on Substances That Deplete the Ozone Layer was established in 1987 in Montreal, Canada (coming into force in 1989). It was an addenda to the Vienna Convention for the Protection of the Ozone Layer; it has since undergone 5 revisions, the latest made in Beijing in 1999. This protocol requires that Azerbaijan regulate the release of several targeted halogenated hydrocarbons (or haloalkanes) known to damage the ozone layer within its jurisdiction.

Mnemiopsis leidyi
Comb jellyfish, an invasive species that arrived in the Caspian Sea through bilge water collected in the Black and Azov Seas by ships traveling through the Volga-Don Canal (arriving in the late 1990s). The invasive species arrived in the Black Sea through bilge water collected by American grain ships off the Atlantic Coast of the U.S. in the early 1980s.

Mytilaster lineatus
Mussel moluscs that have invaded the Caspian Sea.

Naphthalene
A colorless or white plate-like crystal that forms from coal tar and crude oil (its most common commercial usage is in the production of moth balls). It is a lightweight PAH composed of two benzene rings that may be ingested, inhaled, or absorbed through the skin, with detrimental effects to both the respiratory and circulatory tracts of animals and humans. Children are particularly vulnerable to its toxicity. It is thought to biodegrade quickly and not bioaccumulate. (CAS 91-20-3)

Nauplii
Plural of nauplius, a crustacean in its earliest larval stage.

Neoprene
A synthetic rubber compound.

Nereis diversicolor
A bristleworm that invaded and colonised the benthos near offshore platforms in the ACG Contract Area.

Nitrogen Oxides (NO_x)

This chemical compound may augment the formation of ozone and photochemical smog at ground level when mixed with VOCs. High levels of these will cause problems to birds and animals, as well as humans. Lower levels will cause fatigue and other symptoms within fauna, while long-term exposure will produce damage to circulatory and nervous systems, as well as a lowered birth rate. Natural and industrial processes produce nitrogen oxides. Once in the air, nitrogen oxides will rapidly convert to nitrogen dioxide and dissolve in airborne or surface water to produce dilute nitric acid (a form of acid rain). In the stratosphere, these can assist in the regeneration of the protective ozone layer, but an excess of nitrogen oxides will react to decrease ozone concentrations.

Non-destructive Testing (NDT)
Methods of inspecting and testing the quality or integrity of vessels or equipment that do not involve the removal or testing to destruction of representative sections.

Non-tidal
Having the quality of being unaffected or insignificantly affected by lunar tidal forces, i.e., the Caspian is a non-tidal sea.

No Observable Effect Concentration (NOEC)
The greatest concentration of a toxin in which exposed organisms are not observed as being adversely affected.

Offshore Chemical Notification Scheme (OCNS)
A UK scheme comprising an inventory of chemicals kept at an offshore site (such as an oil rig). The scheme was set up to classify chemicals based on a qualitative assessment of their hazardous characteristics (Class A chemicals being the most hazardous, Class E being the least). It was modified to meet the new 2002 OSPAR standards for HOCNF. The OCNS is still used to classify chemical hazards by UK companies.

Oil Rocks (*Nyeftyanye Kamni* or *Neft Dashlari*)
The first offshore oil-drilling platform constructed in 1949 by Soviet engineers near offshore rocks with the same name. Located 10 km offshore, 110 km east of Baku, just west of the ACG Contract Area.

Oligochaete
Any of various annelid worms of the class *Oligochaeta*, including the earthworms and a few small freshwater forms.

Open drains system
A drainage system designed to capture runoff from processing areas exposed to weather and surface water.

Operate
In the BP Capital Value Process, within this fifth and final stage the project processes are evaluated to ensure that they are meeting required specifications. Management shifts from that of the Project Team to that of the Operations Team.

Operator
The company responsible for conducting operations on a concession on behalf of itself and any other concession-holders.

Organotin
Chemical compounds based on tin with hydrocarbon substituents. An organotin compound is commercially applied as a hydrochloric acid scavenger (or heat stabilizer) in polyvinyl chloride and as a biocide. Tributyltin oxide (or tributyltin for short) has been extensively used as a wood preservative. Tributyltin compounds are used as marine anti-biofouling agents. Concerns over toxicity of these compounds (some reports describe biological effects to marine life at a concentration of 1 nanogram per liter) have led to a world-wide ban by the International Maritime Organization (restricted by the 2003 Annex I of the International Convention on the Control of Harmful Anti-Fouling on Ships).

Oxygen scavenger
A chemical used to remove oxygen from water, typically ammonium bisulphate. It reacts with oxygen once, after which the residues are relatively inert, of low toxicity, and pose no risk to the environment.

Ozone treatment
A tertiary water treatment technique that is used for oxidation of dissolved iron and manganese in water and as a biocide. It has also been used successfully in secondary treatment as a spontaneous flocculation agent to enhance fine particle removal.

pH
A scale of alkalinity or acidity, running from 0 to 14 with 7 representing neutrality, 0 maximum acidity and 14 maximum alkalinity.

Phenanthrene
Also called PHE, this is a lightweight PAH composed of three benzene rings, derived from coal tar and the incomplete combustion of fossil fuels. It is widely distributed in aquatic environments, and may have similar effects to naphthalene. However, its precise effects on human, fauna, and flora are understudied and not known. (CAS 85-01-8)

Phenols
A class of chemical compounds that consist of a hydroxyl group attached to an aromatic hydrocarbon group; they are similar to alcohols, but more acidic. It enters wildlife and humans through inhalation, ingestion, and absorption through the skin. Acute poisoning in fauna may lead to death, while long-term exposure may shorten lifespans, decrease reproductive health, and cause changes in appearance and behavior. Often produced as a waste product from crude oil processing, these persist within water with a half-life of 2-20 days. These are three times as likely to migrate to water than they are to air. (CAS 108-95-2)

Phragmites
Common reeds. May be used for reed bed treatment of Produced Water and other contaminated water. (Treatment involves bacteriological degradation of hydrocarbons and adsorption of heavy metals and other non-organic compounds into the soil surrounding the reed root system.)

Phytoplankton
Microscopic planktonic plants, e.g. diatoms, dinoflagellates.

Pipeline Inspection Gauge (PIG or pig)
A bullet shaped, cylindrical, or spherical capsule inserted into a pipeline flow that travels along with the fluid in the pipeline. Maintenance Pigs are frequently used to scrape pipelines clean from rust, wax, or other deposits, as well as redistribute inhibitor chemicals along the pipeline wall. Intelligent Pigs, carry instrumentation used in pipeline inspection.

Pigging
The act of sending a pipeline inspection gauge, or pig, through a pipeline. For the Produced Water pipeline, the running of maintenance pigs (a non-intelligent pig that serves to clear solids from the pipeline and allow for more effective spreading of anti-corrosion material) will be once every 2 weeks. Inspection pigs (an intelligent pig that monitors pipeline structural characteristics) will be run once every 3 years.

Pipeline Lay Barge (PLBG)
A vessel designed for welding together pipelines and laying them on the seabed. The "*Tofiq Ismailov*" has been selected for use in the Produced Water pipeline project.

Plankton
Tiny plants and animals that drift in the surface waters of seas and lakes. Of great economic and ecological importance as they are a major component of marine food chains.

Platform
One of the various types of offshore structures.

Pollution
The introduction by man, directly or indirectly, of substances or energy to the marine environment resulting in deleterious effects such as harm to living resources; hazards to human health; hindrance of marine activities including fishing; and impairment of the quality for use of seawater and reduction of amenities.

Pollution Prevention Environmental Focus
That portion of the Contractor Implementation Plans and Procedures (CIPP) that details the minimum standards for prevention of air, land, and water pollution during construction of the project.

Polychaete
Any of various annelid worms of the class *Polychaeta*, including mostly marine worms such as the lugworm, and characterized by fleshy-paired appendages tipped with bristles on each body segment.

Polycyclic Aromatic Hydrocarbon (PAH)
Hydrocarbons whose carbon atoms form more than one ring (a single ring version of this hydrocarbon is called a Monocyclic Aromatic Hydrocarbon, or MAH). Classification is generally by the number of rings that exist within a single molecule. Formed from the incomplete combustion of carbon containing fuels, these are known carcinogens. PAHs usually break down in sunlight or microorganism attack over a period of days or weeks. They frequently attach themselves to dust particles, and often accumulate in benthic environments. They have moderate to high acute toxicity to aquatic life and birds, and can harm plantlife. They bioaccumulate; fish and shellfish will contain more PAH than their surrounding environment. (More than 100 compounds exist).

Polychlorinated biphenyls (PCBs)
Typically a clear viscous liquid used for electrical transformer dielectric fluid, lubrication fluid, heat transfer fluid, and as an additive for a number of commercial products. The compound has been known to cause skin irritation, liver damage, changes to the immune system, sterilization, and cancer.

Polymer
Two or more molecules of the same kind, combined to form a compound with different physical properties.

Poverty
Lacking in economic and other resources to a level where deprivation of essential goods and services may take place. In the 2002 household-based survey, this level was set at 175,000 AZM, or US$36 monthly.

Practice
Accepted methods or means of accomplishing stated tasks.

President Heydar Aliyev class tanker
A tanker ship with a greater than 7,800 gross tonnage, nearly 150 m length, 17.3 m beam, and estimated 8.2 m draught fully loaded. Given that this vessel is likely to have the greatest draught among those regularly traveling over the pipeline within Sangachal Bay, it has been estimated that pipeline burial should take place to an 11 m depth.

Procurement and Supply Chain Social Focus
That portion of the Contractor Implementation Plans and Procedures (CIPP) that details the requirements and standards for the purchase and supply of materials, goods, and services during construction of the project.

Produced Water
Water that naturally accompanies produced oil. Also known as produced formation water.

Produced Water Cooler
A fin fan electrically driven cooler unit that will reduce the temperature of the Produced Water from 70°C to 46°C prior to entering into the Dissolved Gas Flotation unit, injecting with chemicals, and pumping offshore. This will reduce the potential for corrosion within the pipeline.

Production
The full-scale extraction of hydrocarbon reserves.

Public Reputation
In the BP Capital Value Select Process, this is the analysis of the project standards set for public reputation, and assessment of the potential for negative publicity and its associated cost.

Pulkovo (1942) Datum
The coordinate grid system with northings and eastings set with an origin at the Pulkovo Observatory in St. Petersburg, Russia. The grid system, established for the Soviet Union, remains in effect today for the post-Soviet republics, including Azerbaijan, which is placed within Gauss-Kruger Projection Zone 8, using the Krassovskiy (1940) Ellipsoid as the earth surface.

Quantity Risk Assessment (QRA)
An analysis of the amount of risk associated with a project based on statistical analysis of risk data and mathematical modeling of assigned risk values. Used to produce the monetary value for useful risk mitigation measures.

Ramsar Convention
The Convention on Wetlands of International Importance, Especially as Waterfowl Habitat was established in Ramsar, Iran, in 1971, and brought into force in 1975. Under this convention, Azerbaijan has designated two areas as wetlands of international importance: one inland, and the other coastal. The coastal area is the complex of Kyzyl-Agach and Lesser Kyzyl-Agach bays, located south of the proposed pipeline route.

Receptors
Any sensitive areas that may be exposed to contamination or other health and environmental threats by a project's construction or operation. Environmental receptors are defined, using the U.S. EPA definition, as any officially designated wildlife sanctuaries, preserves, refuges, or areas. Socio-economic receptors are defined within this project as any facility of socio-economic importance that might be affected by the project's construction or operation.

Recruitment, Employment, and Training Social Focus
That portion of the Contractor Implementation Plans and Procedures (CIPP) that details the minimum standards and requirements for selection, training, and deployment of the work force to be employed in construction of the project.

Recycling/Recovery
The conversion of wastes into usable materials and/or extraction of energy or materials from wastes.

Red List / Red Book
A list comprised of rare or threatened species of plants and animals. The book containing Red List species.

Reduction
The generation of less waste through more efficient practices.

Reed bed treatment
A process used for produced water treatment where contaminated water is left in residence in a bed of reeds; bacteria in the root system removes the chemicals from the water and leaves it in the soil. The water is then allowed to leave the treatment area for release into the surrounding environment or transported for disposal elsewhere. The option is not considered viable for this project as the reed beds themselves must be disposed periodically as hazardous waste, the quality of treatment may not be consistent due to filtration blockages within the reeds over time (requiring added monitoring and maintenance), the beds would require extensive area to treat the processed water from this project, and highly saline treated water could not be used for agricultural purposes.

Reservoir
A porous, fractured or cavitied rock formation with a geological seal forming a trap for producible hydrocarbons.

Reservoir pressure
The pressure at reservoir depth in a shut-in well.

Residual impacts
Impacts that survive mitigation measures, including those incorporated into the project's base case design and those developed in addition to the base design, have been applied.

Residual significance
Significance of a residual impact, expressed as the product of an assigned value of consequences of the impact, and the likelihood it will happen.

Reuse
The use of materials or products that are reusable in their original form.

Ridge Crest Province
A province assigned in the ACG Contract Area Baseline Survey (1996) to the crest of the Absheron Ridge. It is characterized by truncations of individual beds that create terraces along the ridgeline.

Riser
A pipe through which fluids flow upwards, as from a subsea wellhead or gathering pipeline to the deck of a platform.

Risk
The product of the chance that a specified undesired event will occur and the severity of the consequences of the event.

Safety and Risk
In the BP Capital Value Select Process, this is the analysis of the safety levels required to not put people or processes at risk.

Salinity
Total amount of solid material dissolved in aqueous solution. Salinity is measured in parts per thousand.

Salyan Highway
The highway which runs from Baku city center to the Iranian border at Astara. An estimated two thirds of all road traffic passing through the Azerbaijan Republic travels this 4-lane dual carriageway highway, which also acts as an arbitrary dividing line between onshore terrestrial habitat and onshore coastal habitat.

Sander fishing
A type of perch formerly used as a subsistence source along the Caspian Sea coast.

Sangachal Terminal
A facility located on Sangachal Bay where crude oil from the ACG Contract Area is preliminarily processed before entry into the Baku-Tbilisi-Ceyhan (BTC) export pipeline

Sangachal Terminal Expansion Program (STEP)
The ongoing project for the orderly expansion of facilities at Sangachal Terminal to meet the needs of new production facilities.

Schmoo
A malodorous deposit found within produced water pipelines and equipment. It is also known to foul injection well formations and holding tanks. It forms from particles of dust, such as formation sands and iron oxides (rust); once these particles are encapsulated in wet crude, they adhere to other similar particles and surfaces of vessels holding the wet crude. Also called black tar, black scale, and asphaltene. Reduction of 10 ppm maximum oil in water will be used to reduce the amount of Schmoo in the pipeline.

Select
In the BP Capital Value Process, within this second stage options that are not rejected during the first, or Appraise, stage are evaluated based on five criteria: technical availability, capability, and operability; safety and risk; cost; environmental assessment; and Public Reputation. The finalised option that is not rejected by this stage is passed into the third, or Define, stage.

Separator
A process vessel used to separate gases and liquids in a hydrocarbon stream.

Sheet piles
An interlocking set of metal sheets that are used as a temporary retaining wall while the permanent retaining structure is installed.

Significance
The significance of the impact is expressed as the product of the consequence and likelihood of occurrence of the activity.

Skimmers
These collect floating oil at the surface of a produced water reservoir after enough time has been provided to separate the water and oil into layers (the oil layer forms on the surface, and the skimmer collects the floating oil).

Solid-liquid hydrocyclone
A devise that uses centrifugal force to separate sand and other particles out of water prior to filtration in a treatment system. Also called a sand separator.

Spill Response Environmental Focus
That portion of the Contractor Implementation Plans and Procedures (CIPP) that details the required response to land-based spills during construction of the project.

Sulphur Dioxide (SO_2)
Contributes to the formation of acids that are deposited into freshwater and terrestrial ecosystems through wet and dry processes. Toxic to humans and able to cause respiratory health problems.

Surfactant
A detergent or emulsifier.

Taxon
Plural - Taxa. A taxonomic category or group.

Technical Availability, Capability, and Operability
In the BP Capital Value Select Process, this is the analysis of whether an option is technically able to deliver what it is designed to do, the option is field-proven, reliable, and may be operated by the personnel available.

Tehran Convention
The UN Environment Programme (specifically, the Caspian Environment Programme) Framework Convention for the Protection of the Marine Environment of the Caspian Sea was established in Tehran, Iran, in November 2003. The Convention, when it comes into force, will require members, consisting of the 5 littoral states of the Caspian Sea, to: prevent, reduce, and control pollution in the Caspian; protect, preserve, and restore the Caspian environment; use the resources of the Caspian in such a way as to prevent harming the environment; and cooperate in achieving these objectives.

Thermocline
A layer of water within a water column where the temperature changes rapidly with depth.

Total Dissolved Solids (TDS)
That portion of solids in a water sample that is able to pass through a 2-micron filter. Determines the level of purity in the water sample.

Total Hydrocarbon Content (THC)
The concentration of chemicals made up of hydrogen and carbon (including all species) within a sample, as expressed in methane equivalents. THC is determined by measuring emissions using a Flame Ionization Detector (FID) calibrated with propane.

Total Petroleum Hydrocarbons (TPH)
A measure of the concentration of hydrocarbons present that originated in crude oil. It is often not practical to measure each chemical in a crude oil contaminated sample separately, but it is possible to measure TPH as a single contaminant. (The term is a misnomer in that few procedures used for determining this quantity are able to collect all fractions of petroleum hydrocarbons in a sample.)

Total Suspended Solids (TSS)
A measure of all particles (sediment, living materials, dead organisms) that are unsettled in a water column. Similar to a measurement for turbidity, this value gives a weight to the amount of material rendering the water column opaque.

Toxicity
Inherent potential or capacity of a test substance to cause adverse effects on living organisms.

Toxicity test
Procedure that measures the toxicity produced by exposure to a series of concentrations of a test substance. In an aquatic toxicity test, the effect is usually measured as either the proportion of organisms affected or the degree of effect shown by the organism.

Transportation Management
That portion of the Contractor Implementation Plans and Procedures (CIPP) that details the minimum standards for transportation and traffic management with emphasis on construction-related vehicles used during construction of the project.

Treatment and Reuse
A disposal option for produced water where contaminated water is treated and reused for agricultural purposes or within the nearby Garadag Cement Plant. These options are not considered viable as the produced water is highly saline and desalination would be required for most crops and cement processing, treatment would have to be reliable enough to satisfy both real and perceived concerns about crops collecting contaminants left in the treated water (and eventually transferring them to consumers), farmers and the cement plant would have to find a replacement water source once the project is over, the rate of water use at the cement plant would be dwarfed by the amount of water produced by the project, and the cement plant may soon be converting to a dry manufacturing operation (removing the need for water altogether).

Trenching
In reference to this project, the excavation of a trench of 1 m depth and 3 m width (at a 1:1 side slope) that will be used to place the pipeline within prior to its burial by natural longshore drift of sediment. This will be performed along the pipeline route to the water depth contour of 11 m.

Ultraviolet (UV) treatment
A tertiary water treatment used to kill off bacteria within water. It also is used to create ozone in water that may be subsequently used for ozone treatment.

Vessel Internal Electrostatic Coalescer (VIEC)
An electrostatic coalescer that is installed into the upstream end of already existing separation equipment on an oil platform.

Vienna Convention
The UN Environment Programme Convention for the Protection of the Ozone Layer was established in Vienna, Austria, in 1985. The Convention requires Azerbaijan to protect human health and environment from the adverse effects of human activities that may modify the ozone layer. This was modified by the Montreal Protocol to this document in 1987 (see Montreal Protocol).

Volatile Corrosion Inhibitor (VCI)
A chemical compound that vaporizes at room temperature then collects on metallic surfaces, forming a very thin anti-corrosion film.

Volatile Organic Compounds (VOCs)
Non-methane VOCs assist in the formation of ‘photochemical oxidants,’ including tropospheric ozone. Many are known or suspected carcinogens.

Waste Management
That portion of the Contractor Implementation Plans and Procedures (CIPP) that details the standards used whereby waste generation is minimalised, and that generated waste is handled, recycled, and disposed in accordance with project procedures.

Water Convention
The UN Economic Commission for Europe Convention on the Protection and Use of Transboundary Watercourses and International Lakes was established in Ramsar, Iran, in 1992, and brought into force in 1996. Under this convention, Azerbaijan is obligated to inform the Azerbaijan public free of charge, and those of the littoral states of Kazakhstan and the Russian Federation upon reasonable payment, of the condition of water in transboundary watercourses (specifically, the Caspian Sea), and measures that are taken to control, reduce, and mitigate water pollution in these treaty-effected waters.

Water injection
The injection of water into a reservoir for the purpose of increasing fluid pressure to the benefit of production of attached wells.

Water separation
The removal of water from the production flow of oil or gas.

Wax
Paraffin wax is a constituent of crude oil that often requires special treatment to allow the oil to flow freely at surface conditions.

Wellhead
A top of casing and the attached control and flow valves. The wellhead is where the control valves, testing equipment and take-off piping are located.

Wentworth Scale
A geometric grade scale for soil particles ranging from clay fraction to boulder-size material. The different material classifications are related to one another by a constant ratio of 1/2 (very course sand is half the size of very fine gravel, etc.). Devised by Udden in 1898 and revised by Wentworth in 1922, it was commonly used in the United States until the advent of the Unified Soil Classification System (USCS).

Wet air oxidation (WAO)
Also known as catalytic wet air oxidation, this is a water treatment process involving high temperature (125-320°C) and pressure (0.5-20 MPa) that converts combustible carbonaceous materials into water and carbon dioxide. Crude oil within the water continuously feeds the combustion, reducing the amount of oil in water (OIW) significantly.

Wet crude
Crude oil that has a significant amount of water within it.

Zinc
As a pollutant, zinc originates from natural and anthropogenic sources (burning wastes, steel production, and mining). This metal attaches itself to particulate matter, which later settles in the soil, often through rain. Zinc doesn't bioaccumulate in plants, but can be toxic to flora if in excess within the soil. Water with higher pH and lower hardness will increase the toxicity of zinc for fauna; it has been known to have a high toxicity, both acute and long-term, for aquatic life, within which the metal will accumulate. (CAS 7440-66-6)

Zooplankton
Name derived from the Greek word meaning "wanderer" or "drifter". While some forms of plankton are capable of independent movement, their position is primarily determined by currents in the body of water they inhabit. By definition, organisms classified as "plankton" are unable to resist ocean currents. Zooplankton are a form of plankton that feed on other plankton. Some of the eggs and larvae of larger animals, such as fish, crustaceans, and annelids, are included here.

UNITS AND ABBREVIATIONS

Units

amu	atomic mass unit
barg	1 bar (gauge) = 14.5 psi
bbl	barrel (6.2898 barrels = 1 m^3)
bcm	billion cubic metres
bpd	barrels per day
bwpd	barrels of water per day
bbl/d	barrels per day
cm	centimetre
ºC	degrees centigrade
dB	decibel
dB(A)	A weighted unit of sound intensity weighted in favour of frequencies audible to the human ear.
eV	electron volt
ft/s	feet per second (English unit speed, SI unit is m/s)
g	gramme
ha	hectare
HP	horsepower (English unit power, SI unit is watt)
hr	hour
h	hour
K	one thousand (eg. 500K = 500,000)
keV	kilo-electron volts
kg	kilogrammes
km	kilometre
km^2	square kilometre
kva	kilovoltampere
kW	kilowatts
l	litres
lb	pounds (imperial)
m	metres
m/s	metre per second
m^2	square metres
m^3	cubic metres
Mbbl	thousand barrels
Mbpd	thousand barrels per day
Mbwpd	thousand barrels of water per day
mbgl	meters below ground level
µm	micrometers or microns
µg	micrograms
mg	milligrams
ml	millilitres
mm	millimetres
MMBtu	Million British thermal units
MMscf	Million standard cubic feet
MMscfd	Million standard cubic feet per day
MMstb	Million standard barrels
MT	metric tonnes
MTPY	metric tonnes per year
MW	Megawatt
ppm	Parts per million
ppmv	Parts per million by volume
psu	Practical Salinity Units (equivalent to grams of dissolved solids per kilogramme of seawater)
s	Second
scf	Standard cubic feet
Sm^3	Standard cubic metres
te	tonnes
TPY	(short) tons per year
yr	Year
“	Inches
%	Percent
%w/w	Percentage of weight for selected material from total sample weight
‰	Parts per thousand
%ile	Percentile
$	United States Dollars
-	Minus
+	Plus
@	At
/	Per
~	Approximately
-ve	Negative
>	Greater than
<	Less than

Abbreviations

ACG	Azeri, Chirag, and Gunashli (Contract Area No. 1)
ADB	Asian Development Bank
ADO	Asian Development Outlook (branch of the ADB)
ADRA	Adventists Development and Relief Agency International
AETC	Azerbaijan Environment and Technology Centre
AFS	Anti-Fouling Systems Convention (The International Convention of Harmful Anti-Fouling Systems on Ships, signed October 2001)
AIOC	Azerbaijan International Operating Company
ALARP	As low as reasonably practicable
AmC	Akvamiljø Caspian
API	American Petroleum Institute
ARB	The Red Book of Azerbaijan SSR (Soviet-era list of endangered birds in Azerbaijan, soon to be updated)
ASA	Applied Science Associates
ASSC	Azerbaijan State Statistical Committee
AYM	Azerbaijan New (*Yeni*) Manat
AzBU	Azerbaijan Business Unit (BP)
AZM	Azerbaijan (Old) Manat
AzSPU	Azerbaijan Strategic Performance Unit (BP)
BACT	Best available control technology
BFG	Fuel gas blanketing
BOD	Biochemical oxygen demand
BP	BP Exploration (Caspian Sea) Limited, acting as operator of AIOC
BPEO	Best Practicable Environmental Option
BTC	Baku-Tbilisi-Ceyhan
BTX	Benzene, toluene, and xylene
BWM	Ballast Water Management (from the International Convention for the Control and Management of Ships' Ballast Water and Sediment)
CA	Central Azeri (platform complex)
CAPEX	Capital expenditure
CAS	Chemicals Abstracts Service (division of the American Chemical Society responsible for assigning identification numbers to chemicals)
CBD	Convention on Biological Diversity
CCEMA	Caspian Complex Ecological Monitoring Administration
CCIP	Contractor Implementation Plans and Procedures
CCP	Contractor Control Plans
Cd	Cadmium
CDC	Center for Disease Control and Prevention
CDC	Climate Diagnostic Center
CEAM	Center for Exposure Assessment Modelling (part of the US EPA)
CEL	Caspian Environmental Laboratory
CEP	Caspian Environment Programme (an UNEP project)
CH_4	Methane
CHARM	Chemical Hazard and Risk Management (method of risk assessment used on North Sea oil platforms)
CIP	Community Investment Programme
CIPP	Contractor Implementation Plans and Procedures
CITES	Convention on International Trade of Endangered Species of Wild Flora and Fauna (enacted 1973, with amendments in 1979 and 1983)
CJSS	Closed Joint Stock Society (or Company)
CLO	Community Liaison Officer
CMC	Contracts Management Committee
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2 Eq	Carbon dioxide equivalent
COD	Chemical oxygen demand
COE	Council of Europe

COP	Community of Practice
CORINAIR	Core Inventory of Air Emissions (emissions standards for the European Union)
CRP	Community Relations Programme
CSC	Caspian Shipping Company (tanker company operating out of AzPetrol Terminal)
CVP	Capital Value Process (BP)
CWAA	Central Waste Accumulation Area
CWP	Compression, Water-injection, and Power platform (Central Azeri)
DGF	Dissolved Gas Flotation
DHV	DHV Group (formerly Dwars, Heederik, en Verhey)
DSV	Diving support vessel
DWI	Deep water injection
E&P Forum	The Oil Industry International Exploration and Production Forum (International industrial representative body to the UN since 1974)
EA	East Azeri (platform complex)
EBRD	European Bank for Reconstruction and Development
EC	European Community
EC_{50}	Median Effective Concentration (dosage where an expected effect takes place 50 percent of the time)
ECA	Export Credit Agency
ECOTOX	Ecological-Toxicological
EIA	Environmental Impact Assessment
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe
EMS	Environmental Management System
ENVIID	Environmental Issues Identification
EOP	Early Oil Project
EOR	Enhanced oil recovery
EPA	Environmental Protection Agency (US)
EPA-16	Group of 16 PAHs targeted by the US EPA
ERA	Environmental Risk Assessment
ERT	Environment and Resource Technology Ltd.
ES	Environmental Statement
ESIA	Environmental and Socio-Economic Impact Assessment
ESMS	Environmental and Social Management System
EUPEC	EUPEC PipeCoatings Co. (seaside industrial area)
FAP	Field abandonment plan
FFD	Full Field Development
FSD	Fixed-speed drive (a type of pump motor)
FSU	Former Soviet Union
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GHSER	Getting HSE Right (BP safety program)
GT	Gas turbine
GWP	Global warming potential
HAZID	Hazard Identification
HFC	Hydrofluorocarbon
Hg	Mercury
HIPPS	High Integrity Pressure Pump System
HOCNF	Harmonised Offshore Chemical Notification Format (EU)
HSE	Health, Safety, and Environment
HSSE	Health, Safety, Security, and Environment
HUC	Hook-up and Commissioning
HVOHL	High Voltage Overhead Lines
IADC	International Association of Drilling Contractors
IAGC	International Association of Geophysical Contractors
IC	Internal combustion
ICSS	Integrated Control and Safety System
IDP	Internally Displaced Person
IEMP	Integrated Environmental Monitoring Programme

IFC	International Finance Corporation (part of World Bank Group)
IGF	Induced Gas Flotation
IMO	International Maritime Organisation
ISO	International Organisation for Standardisation
IUCN	World Conservation Union (formerly “International Union for the Conservation of Nature”)
JSC	Joint Stock Company
KAOC	Karasu Operating Company
LC_{50}	Median Lethal Concentration (dosage where death occurs 50 percent of the time)
LC72	London Dumping Convention of 1972
LP	Low Pressure
LPS	Low Pressure Separator
MARPOL (73/78)	International Convention for the Prevention of Pollution from Ships of 1973, as modified by the Protocol of 1978
MBR	Membrane bioreactor
MCCI	McDermott Caspian Contractors, Inc.
MEG	Mono-ethylene glycol
MENR	Ministry of Ecology and Natural Resources (Azerbaijan)
MLLW	Mean lower low water (defines local “sea level”)
MOL	Main Oil Line
MOLPU	Main Oil Line Production Unit (Division of SOCAR)
MP	Medium pressure
MPC	Maximum Permissible Concentration
MPN	Most probable number
MPPE	Macro-Porous Polymer Extract
MSD	Marine sanitation device
MSDS	Material Safety Data Sheet
NDT	Non-destructive testing
NGO	Non-Governmental Organisation
NMVOC	Non-methane volatile organic compound
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NOEC	No Observable Effect Concentration
NO_x	Nitrogen oxides
NPD	Naphthalenes, phenanthrenes, and dibenzothiophenes (low molecular weight PAHs)
O&GPD	Oil and Gas Production Department
OCNS	Offshore Chemical Notification Scheme (UK)
ODS	Ozone depleting substance
OECD	Organisation for Economic Cooperation and Development
OIS	Ondeo Industrial Solutions
OIW	Oil in water
OP	Operational Policy
OP/BP	Operational Policy/Bank Procedure
OSCE	Organisation of Security and Cooperation in Europe
OSCP	Oil Spill Contingency Plan
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic (the 1992 merging of the 1972 Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Airplanes and the 1974 Paris Convention for the Prevention of Marine Pollution from Land-based Sources)
OSRP	Oil Spill Response Plan
PAH	Polycyclic aromatic hydrocarbons
PCDP	Public Consultation and Disclosure Plan
PDQ	Production, Drilling, and Quarters platform
PFC	Perfluorocarbon
pH	Acidity / alkalinity (from “potential of Hydrogen”)
PIG	Pipeline Inspection Gauge
PLBG	Pipeline lay barge
PM	Particulate matter
PNEC	Predicted no-effect concentration
POB	People on board (sea-going vessels)

PPAH	Pollution Prevention and Abatement Handbook (World Bank Group document)
PRSP	Poverty Reduction Strategy Paper
PSA	Production Sharing Agreement
PT	Particulate
PU	Performance Unit (BP)
PWD	Produced water disposal
QA	Quality assurance
QRA	Quantitative Risk Analysis
R&MG	Research and Monitoring Group
RB211	Rolls Royce power plant (one of which provides power to Sangachal Terminal)
RCM	Recording current meter
ROW	Right of way
RPSA	Rehabilitation Production Sharing Agreement
RSK	RSK Environment Ltd.
SD	Shah Deniz (Contract Area No. 3)
SDGE	Shah Deniz Gas Export
SEA	Strategic Environmental Assessment
SF_6	Sulphur hexafluoride
SIMOPS	Simultaneous operations
SO_2	Sulphur dioxide
SOCAR	State Oil Company of the Azerbaijan Republic
SO_x	Sulphur oxides
SPS	ShelProjectStroi (fabrication yard, 18 km west southwest of Baku city centre)
STEP	Sangachal Terminal Expansion Programme
SWI	Shallow water injection
TB	Tuberculosis
TDS	Total dissolved solids
THC	Total hydrocarbons
THPS	Tetrakis (hydroxymethyl) phosphonium sulphate
TKAZ	TKAZ-Baku (onshore pipeline construction contractor)
TN	Technical Note
TOP	Top of pipe
TPH	Total petroleum hydrocarbons
TPS	Tilted plate separator
TROS	TR Oil Services Ltd., a Clariant Group Company (manufacturer of corrosion inhibitors, biocides, and related products)
TSS	Total suspended solids
UCM	Unresolved complex mixtures (unidentified pollutants within a laboratory sample)
UK	United Kingdom
UKOOA	United Kingdom Offshore Operators Association Ltd.
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Fund for Population Activities
UNHCR	United Nations High Commission for Refugees
UNICEF	United Nations Children’s Fund (prior to 1953, United Nations International Children’s Emergency Fund)
UNIDO	United Nations Industrial Development Organisation
URS	URS Corporation Ltd.
US EPA	United States Environmental Protection Agency
USA	United States of America
USAID	United States Agency for International Development
UV	Ultraviolet
VCI	Volatile corrosion inhibitor
VFD	Variable frequency drive (a type of pump motor)
VIEC	Vessel Internal Electrostatic Coalescer
VOC	Volatile organic compound

VP	Visual Plumes (a US EPA computer modelling system)
VpCI 609	Amine carboxylate, a corrosion inhibitor
WA	West Azeri (platform complex)
WAF	Water Accommodated Fraction (fraction of hydrocarbons that may be observed in suspension and analysed as water soluble fraction after allowing to settle for 24 hours prior to water toxicity testing)
WB	World Bank
WBG	World Bank Group
WHO	World Health Organisation
WI	Water injection
WIO	Water in oil
WST	Weather station

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ACG FFD Produced Water Disposal Project Environmental & Socio-Economic Impact Assessment

Non Technical Executive Summary

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ES1 Introduction

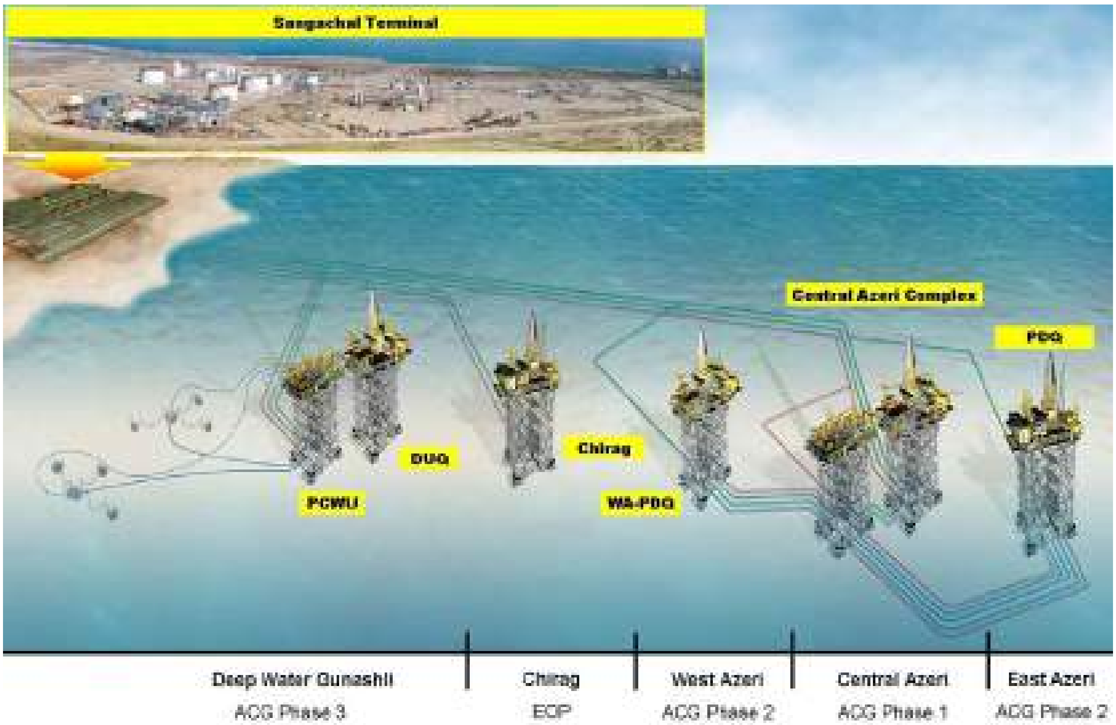
This Environmental and Socio-Economic Statement (ES) has been prepared following a detailed Environmental and Socio-economic Impact Assessment (ESIA) of the proposed Azeri, Chirag, Gunashli Full Field Development Produced Water Disposal (ACG FFD PWD) Project. This ES report has been prepared for submission to the Azerbaijan Ministry of Ecology and Natural Resources (MENR) to gain approval for the project and as such, has been conducted in accordance with the legal requirements and policies of Azerbaijan and in line with International Finance Institutions (IFIs) requirements established during the phased development of ACG. The ESIA process has also been undertaken in the context of Azerbaijan International Operating Company's Health, Safety and Environment (HSE) Policy.

This Executive Summary provides a non-technical abstract of the proposed ACG FFD PWD Project, project alternatives, key findings of the environmental and socio-economic impact assessment and conclusions of the ESIA process.

ES1.1 Project background and objective

The ACG Contract Area has estimated oil reserves in excess of 5.4 billion barrels of oil. It lies in the Azerbaijan sector of the Caspian Sea, approximately 120 km south east of Baku and covers an area of 432 square kilometres in water depths ranging from 100 m to 400 m. Primary oil bearing zones occur at depths of between 2,500 m and 3,000 m below the seabed. The ACG Contract Area was developed in a phased approach and together with the Chirag Early Oil Project (EOP) represents the ACG FFD Project (Figure ES1).

Figure ES1 The ACG FFD Project



Separate ESIAs were conducted for each of the ACG Phases, as follows:

- Phase 1 Development: Development of the Central Azeri (CA) reservoir with a Production, Drilling and Quarters (PDQ) Platform bridge-linked to a Compression and Water injection Platform (CWP), a 30" sub-sea oil pipeline and a 28" gas line to shore. The project also linked with the Chirag field.

- Phase 2 Development: Development of West Azeri (WA) and East Azeri (EA) with two fixed production and drilling facilities, a 30" sub-sea oil pipeline and in-field sub-sea pipelines.
- Phase 3 Development: The last phase of development of the ACG FFD Project, developing the hydrocarbon reserves in the Deep Water Gunashli (DWG) sector of the ACG Contract Area by two platforms; a Drilling, Utilities and Quarters (DUQ) platform bridge linked to a Production, Compression Water Injection and Utilities (PCWU) platform with hydrocarbon export by tie-ins to the earlier ACG Phases export pipeline infrastructure. In additon, the project requires the installation of a subsea water injection development (consisting of two subsea manifolds and associated facilties tied back to the offshore platform) for reservoir pressure maintenance.

The respective ESIA reports for ACG Phases 1, 2 and 3 are available online at:
http://www.bp.com/subsection.do?categoryId=9006656&contentId=7013370

The oil produced from the ACG Contract Area contains water which requires removal. Offshore facilities can remove 95% produced water from oil for reinjection offshore therefore 5% produced water is sent onshore co-mingled with oil. This Produced Water, separated out of the product at the platform, is reinjected offshore and the percent remaining in the oil is received onshore at Sangachal Terminal.

At Sangachal Terminal the Produced Water is further separated in order to achieve the water in oil (WIO) specification required for delivery to the Baku-Tbilisi-Ceyhan (BTC) export pipeline. This Produced Water requires disposal. The ACG FFD PWD project will deliver this solution over the long term.

ES1.1.1 Project policy and administrative framework

The ACG FFD PWD Project, as a part of the overall ACG FFD project, is subject to the terms and conditions of the ACG Production Sharing Agreement (PSA), BP Health Safety Security and Environment (HSSE) Policy and the ACG FFD Health, Safety, and Environment (HSE) Design Standards. The project will also be undertaken in accordance with applicable International Funding Institutions (IFIs) environmental and social policies and guidelines.

In Azerbaijan, major private and public developments require the preparation of an ESIA. The objective of the ESIA process is to provide a means whereby adverse impacts can be identified and either avoided or minimised to acceptable levels. During previous Phases of the ACG development and as reiterated in the ACG FFD Phase 3 ESIA, AIOC/BP committed to conducting an ESIA for the long-term disposal solution for produced water from the ACG FFD project. This commitment formed part of a conditional approval for the Phased development of the ACG FFD project.

The main environmental regulatory body is the MENR, which was formed from the merger of four state organisations comprising the State Committee for Ecology, State Committee for Hydrometeorology, State Forestry Committee, and the State Committee for Geology. The MENR apply the fundamental principle of the using the Law of the Azerbaijan Republic on Environmental Protection, August 1999, and the Handbook for the EIA Process published in 1996 with the assistance of the United Nations Development Programme (UNDP).

The concluding step of the ESIA process is the public disclosure of a draft Environmental Statement (ES) for which comment is sought from the public and regulatory authorities. After the disclosure period of 60 days, the draft ES is revised and a final ES is submitted to the MENR, formally requesting their approval for the project.

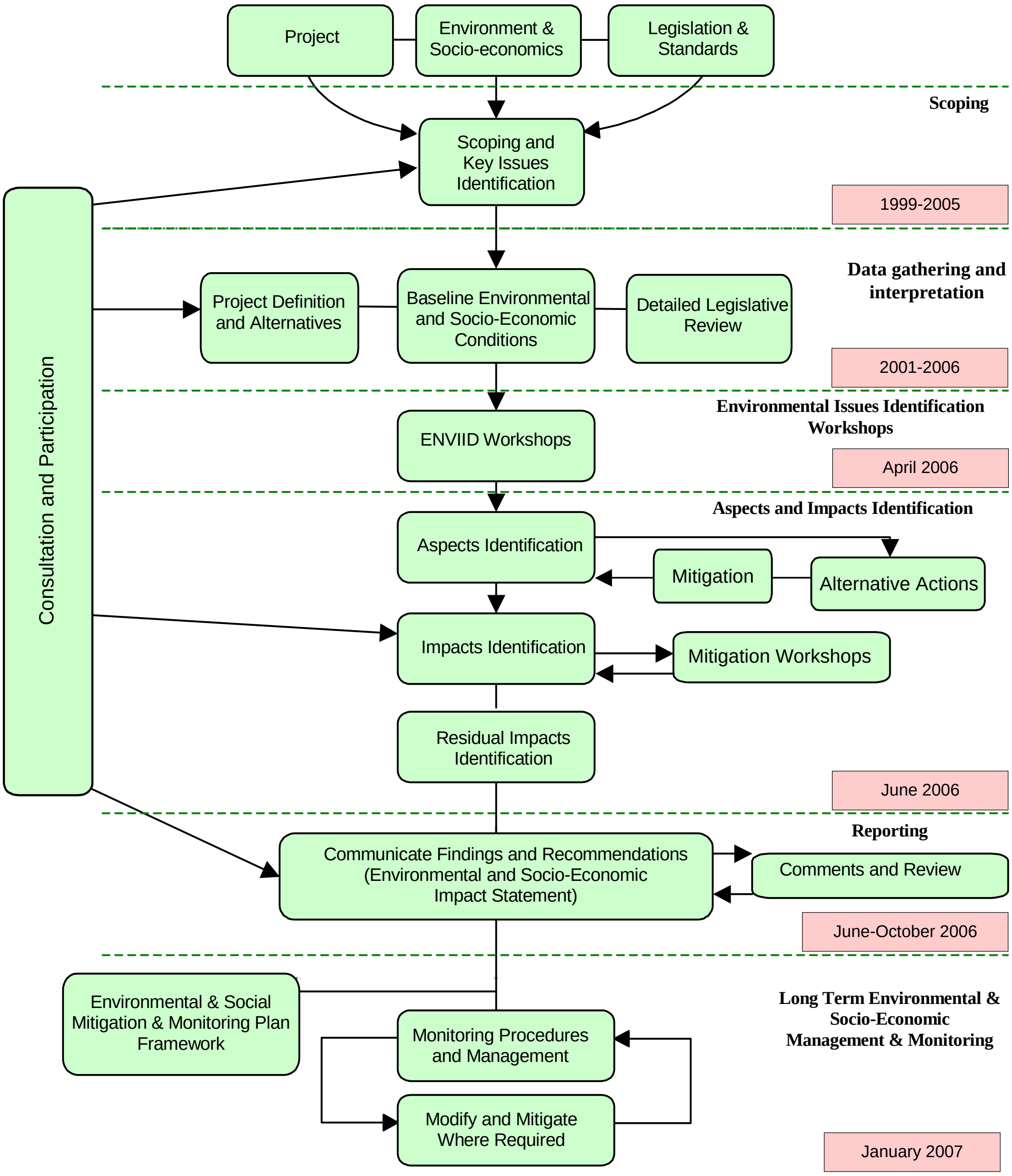
ES2 ESIA process

The ESIA process incorporates a number of steps. A key element is the interaction with the engineering design team and stakeholders with the objective of removing, or at a minimum reducing, as many of the potentially significant impacts as practicable, while enhancing positive benefits of the project wherever possible. This has been achieved as follows:

- Definition of the proposed project activities and the natural, regulatory (i.e., legal), and socio-economic environments in which these activities would occur. This was achieved through Scoping, which is identifying activities that have a potential to interact with the environment. Scoping was conducted as the first stage in the ESIA process so that a focus on the priority issues (i.e., those that have the greatest potential to affect the natural and/or socio-economic conditions) was established for the rest of the ESIA process.
- Assessing a wide range of design options against numerous criteria including environmental and social impact, safety, technical feasibility, cost, ability to meet project needs and stakeholder concerns.
- Gathering and review of up to date environmental and socio-economic data relevant to the proposed development area (concentrating on the area in the vicinity of the existing Sangachal Terminal, onshore fabrication yards, and the offshore environment in the vicinity of the proposed pipeline route).
- Environmental and Socio-economic Issues Identification (ENVIID) workshops held between the ACG FFD PWD project team and the independent ESIA consultants to identify the project environmental and socio-economic aspects associated with all proposed activities from construction through installation and operation, including planned routine activities (activities occurring during normal operating conditions), planned but non-routine activities (activities that are planned to occur outwith desired normal operations but within operational design parameters) and unplanned (accidental) events. Proposed project activities and potential events were considered in terms of their potential to:
  - Interact with the natural environment including its physical and biological elements;
  - Breach the PSA, relevant international, national, industry and operator and partner standards and operator/partner policy; and
  - Interact with the existing socio-economic environment.
- Mitigation workshops held in London and Baku with the relevant project design teams following the impact assessment of the proposed ACG FFD PWD Project. These workshops were designed to:
  - Confirm the level and accuracy of project design defined in the Project Description and used for impact assessment;
  - Discuss and confirm mitigation measures incorporated into the project to ensure that the impact assessment was informed and accurate;
  - Communicate the results of the impact assessment and identify any areas where additional mitigation may be required; and
  - Facilitate the development of mitigation and monitoring to be committed to in the ESIA, in order to reduce significant or residual impacts.
- Inviting comment on the project through the public consultation and disclosure programme. The objectives of this process were to inform stakeholders about the project, allow stakeholders to raise key issues and concerns associated with the project, source accurate information, identify potential impacts and offer the opportunity for alternatives or objections to be raised by the potentially affected parties, non-governmental organisations, members of the public and other stakeholders. Consultation was conducted at stages throughout the ESIA from the assessment of project options to the review and request of comments on the draft ES report on the selected option prior to submission of the final ES requesting approval from the MENR.

The ESIA process for the ACG FFD PWD Project was built on a systematic approach to the evaluation of the project in the context of the natural, regulatory, and socio-economic environments of the area in which the development is proposed, as developed and adhered to during Phases 1, 2, and 3. This process is summarised in Figure ES2 showing dates of activity for the key stages of the ESIA.

Figure ES2 The ACG FFD PWD Project ESIA process



Note: The Environmental and Social Mitigation and Monitoring Plan is also commonly referred to as the Environmental and Social Action Plan.

ES3 Project Description

ES3.1 Option assessment

A number of alternative engineering design options were considered for the ACG FFD PWD Project, including the "no development option". This option is to do nothing and aim to manage Produced Water for the long term using the current facilities. The no development option was rejected as a viable solution for the ACG FFD PWD project as Produced Water volumes over the long-term will exceed the disposal capacity of the short-term disposal option and the storage capacity of Sangachal Terminal. The result is a waste stream with no disposal option which would mean that oil production would have to be reduced and eventually stopped to reduce or stop Produced Water production.

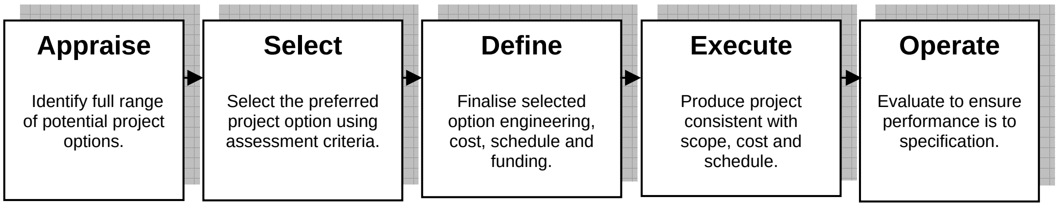
Studies to consider various Produced Water Disposal (PWD) options began in 1999 and involved numerous BP and independent technical experts. These studies resulted in a number of potential project solutions being developed and considered. These were evaluated using a number of screening criteria as follows:

- **Technical** – this considers technical availability, capability, and operability of the option. The option needs to be technically capable of delivering the specification required, proven in the field, and reliable to ensure minimum downtime, and the appropriate skills to operate must be available.
- **Safety** – the option needs to achieve appropriate safety levels that will not put people or process plant at risk.
- **Environmental and socio-economic** – the option needs to meet the environmental and socio-economic standards that the project has set. Impacts should be considered as direct impacts as well as the potential for perceived impacts that may introduce risks to reputation.
- **Reputation –** the option needs to meet the project standards for public reputation. The option is assessed for the potential to result in negative publicity and associated cost.
- **Cost –** the capital expenditure (CAPEX) of each project concept calculated for comparison. This includes CAPEX estimates for the cost of manufacture, construction, and installation.

BP's Capital Value Process (CVP) was used to check key project development decisions and provide assurance that the project definition is sound. The CVP is synergistic with standard engineering design phases and consists of a number of stages (Figure ES3) with 'gates' between stages that all project development decisions must pass through.

Project concept design options are considered in terms of their feasibility during the Appraise Stage. Recommended design options are then passed into the Select Stage during which the preferred option for development is selected. At the time of public disclosure of the ESIA (September, 2006), the ACG FFD PWD Project was in the Define stage of the CVP.

Figure ES3 BP Capital Value Process

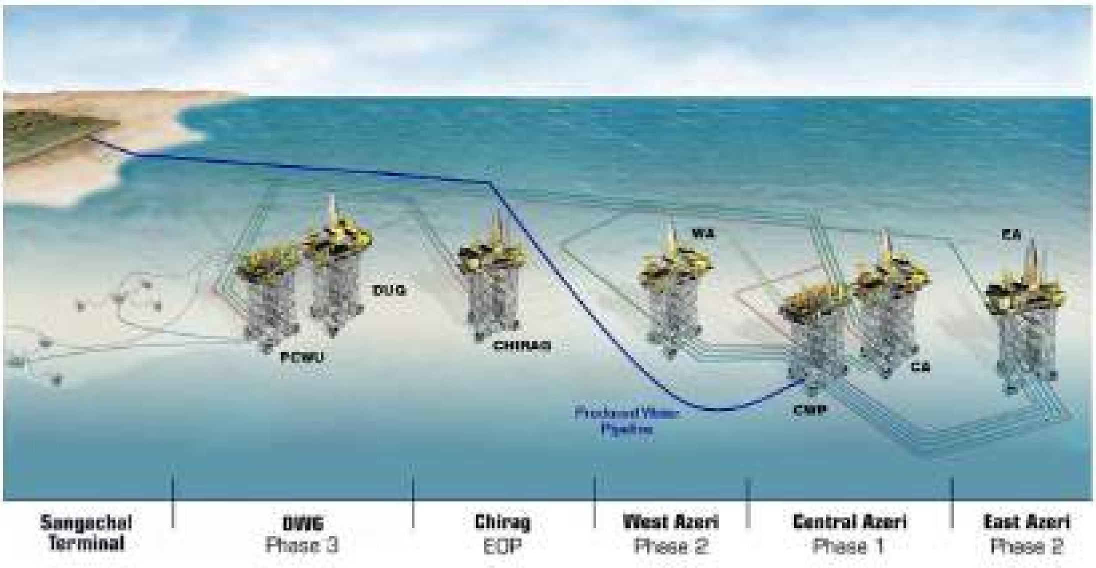


ES3.2 Selected project option

From the onset the ACG FFD PWD Project has had a very strong driver to deliver the best Environmental solution possible, which has influenced the ultimate choice of disposal route. The ACG project carried out an extensive review of 11 disposal options over a number of years which also included pilot trials. Options assessed included biological treatment, treatment via a process plant, onshore reinjection, additional offshore removal, evaporation ponds and irrigation. All options were assessed to identify the Best Practicable Environmental Option (BPEO).

The selected project option involves the installation of a dedicated 14-inch diameter, 189 km long Produced Water pipeline from Sangachal Terminal to the ACG Phase 1 location for tie in at the Compression and Water Injection Platform (CWP) at Central Azeri (Figure ES4). The pipeline will transport Produced Water from Sangachal Terminal to CWP where it will be reinjected into the ACG reservoir along with the Produced Water that is separated offshore.

Figure ES4 Proposed Produced Water Pipeline in relation to ACG FFD facilities



The Produced Water coming ashore through the oil pipeline is currently mixed with crude oil, i.e., “wet crude,” and is predicted to be 5 percent of the total fluids within the incoming pipeline. At Sangachal Terminal the wet crude is heated and stabilised in Medium Pressure (MP) and Low Pressure (LP) Separators. The heated wet crude is dehydrated by electrostatic coalescers to reduce water content in the oil to roughly 0.3-0.5 percent Water In Oil (WIO), the required specification of the BTC export pipeline.

The Produced Water that is separated from the oil is pumped to PW storage tanks. The ACG FFD PWD Project will require additional Produced Water storage at the Terminal. There will also be the requirement for additional treatment and export facilities. The following new facilities will be required at Sangachal Terminal:

- A 130,000 bbl Produced Water storage tank
- De-oiling package
- Filter package to remove sand and solids
- Transfer pump package
- Cooler package

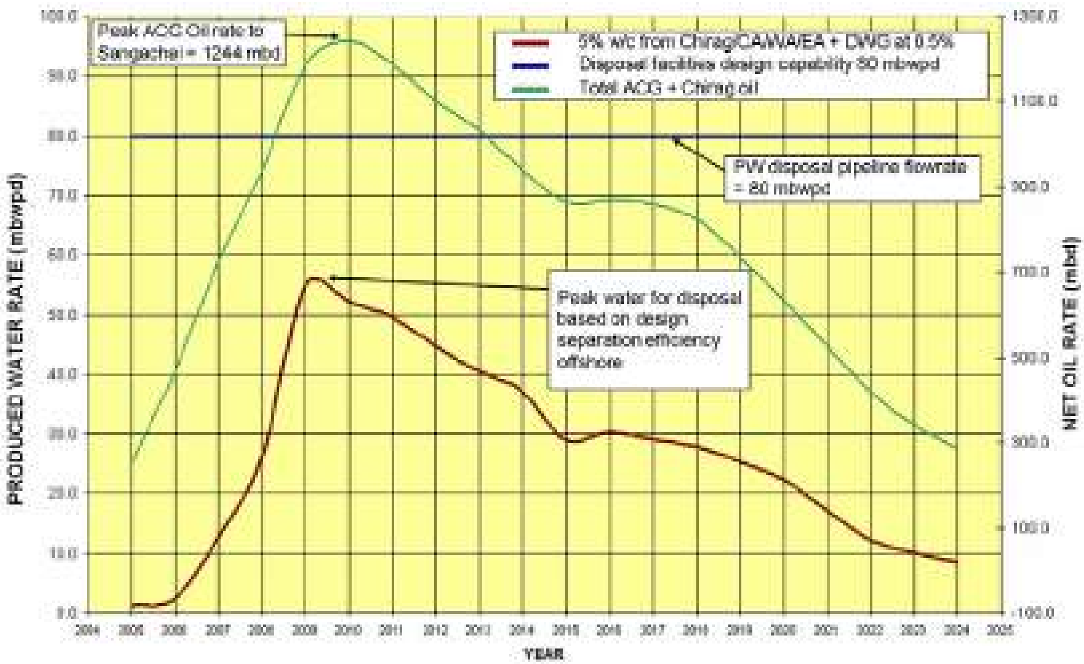
- Export pump package
- Chemical injection package
- Pig launcher

These facilities provide important further treatment to remove oil and solids from the Produced Water. This reduces the corrosion potential of the Produced Water in the pipeline and prevents reinjection problems offshore. The Produced Water will be pumped from the storage tank to the de-oiling and filter packages before being cooled and chemically inhibited to further reduce the chance of corrosion. Following these processes, the Produced Water then will be ready to be pumped into the proposed ACG FFD PWD pipeline. The pig launcher enables the pipeline to be regularly maintained, further reducing the possibility of corrosion. Clean-up pigs will be run every 2 weeks, and inspection/intelligent pigs to detect any corrosion will be run as required (initially believed to be every 2-3 years). Pigging will take place from onshore to offshore and any pigging waste arriving at CWP will be collected into sealed containers and shipped to shore for hazardous waste disposal.

The amount of Produced Water that Sangachal Terminal is predicted to receive between 2005 and 2025 is shown in Figure ES5. This figure identifies the design profile for the predicted Produced Water production over the life of field. The figure also shows the oil production rate over the life of field, with the Produced Water peak rate occurring at the same time as the oil peak production in 2009, followed by a decline in Produced Water volumes. To ensure there will be sufficient capacity in the pipeline for any changes to the Produced Water profile, the design specification for the pipeline was sized for 80,000 bbl/d (horizontal line on Figure ES5), which will allow for additional PWD capacity.

The proposed ACG FFD PWD Project is scheduled to be operational in 2008. Produced Water disposal prior to 2008 is not within the scope of this ESIA but will be disposed of by a means that is in agreement with the MENR environmental, health and safety requirements.

Figure ES5 Produced Water long-term profile



ES3.3 ACG FFD PWD Project procurement and transportation

ACG FFD PWD facilities will be provided by a combination of in-country and out-of-country procurement, fabrication and construction. Transportation of out-of country components to Azerbaijan will be by a combination of vessel, rail and road using approved routes established for the ACG Phase 1, 2 and 3 Projects. The main proven routes are the Russian Federation canal system and road and rail networks through Turkey/Georgia and Iran depending on the point of origin of each component.

In summary, the fabrication and construction of the project facilities and components will be as follows;

- Pipeline sections will be procured out-of country and transported to the EUPEC fabrication yard where they will be coated with concrete and inspected.
- Terminal facilities such as vessels, pipework, and treatment equipment will be procured out-of country and transported directly to the Sangachal Terminal laydown area for inspection and fabrication onsite.
- Terminal construction materials will be sourced in-country wherever possible as required.

ES3.4 Construction of Terminal facilities

The area within Sangachal Terminal for the location of the ACG FFD PWD facilities was designated during terminal expansion as part of ACG Phase 1. As a result, all construction activities required at Sangachal Terminal for the ACG FFD PWD project will be within the established boundary and existing construction areas at the Terminal.

At the time of the ESIA, MENR approval had been granted to commence civil works which includes connection to underground services such as drains and firewater systems and earthworks to establish foundations at the terminal in preparation for the arrival of facilities. Once the civil works are complete, the Produced Water tank, treatment, pumps and corrosion management facilities will be constructed and connected by new pipework. Construction methods are based on those already established for previous phases of Sangachal Terminal, with due care and attention to avoid safety and environmental incidents.

Operation at Sangachal Terminal will carry on throughout the construction phase of the ACG FFD PWD project and it may be necessary to carry out ‘hot work’ at times adjacent to producing plant. The area under construction will be fenced off and permits will be required for access to ensure the safety of personnel entering the area.

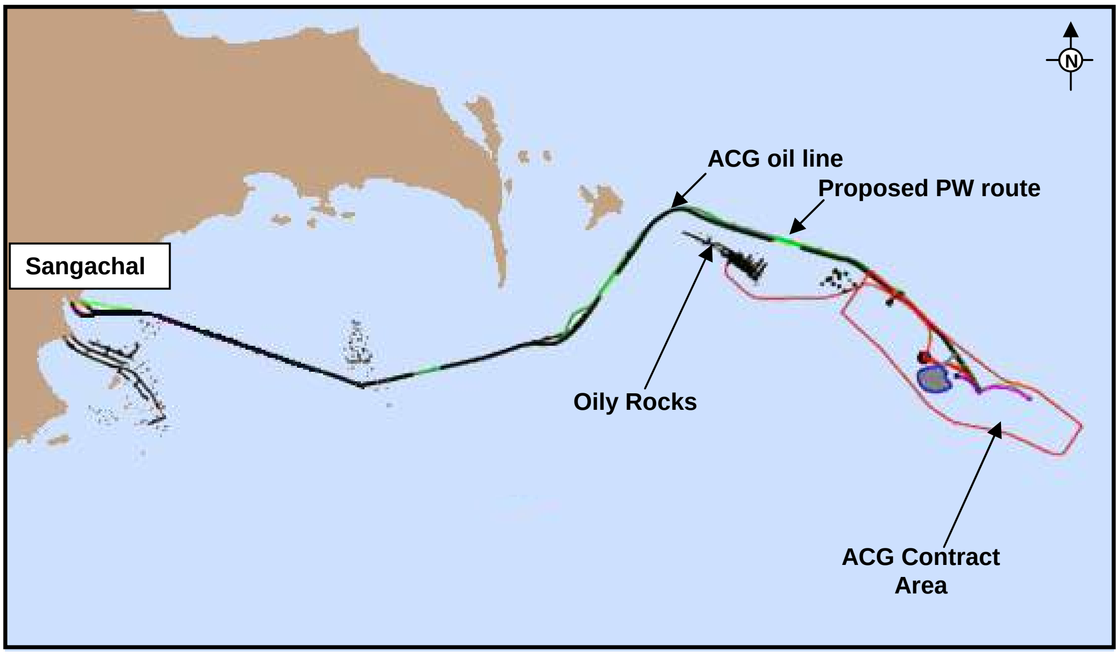
Utilities required during the ACG FFD PWD Terminal construction phase will be provided by existing facilities at the Sangachal Terminal. This includes the supply of diesel, power generation requirements, waste collection and disposal, sewage and wastewater arrangements.

ES3.5 Pipeline installation

The proposed ACG FFD PWD pipeline runs from a riser on the CWP platform at CA, following the existing ACG FFD production pipeline route to the onshore “landfall” (or beach) site in Sangachal Bay where it will be brought ashore northeast of the EOP outfall pipeline (Figure ES6). The landfall site is an existing construction area and has been used to bring ashore a total of 6 pipelines for the ACG and Shah Deniz Gas Export (SDGE) Projects. Within the existing landfall site additional land will be required northeast of the pipeline route for onshore vehicle access; this will be within the landfall security fence boundary. The area will be subject to reinstatement after all pipeline construction activities are complete in fulfilment of the commitments made under ACG Phase 1.

Once onshore the ACG FFD PWD pipeline will be routed within the existing pipeline right of way (ROW) established for the earlier ACG FFD and SDGE oil and gas lines, running 1.8 km to the tie in point at Sangachal Terminal. The total length of the pipeline will be approximately 189 km from the Terminal boundary to the CWP tie in.

Figure ES6 PWD pipeline route from landfall to ACG FFD Phase 1 offshore location



ES3.5.1 Offshore Installation

Marine installation of the Produced Water pipeline will be conducted by the Pipeline Lay Barge (PLBG) "*Tofiq Ismailov*" as part of the present campaign for the ACG FFD and SDGE Projects. The PLBG will be assisted by supply, support and anchor handling vessels and will lay the pipeline in sections, progressing to the shore.

The offshore section of the pipeline from the CWP to a water depth of 11 m will be laid directly on the seabed. In water depths of less that 11 m the pipeline will be trenched to afford some protection to the pipeline from vessel activity and to ensure that it does not create a seabed obstruction. A trench will be excavated prior to pipeline installation to a depth which will allow a seabed coverage of 0.5 m above the Top of Pipe (TOP) once it is inplace. Once the pipeline is installed the trench will be left to naturally backfill and bury the pipeline.

ES3.5.2 Pipeline landfall

The PLBG can lay the entire marine section of the pipeline from CWP to a water depth of 5 m, where it is restricted by the 1 m clearance required to safely pass over other pipelines on the seabed. The PLBG will approach the shore to a point of around 1.2 km distance from the landfall point where it will anchor. The remainder of the pipeline will then be made up on the barge and pulled to shore until the tie-in point.

In water depths of less than 3 m, it will not be possible to excavate the pipeline trench from a vessel. A temporary finger pier, or "berm" will need to be constructed to provide a surface for an excavator to trench from the 3 m water depth to shore. This approach is consistent with the pipeline installation for ACG Phase1 and 2, as well as for the SDGE Project. The temporary berm will be installed in the same way as for these previous pipeline projects, taking one month to construct and one month to remove. The berm is expected to be in place fully constructed for a maximum of 2 months.

ES3.5.3 Onshore installation

The onshore section of pipeline is 1.8 km and the entire onshore length will be buried to a depth of 0.5 m TOP. The existing ACG, SDGE pipeline ROW from Sangachal Terminal to the landfall site requires the Produced Water pipeline to make 21 crossings including a road, a railway track, and various third party pipelines/service lines. Consistent with ACG Phase 1,2 and SDGE Projects the crossing of the Salyan (Baku-to-Astara) Highway will consist of hand and machine excavation of part of the highway, installation of the pipe sections, and road restoration prior to continuing on the second half of the highway. Rail crossing will be by drilling directly through the railway embankment and installing a sleeve through which the pipeline will be pulled. Where the pipeline crosses existing services, reinforced concrete protective slabs shall be placed over the pipelines at the crossing point.

Once the onshore section of the pipeline is completed the area will be reinstated using the material excavated during onshore trenching. Permanent surface warning tiles shall be placed on the pipelines to indicate their points of intersection with other services.

ES3.6 Facilities commissioning

The PWD pipeline will be tested separately for the onshore and offshore sections before they are connected and subject to final testing. The section of the Produced Water pipeline running from Sangachal Terminal to the beach-pull site will be hydrotested with potable water dosed with a bio-friendly volatile corrosion inhibitor (VCI). The hydrotest water will be reused in different sections whenever possible. When testing is complete the water will be discharged to the Sangachal Terminal holding pond to enable chemical degradation. The water will be tested periodically until sufficiently degraded prior to discharge to the outer drainage channel.

The ACG FFD PWD pipeline from the landfall to offshore will be flushed with inhibited seawater to remove any debris. A small amount of this water will be discharged at the riser base along with any debris from the pipeline construction process such as welding rods. The pipeline will then be hydrotested with seawater inhibited with the chemical recipe approved for ACG FFD Phase 1 and 2, and SDGE pipelines. This hydrotest water will then be left in the pipeline until Produced Water export begins, at which time is expected that the hydrotest water will be reinjected into the CWP water re-injection wells in the same way as the Produced Water from the ACG FFD PWD pipeline.

ES3.7 PWD Operation

The operation and maintenance of the terminal PWD facilities and dedicated Produced Water pipeline will be the responsibility of Terminal Operations throughout the life of the ACG FFD project. Appropriate operating procedures will be established during the Operate stage of the project when projects are handed over to operations. Similarly, the reception and injection of the Produced Water from Sangachal Terminal into the CWP water re-injection wells along with the Produced Water separated offshore will be under the management of CA Complex Operations, as approved under ACG Phase 1.

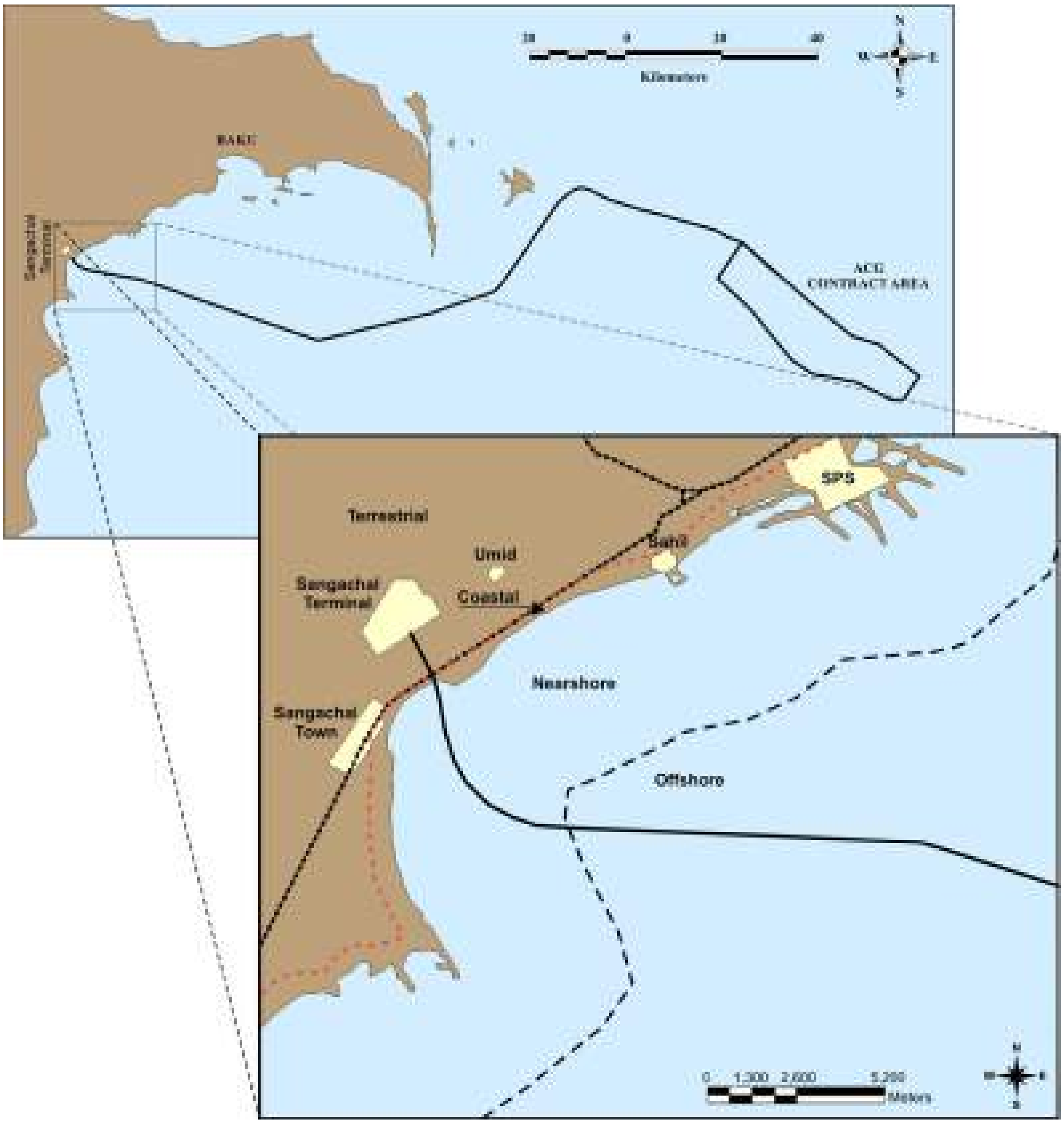
ES4 Existing Natural Environment

The ACG FFD PWD project is the latest project in the phased FFD of the ACG Contract Area and a considerable amount of environmental information has been gathered over the period from 2000 to present and reported in previous ESIAs. Since the time of these earlier ESIAs, a series of terrestrial and marine studies have been carried out in the vicinity of Sangachal Terminal and Sangachal Bay as part of the commitments under the Integrated Environmental Monitoring Plan (IEMP).

In terms of the data relevant to the ACG FFD PWD Project, new or updated environmental data was sought in the project study as follows:

- the onshore environment, defined as the area from the boundary of Sangachal Terminal along the ACG FFD Phase 1, 2 and SDGE pipeline ROW to the highway;
- the coastal environment, defined as the ACG and SDGE pipeline landfall site and Sangachal Bay to the 11 m water depth; and
- the offshore environment, defined as from 11 m water depth (where pipeline trenching ends) to the CA platform at ACG FFD Phase 1 (Figure ES7).

Figure ES7 Definition of the project study area for the environmental and social description



ES4.1 Onshore environment

The onshore environment for the ACG FFD PWD Project is located solely in areas that are or have been used for earlier construction and fabrication of ACG facilities. No additional land take will be required for the terminal facilities associated with the proposed project and the onshore pipeline ROW from Sangachal Terminal to the landfall site is a designated no development zone. Supply activities for the pipeline installation programme will be required from SPS but will not require any new facilities beyond those currently provided by the facility. Both Sangachal Terminal and the SPS Yard have been operating as industrial facilities for over 10 years.

Sangachal Terminal is located in a semi-desert area, in a low-lying basin on the margin of the Caspian Sea, approximately 10 to 12 m above the local sea level. The area is characterised by a warm semi-arid steppe climate giving a mean temperature in summer of 26°C and 0°C in winter and a little rainfall occurring between October and March. A locally thermally driven wind system is based on onshore/offshore pressure differences and can result in very strong winds occurring with little forewarning.

The SPS yard lies approximately 20 km southwest of Baku and 12 km east-northeast of Sangachal Terminal on the western coastline of the Caspian Sea. A coastal plain with undulations of up to 2 m surrounds the yard, backed by steeply sloping hills affiliated with the *Qaraqus Dagi* (Blackbird Mountain), forming a ridgeline locally that runs approximately parallel to the coast. The coastline in the vicinity of the yard is characterised by shallow lagoons. The yard area itself is significantly degraded with little apparent ecological value.

Soils at the pipeline ROW running from Sangachal Terminal to the landfall site have a low humus content, short soil profile and low agricultural productivity. No aquifers supplying potable water have been found in the vicinity of the Sangachal Terminal and no significant ground water has been identified in surveys.

ES4.1.1 Flora and fauna

The potential for the ACG FFD PWD Project to interact with onshore flora and fauna receptors is limited given that all onshore activities, except for transportation, will take place within the boundaries of areas where construction has been occurring for a number of years as a result of earlier ACG Phases.

A walkover survey performed in 2005 by URS of the proposed ACG FFD PWD pipeline ROW between Sangachal Terminal boundary and the Salyan Highway confirmed two main terrestrial habitats reported in previous surveys:

- semi desert scrub; and
- marshland occurring in a series of artificial and natural drainage channels running between the main terminal access road and the old access road.

The semi-desert scrub areas provide a suitable habitat for a variety of species including red-tailed sanderling (*Meriones lybicus*), wall lizards (including *Eremias and Ophisops* species), snakes (including dice snake *Natrix tesellata* and Dahl'swhipsnake *Colubernajadum*) and the Red-listed spur-thighed tortoise (*Testudo graeca*). Rodent burrows and brown hare (*Lepus europeaus*) have also been frequently observed during walkover surveys of the area.

The marshland habitats show seasonal variation based on the availability of water during the year and when water is abundant they provide a valuable habitat for amphibians, primarily common marsh frog (*ranna ridibunda*), and reptiles such as the European Pond Turtle (*Emys orbicularis*) and the Caspian Pond Turtle (*Mauremys caspica*).

Near the Sangachal Terminal recovery of vegetation has taken place naturally up to the present, especially in the southern part of the area where grazing marsh exists (with reeds, reedmace, and rushes of the *Juncus* sp.) and in the tamarisk scrubland, the latter providing suitable bird breeding habitat.

Bird surveys (conducted in 2001, 2002, 2004, and 2005) have recorded a total of 54 different species in the area during the breeding seasons (URS, 2005a). Important bird species identified (in terms of vulnerability) comprised breeding greater sand plover, booted warbler, and black-bellied sandgrouse (the latter is a Red Data species).

The survey also found that several common bird species have been displaced (or now occupy smaller territories) as a result of construction activities not connected to Sangachal Terminal. The latest breeding bird survey (conducted in 2005) concluded that the footprint of the terminal area appears not to have significantly impacted breeding bird populations.

The SPS Yard is located close to a pair of shallow lagoons known as the Shelf Factory Lagoons, separated from the Caspian by shingle banks and reeds. These are proposed as a Ramsar site due to the abundance of overwintering wildfowl and the presence of three ARB listed species and the IUCN Red Listed Pygmy cormorant (*Phalacrocorax pygmeus*). Vessel support and supply activities associated with the ACG FFD PWD pipeline installation will not influence these areas.

ES4.2 Coastal environment

Coastal areas in the immediate vicinity of the proposed ACG FFD PWD pipeline landfall have been subjected to a variety of anthropogenic changes since 2001 through the installation of the ACG FFD Phase 1 and 2 oil and gas pipelines, the SDGE gas pipeline, associated methanol-ethanol-glycol (MEG) lines, and fibre optic lines. To date six pipelines have been installed. All surface vegetation has been removed from the landfall site, the area has been graded to provide hard standing for equipment and temporary buildings have been erected. As a result there is no flora within the fenced area of the site.

The surrounding vicinity of Sangachal Bay coastal environment is undisturbed and displays several habitats including:

- coastline with sparse vegetation (primarily Persian bindweed or *Convolvulus persicus*, and Siberian tournefortia or *Argusia sibirica*),
- littoral reedbeds (the sharp rush or *Juncus acutus*, the common reed or *Phragmites australis*, tamarisk scrub or *Tamarix*, and reedmace or *Typha* sp.),
- shallow lagoons, a salt marsh dominated by the glasswort *Salicornia europea*, and
- semi-desert areas with two main components: a wormwood species (*Artemisia fragrans*) and saltwort tumbleweed species (*Salsola dendroides* and *Salsola nodulosa)*.

Several Azerbaijani Red Book (ARB) species have been recorded in this area, and these include; ferula (*persica*), *Cladochaeta candidissima* (IUCN, Indeterminate), *Glycyrrhiza glabra*, and nitre bush (*Nitraria schoberi*). Dead individuals of *Calligonum bakuensis*, an IUCN (Indeterminate) and ARB species, were also recorded.

The coastal zone of the Caspian, from Azerbaijan to Iran, is one of known ornithological importance, supporting both nationally and internationally significant numbers of migrating and overwintering birds during the autumn and winter. Ornithological surveys have been conducted along the Caspian Sea coastline since 2000 as part of the ACG FFD projects. These surveys consistently show that the main sites of importance are Sangachal Bay and the Shelf Factory Lagoons (SPS yard). Throughout the survey periods the most abundant species within the Sangachal Bay survey area were tufted duck (*Aythya fuligula*), coot (*Fulica atra*), and common pochard (*Aythya ferina*). In several years of the survey populations of great crested grebe and tufted duck were present in internationally important numbers.

The continued importance of Sangachal Bay and the SPS demonstrates that activities in these areas have not had a significant impact on the suitability of these sites to host large seasonal numbers of bird populations.

ES4.3 Nearshore and offshore environment

Sangachal Bay is a shallow bay that slopes gently from the shoreline for approximately 600 m, where a 5-6 m deep shelf develops. A sill defines the seaward side of this shelf along the ACG FFD PWD pipeline route 3-5 km from the shore. From this sill, the bathymetry continues to descend into open sea, reaching a depth of 11 m at an average of 5 km offshore.

Surveys conducted as part of the pipeline trenching study show that sediments in the bay to 11 m water depth compose of a mixture of sand underlain by clayey seabed with limestone outcroppings, leading to deeper layers of sandy sediments in increasing water depths away from the shore. Mats of seagrass *Zostera nolti* (dwarf eelgrass), occur at several areas along the proposed pipeline route where the seabed consists of sandy deposits, up to 3.2 km from the shore.

The ACG Contract Area is approximately 40km in length, 11.5 km wide, and lies in the Middle Caspian. The area is characterised by an uneven topography, natural gas seeps, mud volcanoes, gas charged sediments, and subsea mudflows. Seabed sediments in the Contract Area are mostly medium to coarse sand with considerable spatial variation in the most abundant particle size. The sediments contain hydrocarbons but it is not possible to determine whether they are of natural or anthropogenic origin. Heavy metal content and radioactivity levels have been measured at typical background levels.

The Caspian sea contains a unique assemblage of fauna. About 75% of the species of the Caspian are endemic, 6% are from the Mediterranean and 3% are from the Arctic. The remaining 16% are freshwater immigrants that have adapted themselves to the salinity of the Caspian. Because of the special nature of the Caspian ecology the introduction of species is a significant concern in the region.

The nearshore benthic fauna of Sangachal Bay show limited diversity with a dominance of a small number of species: the invasive polychaete worms *Nereis diversicolor* and *Hypaniola,* the native oligochaete *Isochaetides*, and the invasive mussel *Mytilaster lineatus.* Non-native species account for most of the biomass. Further offshore, suspension and deposit feeders such as worms (oligochaete and polychaete, the latter predominantly *ampharetid polychaetes*), and amphipod crustaceans dominate the benthos.

The offshore benthic communities in the Contract Area show crustacean-dominated communities in the northwest of the Area and annelid-dominated communities in the southeast. Benthic surveys at CA where the PWD pipeline will tie-in, show several species of crustaceans (amphipods and cumaceans) and molluscs and an abundance of polychaete and oligochaete worms. Seed shrimp (*Ostracoda*), oligochaete worms (*Isochaetides michaelseni* and *Tubificidae* spp.), amphipod crustaceans (*Gammarus* spp.), cumacean crustaceans (*Schizorhynchus eudorelloides*), and polychaete worms (*Hypania invalida*) were among the most common species. Bivalve molluscs (the mussel *Dreissena rostriformis*, *Dreissena grimmi*, and the clam *Abra ovata*) occur in low numbers.

Fish monitoring studies in Sangachal Bay and the ACG Contract Area show an abundance of sandsmelt (*Atherina mochon caspia*), vobla (*Rutilis rutilis kurensis*), and goby (*Neogobius fluviatilis pallasi*). Kilka (herring family) can also be encountered in large numbers offshore. Migratory species including sturgeon species, Caspian salmon (*Salmo trutta caspius*), Caspian lamprey (*Caspiomyzon wagneri*), and seashad may also be found within the nearshore and Contract Area.

Resident and other species, other than the goby, include: the pipefish (*Syngnathus nigrolineatus*), which more frequently congregate nearshore (Kosarev and Yablonskaya, 1994) and mullet, which was introduced from the Black Sea in the 1930s.

ES5 Existing Socio-Economic Environment

The ACG FFD PWD Project is a relatively small project compared to ACG Phase 1,2 and 3. This latest project will be conducted within existing facilities as discussed and will use the existing workforce from the ACG FFD projects based at these facilities. As such, there will not be the influx of large numbers of foreign workers, largescale job creating or development at new locations. Therefore, regional data on the socio-economic environment, together with demographic information for Sangachal and the surrounding regions of Sahil and Umid provided by the Garadag Executive Power (government of the Garadag District within the Sahar/Municipality of Baku) is as provided in previous ESIAs has not been repeated.

As discussed, the ACG FFD PWD project incorporates onshore works through the installation of the PWD pipeline from Sangachal Terminal to the landfall at Sangachal Bay, and offshore from the landfall to the CA and DWG fields in the ACG Contract Area. The social focus is therefore on the services, infrastructure and socio-economic activity in these project areas.

The onshore pipeline route between Sangachal Terminal and the Salyan Highway is in an existing ROW and a designated no development zone. Within this area, the PWD pipeline route crosses 24 third-party utility lines and pipelines, the Baku-Alyat electric railway line and the Salyan Highway. Some of the third party services are abandoned whilst others provide electricity, communications, oil, gas, and water.

Offshore infrastructure in the vicinity of the proposed ACG FFD PWD pipeline consists of the oil and gas pipelines installed as part of the ACG FFD and SD Projects. In addition, a number of seabed obstructions and the offshore Sangachal and March 8th oilfields are located to the south of the proposed landfall site.

Shipping activities in Azerbaijan waters include commercial trade, passenger and vehicular ferry transport, military, scientific and research operations, and service and supply operations to the offshore oil and gas industry. Merchant shipping levels have varied in the last decade, with a substantial increase seen in recent years due to the offshore oil and gas projects, particularly those of AIOC.

The State Maritime Administration governs vessel activity in Azerbaijan and two registered shipping lanes pass in proximity to the proposed PWD pipeline landfall location. In addition to the shipping lanes, a number of prohibited areas are located in Sangachal Bay due to tanker movements to and from the AzPetrol terminal. A total of 34 tankers use the registered lanes, transporting over 10 million tonnes of oil cargo in 1,200 trips to the terminal each year. The largest tanker vessel is approximately 13,500 tonnes (dwt) which when fully laden with cargo has a draft of 8.2 m. This data lead to the decision to trench the proposed PWD pipeline in water depths of less than 11 m (ensuring that the pipeline is buried to a depth of 1 m below the seabed).

The Caspian Sea is an important fishing area, with fishing representing 1 percent of Azerbaijan GDP. The main fishing activities involve commercial catches of sturgeon, sprat, carp, darters, gobies, herring, salmon and mullet. No known fishing areas are located along the proposed PWD pipeline route. Known fishing grounds exist to the north and south of Sangachal Bay and there is the potential for fishing vessels to be present in the vicinity of the PWD pipeline as they journey to and from these areas. Fishing activities in the proposed project area also include recreational and subsistence fishing in Sangachal Bay, some using small boats and nets.

Offshore fishing vessels typically target the catch kilka species and currently 100 boats are believed to be active in the industry. Offshore platforms and live pipelines are plotted on admiralty charts and subject to a safety exclusion zone, although fishing over pipelines may occur and is difficult to police.

ES6 Environmental Impact Assessment

ES6.1 Impact assessment steps

The impact assessment was performed considering the ACG FFD PWD Project as occurring in a number of distinct project phases:

- International equipment and pipeline fabrication, procurement, and transportation
- Sangachal Terminal ACG FFD PWD project facilities
- PWD pipeline installation, commissioning, and operation
- Offshore facilities hook-up and commissioning (HUC) and operation

The following steps were undertaken in the assessment for each of the above phases:

- Routine, planned non-routine, and unplanned or accidental activities of the project were identified, and the potential environmental and socio-economic aspects[1] associated with these activities were discussed with project engineers through the ENVIID workshops (Section ES2).
- For each aspect, potential impacts[2] were considered and the effect of mitigation measures established through the design process/mitigation workshops were then taken into account. These measures comprise either specific design components or operational management procedures developed as part of the ACG FFD PWD Project to eliminate or reduce the potential for impacts from the identified activities.

  In addition, mitigation/management measures developed as part of ACG Phase 1,2 and 3 were taken into consideration, particularly the environmental and social management procedures that have been put in place as these will also form the basis of the ACG FFD PWD Project. Consideration was also given to the potential for PWD activities to contribute to the accumulation of impacts from ACG FFD or other BP AzBU activities in the region.

- Residual impacts are defined as those remaining after consideration of established mitigation and management measures. Where the potential for residual impacts was identified, these were assessed using probability of occurrence (likelihood) and consequence criteria. Based on the scoring, impacts were ranked in terms of 'significance' by assigning a scale of Low, Medium, High and Critical (critical being the highest).

  Key comments and feedback from the stakeholders through consultation during the ESIA process for the ACG FFD PWD Project, as well as experience from issues raised during ACG FFD Phases 1, 2, and 3 were also included in the impact assessment process.

- Where the residual impact was found to be of Low significance, no further mitigation measures were considered necessary, unless the impact had been raised as being of concern during consultation (including previous consultation for ACG FFD Phases 1, 2, or 3). For these perceived impacts as well as those identified as being of medium or above significance, discussion is provided and where necessary additional management measures were identified.

[1] Environmental aspect is defined as "An element of an organisation's activities, products, or services that can interact with the environment", Environmental Management Standard ISO 14001.

[2] Environmental impact defined as "Any change to the biophysical environment, positive or negative, that wholly or partially results from a project activity or associated process", Environmental Management Standard ISO 14001.

ES6.2 Summary of the Impact Assessment Results

The majority of activities proposed for the ACG FFD PWD Project will not result in a significant residual environmental or social impact. This is due to the small scale of the activity, the distance of the activity from receptors or from the effective mitigation of impacts achieved in the design implemented by the PWD Project or from earlier Phases 1, 2 and 3 projects.

The results of this assessment show that no impacts were identified with a high residual significance. Over the project, one impact was identified as medium associated with an accidental/unplanned event. Two impacts identified as low were highlighted for discussion due to other factors (Table ES1).

Table ES1 Summary of residual impacts and issues from ACG FFD PWD Project

Activity	Aspect	Significance/Justification
Accidental Events		
Pipeline operation	Corrosion causing potential release of contaminated PW onshore/offshore	**Medium**: Contamination of onshore/offshore environments
Pipeline operation	Potential damage to line from impact (vessel grounding/anchor impact) and release of contaminated PW offshore	**Low:** Low probability of pipeline breach but anchor impact has occurred on the ACG Phase 1 lines
Decommissioning	Removal of facilties at the end of the project lifetime, when no further PW will be produced	**Low**: Wider issue for all BP projects

ES6.2.1 Corrosion and potential release of contaminated PW

The Produced Water pipeline is of a steel construction and at risk of corrosion from the inventory. The project has developed a corrosion management plan which requires the injection of chemicals into the pipeline to remove oxygen content and biological action. Any uncontrolled release of Produced Water due to corrosion would result in environmental impact.

To assess the potential impact on the environment modelling was performed simulating a continuous uncontrolled release characteristic of corrosion damage causing loss of pipeline integrity at two locations; Sangachal Bay and CA. The model found that due to the slow release rate the Produced Water rapidly diluted in less than 6 m of the release point and within 50 seconds of entering the environment. The Produced Water was diluted approximately 80 times within this distance. Toxicity test of Produced Water conducted on Caspian specific species shows a lethal effect toxicity of 40 times dilution (or 2.5 percent). This suggests that there would be negligible impacts on the seabed benthos associated with such a release, due to the speed and distance at which the Produced Water is diluted to below the lethal effect level.

A long-term continuous uncontrolled release of Produced Water into the Caspian Sea would be unacceptable considering the environment, AIOC Corporate Standards and national legislation. As such, the corrosion management plan is essential. In addition to chemical injection, the PWD pipeline will be monitored by a leak detection system. Regular pigging, including intelligent pigging every few years, will also be used to detect corrosion over the expected amount and highlight any integrity issues with the pipeline. Regular surveying will also be conducted to monitor the condition of the pipeline as part of the operational pipeline-monitoring programme for the ACG Phase 1, 2 and 3.

ES6.2.2 Potential damage to line from impact and release of contaminated PW offshore

The risk of the PW pipeline becoming damaged and releasing inventory through direct impact from either vessel grounding in the nearshore zone or anchor impact is low. However, current experience from ACG Phase 1 has shown that anchor impact across the pipeline has occurred, although not sufficient to comprise the structural integrity of the line.

Dispersion modelling was conducted to assess the behaviour of a single largescale release as a result of complete pipeline failure, using a release hole equal to the diameter of the pipeline. Two scenarios were run selecting a large release in Sangachal bay and at the CWP location. Simulations were run under summer and winter conditions. The results of the model show rapid dilution (as with the corrosion simulation) to less that 400 times (10x less than the toxicity test results) within 8 hours for Sangachal Bay and 13 hours for the offshore location.

The project design has incorporated the following measures to afford some protection to the ACG FFD PWD pipeline:

- In water depths less than 11 m the pipeline will be buried to a depth of 0.5 m TOP coverage under the seabed. This will ensure that the pipelines do not constitute a hazard to vessel navigation in the nearshore zone.
- The Produced Water pipeline will be concrete coated along its entire length. To enhance protection, the concrete coating will be of a greater thickness for the section of the pipeline in nearshore shallow waters. Offshore water depths are such that anchor velocity will be reduced as the anchor is deployed thereby reducing the potential impact on the pipeline.
- The pipeline will be located within the safety exclusion zone that currently exists for the ACG and SD oil and gas lines. This exclusion zone prohibits certain activities such as anchoring in the location of the pipelines.
- Once installed, the position of the pipelines and the safety exclusion zone will be plotted on Admiralty charts, which are made available to vessel operators in the region.

ES6.2.3 Decommissioning

The decommissioning of the ACG FFD PWD Project represents a wider issue as all ACG FFD facilities require decommissioning at the end of the project lifetime. Under the terms of the ACG PSA, AIOC is required to produce a field abandonment plan one year prior to completion of 70 percent production of identified reserves. The PSA however, does not state specific requirements on the methodology of decommissioning.

It is recognised that technology, facilities and infrastructure will change over the lifetime of the project within the Caspian region, as will international experience in decommissioning oil and gas installations. The current international approach to decommissioning is to conduct a BPEO to provide a comparative assessment of available options. The purpose of the BPEO will be to consider both the potential alternative uses for facilities to extend their operational life and detailed options for field abandonment assessed in terms of environmental impact, health and safety, technical feasibility and cost effectiveness.

SOCAR will assume ownership for all ACG facilities at the end of the PSA agreement in 2024. To address the financial burden associated with decommissioning and abandonment, all partners involved in the ACG projects are required under the PSA to contribute a proportionate share of the revenue raised from the projects to cover decommissioning costs. These funds will be used to establish an “Abandonment Fund” such that the funds can be accrued against the decommissioning costs. Under the terms of the PSA, SOCAR as future operators of the ACG development will inherit the Abandonment fund set aside for this purpose.

ES7 Conclusions

The oil produced from the ACG Contract Area contains water which requires removal. Offshore facilities can remove 95% produced water from oil for reinjection offshore therefore 5% produced water is sent onshore co-mingled with oil. This Produced Water, separated out of the product at the platform, is reinjected offshore and the percent remaining in the oil is received onshore at Sangachal Terminal. This Produced Water needs to be removed through further separation at the terminal in order to achieve the WIO specification required for delivery to the BTC export pipeline.

The ACG FFD PWD Project is proposed for the solution for the disposal of the Produced Water generated at Sangachal Terminal. The proposed Project will send the Produced Water back offshore via a dedicated pipeline for reinjection at the CA Complex.

One residual impact has been identified as of medium significance; an uncontrolled continual release of untreated Produced Water as a result of pipeline corrosion. Considering the implementation of the corrosion management plan and leak detection system developed for the project the likelihood of such an event occurring is low.

On consideration, the ACG FFD PWD Project within the context of ACG FFD is deemed to deliver a long-term environmentally and socially acceptable solution to the disposal of Produced Water in fulfilment of the commitments made under ACG Phase 1, 2 and of the conditional approval granted for ACG Phase 3.

1 Introduction

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1.1 Introduction

This Environmental and Socio-Economic Statement (ES) reports the results of the detailed Environmental and Socio-economic Impact Assessment (ESIA) conducted for the proposed Azeri, Chirag, Gunashli Full Field Development Produced Water Disposal (ACG FFD PWD) Project. The proposed project involves the installation of a dedicated 14-inch diameter, 189 km long Produced Water pipeline from Sangachal Terminal to the ACG Phase 1 location for tie in at the Compression and Water Injection Platform (CWP). The pipeline will transport Produced Water from Sangachal Terminal to CWP for re-injection offshore.

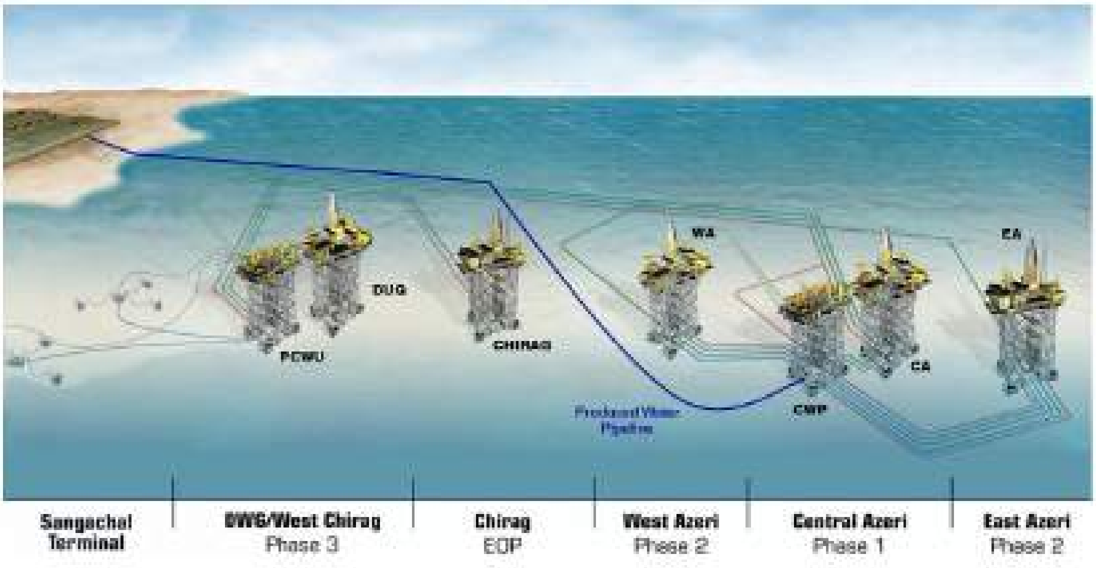
The ES has been prepared for submission to the Azerbaijan Ministry of Ecology and Natural Resources (MENR) to gain approval for the project and, as such, has been conducted in accordance with the legal requirements and policies of Azerbaijan. In addition, the ESIA process has been undertaken in the context of BP’s Health, Safety and Environment (HSE) Policy as described in Chapter 2.

1.2 Project background

The ACG Contract Area has estimated oil reserves in excess of 5.4 billion barrels of oil. It lies in the Azerbaijan sector of the Caspian Sea, approximately 120 km south east of Baku and covers an area of 432 square kilometres in water depths ranging from 100 m to 400 m. Primary oil bearing zones occur at depths of between 2,500 m and 3,000 m below the seabed. The ACG Contract Area was developed in a phased approach and together with the Chirag Early Oil Project (EOP) the following projects represent the ACG FFD Project:

- Phase 1 Development: Development of the central part of the Azeri reservoir with a Production, Drilling and Quarters (PDQ) Platform bridge-linked to a Compression and Water injection Platform (CWP), a 30” sub-sea oil pipeline and a 28” gas line to shore. The project also linked with the Chirag field.
- Phase 2 Development: Development of the west and east parts of the Azeri reservoir with two fixed production and drilling facilities, a 30” sub-sea oil pipeline and in-field sub-sea pipelines.
- Phase 3 Development: The last phase of development of the ACG FFD Project, developing the hydrocarbon reserves in the Deep Water Gunashli (DWG) sector of the ACG Contract Area by two platforms; a Drilling, Utilities and Quarters (DUQ) platform bridge linked to a Production, Compression Water Injection and Utilities (PCWU) platform with hydrocarbon export by tie-ins to the earlier ACG Phases export pipeline infrastructure. In additon, the project requires the installation of a subsea water injection development (consisting of two subsea manifolds and associated facilties tied back to the offshore platform) for reservoir pressure maintenance.

Figure 1.1 Proposed Produced Water Pipeline in relation to ACG FFD



The oil produced from the ACG Contract Area contains water which requires removal. Offshore facilities can remove 95% produced water from oil for reinjection offshore therefore 5% produced water is sent onshore co-mingled with oil. This Produced Water, separated out of the product at the platform, is reinjected offshore and the percent remaining in the oil is received onshore at Sangachal Terminal.

At Sangachal Terminal the Produced Water is further separated in order to achieve the water in oil (WIO) specification required for delivery to the Baku-Tbilisi-Ceyhan (BTC) export pipeline. This Produced Water requires disposal. The ACG FFD PWD project will deliver this solution

From the onset the Produced Water Disposal Project has had a very strong driver to deliver the best Environmental solution possible, which has influenced the ultimate choice of disposal route. The ACG project carried out an extensive review of 11 disposal options over a number of years which also included pilot trials. Options assessed included biological treatment, treatment via a process plant, onshore reinjection, additional offshore removal, evaporation ponds and irrigation prior to the ultimate disposal route being identified as being the Best Practicable Environmental Option.

The ACG project will dispose of produced water received onshore by providing a dedicated pipeline to carry the Produced Water from the Terminal back to the offshore Compression and Water-injection Platform (CWP) at Central Azeri (CA) where it will be reinjected into the ACG reservoir along with the Produced Water that is separated offshore.

The proposed ACG FFD PWD Project is scheduled to be operational in 2008. Produced Water disposal prior to 2008 is not within the scope of this ESIA but will be disposed of by a means that is in agreement with the MENR environmental, health and safety requirements.

1.3 Environment and Socio-economic Impact Assessment

1.3.1 Objectives

The overall objective of the ESIA process for the ACG FFD PWD Project is to ensure that any adverse environmental or socio-economic impacts arising from proposed project activities are identified and where possible, eliminated or minimised through early recognition of and response to the issues.

The purpose of the ESIA is to:

- ensure that environmental considerations are integrated into the project planning and design activities;
- ensure that a high standard of environmental performance is planned and achieved for the project;
- ensure that environmental and social aspects and impacts are identified, quantified where appropriate, assessed and mitigation measures proposed;
- ensure that legal and company policy requirements and expectations are addressed;
- consult with all of the project stakeholders and address their concerns; and
- demonstrate that the project will be implemented with due regard to environmental and social considerations in mind.

Potential impacts of all stages of the project, from transportation of the pipeline and terminal modification through installation to operation are evaluated against the following:

- applicable national and international environmental standards, regulations and guidelines;
- existing environmental conditions;
- issues and concerns raised by project stakeholders (including issues raised during previous phases of ACG).

The assessment of the potential impacts from the project includes an evaluation of the implementation, quality and effectiveness of existing and planned environmental controls, monitoring and mitigation, either developed as part of earlier phases of ACG or specific to the ACG FFD PWD Project. Where residuals impacts are found, additional mitigation and monitoring is identified.

1.3.2 Structure of the Environmental Statement

This ES has been compiled to report the findings of the detailed ESIA process. The contents are summarised in Table 1.1.

Table 1.1 Structure and Content of the ES

Chapter/Title	Content
Executive Summary	A summary of the Environment Statement report.
Units and Abbreviations	A list of the units and abbreviations used in the ES.
Glossary	A glossary of terms used in the ES.
1 Introduction	A description of the ACG FFD PWD Project in the context of the phased development of the ACG Contract Area, the objectives of the environmental and socio-economic impact assessment, and the structure of the ES report.
2 Policy Legal and Administrative Framework	A summary of the HSE requirements set out in the ACG PSA, HSE policies of the project, relevant international and national environmental standards and guidelines.
3 ESIA Methodology	A description of the methods used to conduct the ESIA.
4 Options Assessed	A description of the alternative concept options assessed for the ACG FFD PWD Project.
5 Project Description	A detailed description of the ACG FFD PWD Project.
6 Environmental Baseline	A description of the environmental baseline conditions in the vicinity of the ACG FFD PWD Project activities.
7 Socio-Economic Baseline	A description of the socio-economic baseline conditions relevant to the ACG FFD PWD Project activities.
8 Consultation	An overview of the consultation undertaken during the ESIA programme and the issues and concerns raised.
9 Environmental and Socio-economic Impacts	An assessment of the potential environmental impacts associated with the ACG FFD PWD Project.
10 Environmental and Socio-economic Mitigation and Monitoring	A description of environmental and social management systems and plans and monitoring measures to mitigate identified impacts from the ACG FFD PWD Project.
11 Conclusions	Conclusions arising from the ESIA process.
References	A list of all of the literature sources referred to in the ES.
Appendices	Supporting technical information referred to in the main text of the ES.

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2 Policy, Regulatory, and Administrative Framework

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2.1 Introduction

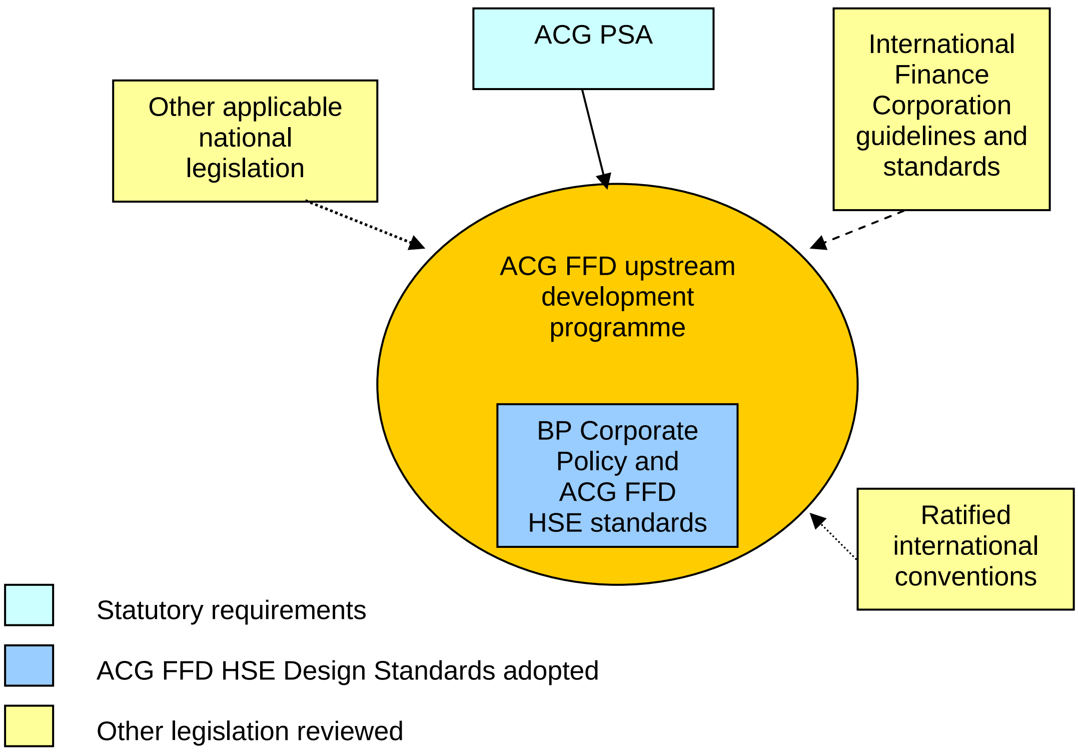
The Azeri, Chirag, and Gunashli (ACG) Full Field Development (FFD) Produced Water Disposal (PWD) project, as a part of the overall ACG FFD project, is subject to the terms and conditions of the ACG Production Sharing Agreement (PSA) (see Appendix I), BP Health Safety Security and Environment (HSSE) Policy and the ACG FFD Health, Safety, and Environment (HSE) Design Standards (see Appendix II).

In addition, BP has set a corporate policy "to do no damage to the environment," which emphasizes prevention of impacts to land, air, and water resources resulting from its operations. The corporate policy also sets high standards for monitoring performance, with the aim to set an example for environmental stewardship within the oil and gas industry.

The PWD project will also be undertaken with due regard to international conventions as ratified by the Azerbaijan government, applicable World Bank and International Finance Corporation (IFC) environmental and social policies and guidelines (refer to Section 2.3).

The legislative framework governing the ACG FFD PWD project is illustrated in Figure 2.1.

Figure 2.1 Legislative framework of the ACG FFD PWD project



The ACG FFD PWD project is the latest in the phased development of the ACG FFD. As such, three Environmental and Socio-economic Impact Assessment (ESIA) reports have been submitted and approved by the Azerbaijan Ministry of Ecology and Natural Resources (MENR). In an attempt to reduce the repetition of information presented in the ESIA reports for each phase of development, this report should be read with reference to the information presented in the preceding ESIAs, as follows:

- ACG FFD Phase 1 Environmental and Social Impact Assessment, 2002.
- ACG FFD Phase 2 Environmental and Social Impact Assessment, 2003.
- ACG FFD Phase 3 Environmental and Social Impact Assessment, 2004.

These reports are available online through the BP website within the Reports and Publications section of the new BP Caspian website, located (as of July 2006) at http://www.bp.com/subsection.do?categoryId=9006656&contentId=7013370. Specifically, readers are directed to the ACG FFD Phase 3 ESIA, Section 2.2 for a description of the ACG PSA, and Section 2.3 for a summary of BP HSSE Policy applying to the proposed project.

The following sections present an overview of each of these key elements of the legal and policy framework for the ACG FFD Project.

2.2 ACG FFD Health, Safety, and Environment (HSE) Design Standards

In 2003, the Azerbaijan International Operating Company (AIOC) partners' Contracts Management Committee (CMC) approved a set of HSE standards for the design of the ACG FFD Project. These standards built upon the standards set out in the PSA, Phase 1 and 2 HSE design standards, taking into consideration international standards and local environmental conditions and were presented in the ACG FFD Phase 3 ESIA. The ACG FFD HSE Design Standards serve as the standards that AIOC has adopted for ACG FFD engineering design. Therefore, while the PSA forms the legal basis for conducting operations, these standards seek to supplement, enhance and further define the standards set forth in the PSA.

These standards are provided in Appendix II of this document and the categories that specifically apply to the aspects of the ACG FFD PWD project are summarised in Table 2.1.

Table 2.1 Summary of the HSE categories for the ACG FFD HSE Design Standards applicable to the PWD project.

Health	Safety	Environment
Medicals	Training	Monitoring and measurement
Hygiene	Design safety reviews	Ozone Depleting Substances (ODS)
Noise	Hazard management plan	Other halocarbons with potential for global warming
Health risk management	Simultaneous Operations (SIMOPS)	Land-take at Sangachal
	Manual handling	Nuisance at Sangachal
	Hazardous substances	Chemicals
	Seismic events	Sewage
	Storm (extreme weather events)	Pipeline construction
		Sand
		Liquid and solid waste
		Cooling water
		Produced Water offshore
		Decommissioning
		Fugitive emissions
		Combustion emissions
		Produced Water onshore
		Energy efficiency
		Onshore discharge of open drains (see Appendix III)

2.3 International Finance Corporation (IFC) environmental and social policies and guidelines

The ACG FFD PWD project shall be undertaken in accordance with applicable IFC environmental and social policies and guidelines, comprising:

- World Bank “Safeguard” Operational Policy (OP) 4.01: “Environmental Assessment” (revised August 2004);
- World Bank “Safeguard” Operational Policy (OP) 4.04: "Natural Habitats" (revised August 2004);
- World Bank “Safeguard” Operational Policy/Bank Procedure (OP/BP) 4.12: "Involuntary Resettlement" (revised April 2004);
- World Bank “Safeguard” Operational Policy Note (OPN) 11.03 "Management of Cultural Property" (September 1986, soon to be replaced with OP 4.11);
- World Bank Group Guidelines for Oil and Gas Development (Onshore) (from the Pollution Prevention and Abatement Handbook, July 1998);
- World Bank Group Guidelines for Thermal Power (New Plants) (from the Pollution Prevention and Abatement Handbook, July 1998);
- World Bank Group General Environmental Guidelines (from the Pollution Prevention and Abatement Handbook, July 1998);
- IFC Environmental, Health, and Safety Guidelines for Oil and Gas Development (Offshore) (December 2000);
- IFC Policy Statement on Forced Labour and Harmful Child Labour (March 1998);
- IFC Environmental, Health, and Safety Guidelines for Hazardous Materials Management Guidelines (December 2001);
- IFC Environmental and Social Guidelines for Occupational Health and Safety (June 2003); and
- IFC Environmental, Health, and Safety Guidelines for Waste Management Facilities (July 1998).

2.4 International Conventions

The Azerbaijan Republic has entered into and ratified a number of international conventions and AIOC will endeavour to provide information necessary to allow the government to meet their obligations with respect to these conventions. The conventions relevant to the ACG FFD PWD project are:

- 1971 Convention on Wetlands (Ramsar Convention);
(ratified by the Republic of Azerbaijan in Baku 2000)
- 1972 Convention for the Protection of the World Cultural and National Heritage;
(ratified by the Republic of Azerbaijan in Baku 1993)
- 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (The London Dumping Convention);
(ratified by the Republic of Azerbaijan in Baku 1997)
- 1973 Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);
(ratified by the Republic of Azerbaijan in Baku 1998)
- 1973 and 1978 International Convention for the Prevention of Pollution from Ships (MARPOL 1973/1978);
(ratified by the Republic of Azerbaijan in Baku 1997)

- 1979 Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention);
  (ratified by the Republic of Azerbaijan in Baku 1999)
- 1985 Vienna Convention for the Protection of the Ozone Layer and Montreal Protocol (1990) and Copenhagen amendments (1992);
  (ratified by the Republic of Azerbaijan in Baku 1996)
- 1991 Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention);
  (ratified by the Republic of Azerbaijan in Baku 2000)
- 1992 Convention on Biological Diversity (CBD);
  (ratified by the Republic of Azerbaijan in Baku 2000)
- 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention);
  (ratified by the Republic of Azerbaijan in Baku 2000)
- 1992 Basel Convention On The Control Of Transboundary Movements Of Hazardous Wastes And Their Disposal (Basel Convention);
  (ratified by the Republic of Azerbaijan in Baku 2001)
- 1992 United Nations Framework Convention on Climate Change (Climate Change Convention, or UNFCCC);
  (ratified by the Republic of Azerbaijan in Baku 1995)
- 1994 Convention to Combat Desertification;
  (ratified by the Republic of Azerbaijan in Baku 1998)
- 1998 Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention);
  (ratified by the Republic of Azerbaijan in Baku 1999)
- Applicable International Labour Organisation conventions.

The following subsections summarise those conventions that are of particular note to the ACG FFD PWD project. It should be noted however, that once international conventions have been entered into and ratified by the Azerbaijan Republic, they subsequently become incorporated into the state legislation. Thus, through compliance with the PSA (Section 2.2), the ACG FFD PWD project will ensure compliance with the conventions outlined further in this section. The environmental standards to be met by the ACG FFD project are detailed in Appendix IX of the PSA (see Appendix I).

It should be further noted that, at present, there are no international guidelines on the removal or decommissioning of disused subsea pipelines.

2.4.1 1998 Convention on Access to Information, Public Participation in Decision Making, and Access to Justice in Environmental Matters (Aarhus Convention)

The convention aspires to guarantee the public of signatory nations the right to access information, participate in decision-making, and obtain justice in the protection of their health and environment. The convention sets out the following:

- Obliges authorities to make available environmental information to their public upon request without discrimination and without having to state an interest. Provisions are made for limits to access of certain types of environmental information, but these limits must take into account the public interest served by the disclosure. The Convention encourages signatories to collect environmental information regularly and disseminate it in the form of a publicly accessible database.

- Entitles the public to participate in environmental decision-making concerning a wide range of economic activities and not simply those covered by environmental impact assessment procedures. Under the Convention, government authorities must ensure public involvement in project planning within their jurisdiction as early as possible. Public participation is encouraged in preparing environmental plans and programmes, and to a lesser degree, in preparing policy.
- Requires the signatory to provide a judicial review process for anyone who considers their request for information to have been inadequately addressed.

- Azerbaijan's accession to the Aarhus Convention was in March 2000; the Convention came into force in October 2001. In terms of the ACG FFD PWD project, this convention sets out the requirement to involve the public in the decision-making process.

2.4.2 1991 Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention)

This Convention was signed in Espoo, Finland, by governments of several European countries, the United States, and the European Community (EC) in 1991. Azerbaijan acceded to the Convention in 1999. The Convention promotes the use of the ESIA as a tool to generate environmentally sound and sustainable economic development while preventing transboundary environmental degradation.

Although the Convention does not specifically address public participation in environmental decision-making, it requires a country in which a proposed activity is to be undertaken to provide an opportunity for the public of other signatory countries affected by that project to participate in the host national ESIA process. As with domestic public comments, the comments from the public of affected other countries are to be considered. Under the terms of this Convention, Azerbaijan is required to notify other treaty signatories if there is a potential impact upon their environment resulting from a development on the territory of Azerbaijan, including its waters. This notification can be done directly or through a third party coordinator.

During ACG FFD Phase 3, AIOC formally informed the Azerbaijan Government of the project ESIA as part of its Scoping process. Additionally, through the Caspian Environmental Programme (CEP) initiative, AIOC informally shared information on the ACG FFD project with the Caspian Sea littoral states to facilitate their participation in the ESIA process where requested. To date, AIOC has not been made aware of any responses from littoral states indicating a desire to participate in the ESIA process; however this information sharing should be repeated for the ACG FFD PWD project. (See Section 2.5.1 for developing legislation referring to Espoo.)

2.4.3 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention)

This Convention aspires to prevent, control, or reduce any transboundary impact resulting from transboundary water pollution. Transboundary waters are defined as those surface or ground waters that are located upon or pass through the boundaries of another convention state. As the Caspian Sea is bordered by four other states, two of which are Parties to the Convention (the Russian Federation and Kazakhstan), it is considered a transboundary watercourse. Article 16 of the Convention contains requirements for public information. Under these requirements, Azerbaijan is required to ensure that information on the conditions of transboundary waters, measures taken to control, reduce, and mitigate transboundary water pollution, and effectiveness of these measures are made available to the public. This includes information on:

- water quality objectives;
- permits issued and the conditions required to be met; and

- results of analysis of water sampling carried out for monitoring and assessment, and results of checking compliance with water quality objectives.

The signatories must ensure that the information is made immediately available to their public and is free of charge. Azerbaijani authorities should provide this same information to the Russian Federation and Kazakhstan upon reasonable payment.

The Water Convention, as it is known, entered into force in October 1996. The Republic of Azerbaijan ratified this in August 2000.

Adopted by the Convention in June 1999 was the **Protocol on Water and Health**. Azerbaijan signed an acceptance of the Protocol in January 2003; the Protocol entered into force in August 2005.

The Water Protocol aspires to protect human health by better water management, which includes the protection of water ecosystems. It covers all watercourses including coastal regions. It is the first international agreement that specifically protects supplies and sources of drinking water, and ensures adequate sanitation within signatory countries. To meet these goals, Parties are required to establish local and national targets for drinking and discharge water quality (the latter of which applies to the ACG FFD PWD project). Also targets are to be set for the performance of water supply and wastewater treatment.

2.4.4 1992 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention)

Azerbaijan is listed as having acceded to the Basel Convention in June 2001. Although this convention primarily deals with transboundary hazardous waste movement, the Convention also requires signatories to:

(a) Ensure generation of hazardous and other wastes within the country is reduced to a minimum, taking into account social, technological, and economic aspects;
(b) Ensure the availability of environmentally sound disposal and management facilities for hazardous and other wastes;
(c) Ensure personnel involved in management of hazardous or other wastes within the country perform the necessary steps to prevent pollution from the wastes they are managing, and that they minimize the consequences of any inadvertently released pollution to human health and the environment

Signatories to the Convention are required to submit annual questionnaires in order to report generation, export and import of the types of hazardous waste that are included in the Convention. The Convention secretariat compiles this data into an annual report that is publicly available. Hydrocarbon/Water mixtures are included in the definitions of Hazardous Wastes in this Convention. Thus, the Convention is significant in terms of the ACG FFD PWD project since produced water disposal falls under the reporting requirements therein.

2.4.5 1971 Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (Ramsar Convention)

Azerbaijan signed the Ramsar Convention in September 2001 and designated two sites as internationally important, one of which is listed as “Marine and Coastal.” This coastal site is known as the Kirov Bays or Kyzyl-Agach (defined as the interconnected Kyzyl-Agach and Lesser Kyzyl-Agach bays, also written *Ghizil-Agaj* or *Qizilagac Korfazi*). Whilst this site is 125 km south of Sangachal and the proposed pipeline route, the location of the site is of importance in terms of risk assessment and emergency response planning for the pipe-laying operations.

2.4.6 1978 International Convention for the Prevention of Pollution from Ships (MARPOL 1973/1978)

This International Convention, first adopted at an International Maritime Organisation (IMO) meeting in 1973, had yet to come into force when it was absorbed by the 1978 Protocol, written at an IMO meeting on tanker safety. MARPOL 1973/1978 came into force in October 1983.

The Convention lists regulations for the prevention, control, and reduction of pollution from shipping, either as a result of accidents or from routine operations.

The first two annexes are compulsory for signatories to the Convention, with the remaining four being optional. Azerbaijan signed to and ratified these first two annexes of MARPOL in 1997, and then the remaining four annexes in 2004.

Altogether, there are six annexes to this Convention:

I. **Regulations for the Prevention of Pollution from Oil**
A revision to this Annex covering limitations on operational discharges is scheduled to come into force in January 2007.
II. **Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk**
A revision to this Annex defining a new categorizing system for noxious substances is scheduled to come into force in January 2007.
III. **Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form**
Signed by Azerbaijan in July 2004, and entered into force October 2004.
IV. **Prevention of Pollution by Sewage from Ships**
Signed by Azerbaijan in July 2004, and entered into force October 2004.
V. **Prevention of Pollution by Garbage from Ships**
Signed by Azerbaijan in July 2004, and entered into force October 2004.
VI. **Prevention of Air Pollution from Ships**
Signed by Azerbaijan in July 2004, and entered into force May 2005.

Whilst it should be noted that the routine discharge of produced water is not a planned activity in this project, a number of principle issues and corresponding standards contained in MARPOL 1973/1978 should be noted for the ACG FFD PWD project when considering any potential unplanned discharges or accidental events. Other issues and standards do apply to the routine activities planned in the Project (e.g., sewage from vessels). These are given in Table 2.2.

The original Convention featured a concept of “Special Areas” where even controlled discharges are banned in protection of that area’s high vulnerability to oil pollution. Since 1973, amendments to the convention have included more Seas and parts of the Oceans to the list of Special Areas, but the list does not include the Caspian Sea.

Table 2.2 Summary of issues, and corresponding standards, governed by MARPOL 1973/1978

Issue	Standard / Rule / Guidance
Produced water / water effluent	Proposed limit of dispersed Oil In Water (OIW) levels for produced water from new installations is 15 ppm.
Contaminated wastewater	Oil must not exceed 15 ppm without dilution.
Bulked chemicals	Prohibits the discharge of noxious liquid substances, pollution hazard substances and associated tank washings. Vessels require periodic inspections to ensure compliance. All vessels must carry a Procedures and Arrangements Manual and Cargo Record Book.
Dangerous goods	Packaging, storage, marking and labelling must be in accordance with internationally recognized codes.
Transfer of oil contaminated wastes	Oil loading terminals, repair or other ports must have shore facilities for the reception of oily wastes. Facilities must meet the needs of the ship without causing undue delay.
Sewage	Discharge of sewage is permitted only if the *ship* has approved sewage treatment facilities, the test result of the facilities are documented, and the effluent shall not produce visible floating solids, nor cause discoloration of, the surrounding water. A revised Annex IV, which entered into force in August 2005 now prohibits sewage discharge except when the ship: • has in operation an approved sewage treatment facility and is discharging sewage which is comminuted (reduced to powder, or pulverized) and disinfected using an approved system at more than 3 nautical miles (5.6 km) from the nearest land; • is discharging sewage which is not comminuted and disinfected at least 12 nautical miles (22.4 km) from the nearest land.
Waste disposal	Disposal of wastes other than ground food wastes (to the required 25mm screen mesh) is prohibited.
Oil spill preparedness	A *shipboard* oil pollution emergency plan shall be produced and implemented in accordance with guidelines developed by the Organization.
Air Pollution	Annex VI, adopted by the Convention in 1997, entered into force in May 2005. It sets limits on emissions of Sulphur Dioxide (SO_x) and Nitrogen Oxide (NO_x) from ships exhausts and prohibits the deliberate emission of any ozone depleting substances. The Annex also sets a global cap on the sulphur content of fuel oil at 4.5 percent m/m. IMO have been called to monitor the average sulphur content of fuel globally once the Protocol came into force. This Annex also prohibits the incineration on board vessels of certain materials, such as contaminated materials and polychlorinated biphenyls (PCBs)

2.4.7 1979 Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)

The Bern Convention aspires to conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several signatory states, and to promote such co-operation.

Azerbaijan is a Party to this Convention, having ratified it in 1999. Therefore, the provisions of this convention as they relate to the Azerbaijan coast and coastal land-take must be considered in terms of the assessment of potential environmental impact arising from the ACG FFD PWD project.

2.5 Developing Legislation

2.5.1 The 2003 Kiev (SEA) Protocol to the 1991 Convention on Environmental Impact Assessment in a Transboundary Context (Kiev or SEA Protocol to the Espoo Convention)

The Protocol on Strategic Environmental Assessment (SEA), known as the 2003 Kiev (SEA) Protocol, was adopted during a meeting of signatories to the Espoo Convention (promoting the use of the ESIA to ensure environmentally sound and sustainable economic development). Once in force, the Protocol will require signatories to evaluate the environmental consequences of their official draft plans and programmes. SEA is undertaken much earlier in the decision-making process than an ESIA, and it is therefore seen as a key tool for sustainable development. The Protocol also provides for extensive public participation in government decision-making in numerous development sectors.

A second amendment to the Espoo Convention was adopted in June 2004, but has yet to be ratified by any state. Once in force, this amendment to the SEA Protocol will:

- Allow affected Parties to participate in Scoping;
- Undertake reviews of compliance;
- Revise the Appendix I (List of Activities) within SEA formatted documents; and
- Make other minor changes.

The significance of this protocol in terms of the ACG FFD PWD project is that once the protocol comes into force, signatory countries (such as the Russian Federation and Kazakhstan) will be required to produce a Strategic Environmental Assessment. Clearly such an assessment will affect the assessment of environmental risk for all major exploration and production projects thereafter.

2.5.2 International Convention on the Control of Harmful Anti-Fouling Systems on Ships (AFS Convention)

The AFS Convention, adopted in October 2001, requires signatories to specifically prohibit organotin compounds (as stated in Annex I) acting as biocides in all ships flying the flag of their countries (as of the Annex's effective date of January 1, 2003), and all ships using ports, shipyards, or offshore terminals of Parties irrespective of national flag flown. The Convention also provides for the prohibition of future harmful anti-fouling compounds, once they are discovered.

By January 1, 2008 (effective date), the Convention states that ships (including offshore platforms such as a pipeline laying barge or PLBG) either:

(a) shall not bear organotin compounds on their hulls or external parts or surfaces; or

(b) shall bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling systems.

The Convention is to go into force one year after no less than 25 countries with a combined Merchant shipping tonnage of a minimum of 25 percent of world shipping tonnage have ratified the agreement. As of the end of May 2006, five years after its signing, a total of 16 countries maintaining 17.3 percent of world merchant shipping have done so. The AFS Convention is therefore not anticipated to affect any vessels involved in the installation of the ACG FFD PWD project pipeline, but the Convention should be noted as potentially affecting any vessels required in maintenance or decommissioning activities during the project lifetime.

2.5.3 2003 Framework Convention for the Protection of the Marine Environment of the Caspian Sea (Tehran Convention)

In November 2003, the five Caspian littoral states, with facilitation by the Caspian Environment Programme (CEP) and the United Nations Environmental Programme (UNEP), signed this Convention in Tehran, Iran. As of December 2005, Azerbaijan had not ratified the Convention.

The purpose of the Convention is to commit Caspian Sea littoral countries to take all necessary measures, individually or collectively, to reduce and control pollution of the sea.

Article 2 defines the Convention objective as the protection, preservation, and restoration of the biological resources of the Caspian Sea from any sources of pollution, as well as sustainable and rational use of these resources.

Article 3 defines the scope of the Convention as the Marine Environment of the Caspian Sea, taking into account any water level fluctuations and pollution from land based sources.

Article 7 states that Parties "shall take all appropriate measures to prevent, reduce, and control pollution of the Caspian Sea from land-based sources." Parties shall also cooperate in the development of Protocols to this Convention that further promote this goal.

Article 8 specifies obligations to prevent, control, and reduce pollution arising from activities on the seabed. Developments of protocols by the Contracting Parties are encouraged to cover this aspect.

Article 9 obligates Parties to take appropriate measures to prevent, reduce, and control pollution from vessels and cooperate in the development of protocols to the Convention prescribing measures, procedures, and standards to this effect, taking into account relevant international standards.

Article 16 obligates Parties to cooperate in scientific research and apply practical measures and procedures to alleviate implications of sea level fluctuations.

Article 17 obligates Parties to apply Environmental Impact Assessments (EIAs) on any planned activity likely to have significant adverse effects on the marine environment, disseminate results of any EIA to other signatories, and develop protocols that determine procedures for EIAs of the marine environment in a transboundary context.

This Convention is currently in final signed form with the Protocols presently in draft form. The Protocols will eventually form the basis for national legislation on which regulations will be based, subject to Azerbaijan ratifying the Convention.

2.5.4 International Convention for the Control and Management of Ship's Ballast Water and Sediments (BWM Convention)

The BWM Convention was adopted during a diplomatic conference of the IMO held in February 2004. Once adopted, it will require signatories to regulate the implementation on all ships carrying that nation's flag a Ballast Water and Sediments Management Plan. For new ships, this will be immediately implemented by the adoptive state; for existing ships, there will be a phase-in period.

All flag-carrying ships of signatories are also to carry a Ballast Water Record Book, and maintain ballast water management procedures to a specified standard. This specified standard was adopted from Guidelines for the Uniform Implementation of the BWM Convention in June 2005 by the IMO Marine Environment Protection Committee (MEPC).

A year later at the March 2006 meeting of the MEPC (also called the 54th Session of that organisation, or the MEPC 54), guidelines were set for approval and oversight of prototype ballast water treatment technology programs. From the 11 guidelines in this document, two systems were approved for immediate use as ballast water management systems. These include:

(a) the use of a biocide for treatment of ballast water; and

(b) the use of electronic means for treatment of ballast water, such as the disinfection of ballast water by electrolysis with generation of free chlorine, sodium hypochlorite, and hydroxyl radicals, and electrochemical oxidation through the creation of ozone and hydrogen peroxide.

The Convention is to go into force one year after no less than 30 countries with a combined Merchant shipping tonnage of a minimum of 35 percent of world shipping tonnage have ratified the agreement. As of the end of May 2006, two years after its signing, a total of 6 countries maintaining 0.6 percent of world merchant shipping have done so. The BWM Convention is therefore not anticipated to affect any vessels involved in the installation of the ACG FFD PWD project pipeline, but the Convention should be noted as potentially affecting any vessels required in maintenance or decommissioning activities during the project lifetime.

2.6 National legislation

Section 2.2 sets out the standards specific to the exploration and development of the Contract Area. As part of the ESIA process, other national environmental legislation was also reviewed with particular regard given to the Environmental Impact Assessment process.

2.6.1 Environmental and Socio-economic Impact Assessment (ESIA)

In Azerbaijan, major private and public developments require the preparation of an ESIA. The objective of the ESIA process is to provide a means whereby adverse impacts can be identified and either avoided or minimised to acceptable levels. During previous Phases of the ACG development and as reiterated in the ACG FFD Phase 3 ESIA, AIOC/BP committed to conducting an ESIA for the long-term disposal solution for produced water from the ACG FFD project. This commitment formed part of a conditional approval for the Phased development of the ACG FFD project.

The fundamental principle of the ESIA is applied by the MENR using the Law of the Azerbaijan Republic on Environmental Protection, August 1999, and the Handbook for the EIA Process published in 1996 with the assistance of the United Nations Development Programme (UNDP). The handbook includes requirements for scientific expertise and public consultation. Following its submission to the MENR the document is reviewed for up to three months by an expert panel.

AIOC/BP has incorporated the elements of this handbook in the ACG FFD ESIA process.

2.6.2 Azerbaijan regulatory agencies

The main environmental regulatory body is the MENR, which was formed from the merger of four state organisations comprising the State Committee for Ecology, State Committee for Hydrometeorology, State Forestry Committee, and the State Committee for Geology. This body is responsible for the following:

- development of draft environmental legislation for submission to the Azerbaijan Parliament (Milli Mejlis);
- implementation of environmental policy;
- enforcement of standards and requirements for environmental protection;
- suspension or termination of activities not meeting set standards;

- advising on environmental issues;
- expert review and approval of environmental documentation, including Environmental and Socio-economic Impact Assessment (ESIA); and
- implementation of the requirements set out in international environmental conventions ratified by the Azerbaijan Republic.

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3 Environmental and Socio-economic Impact Assessment Methodology

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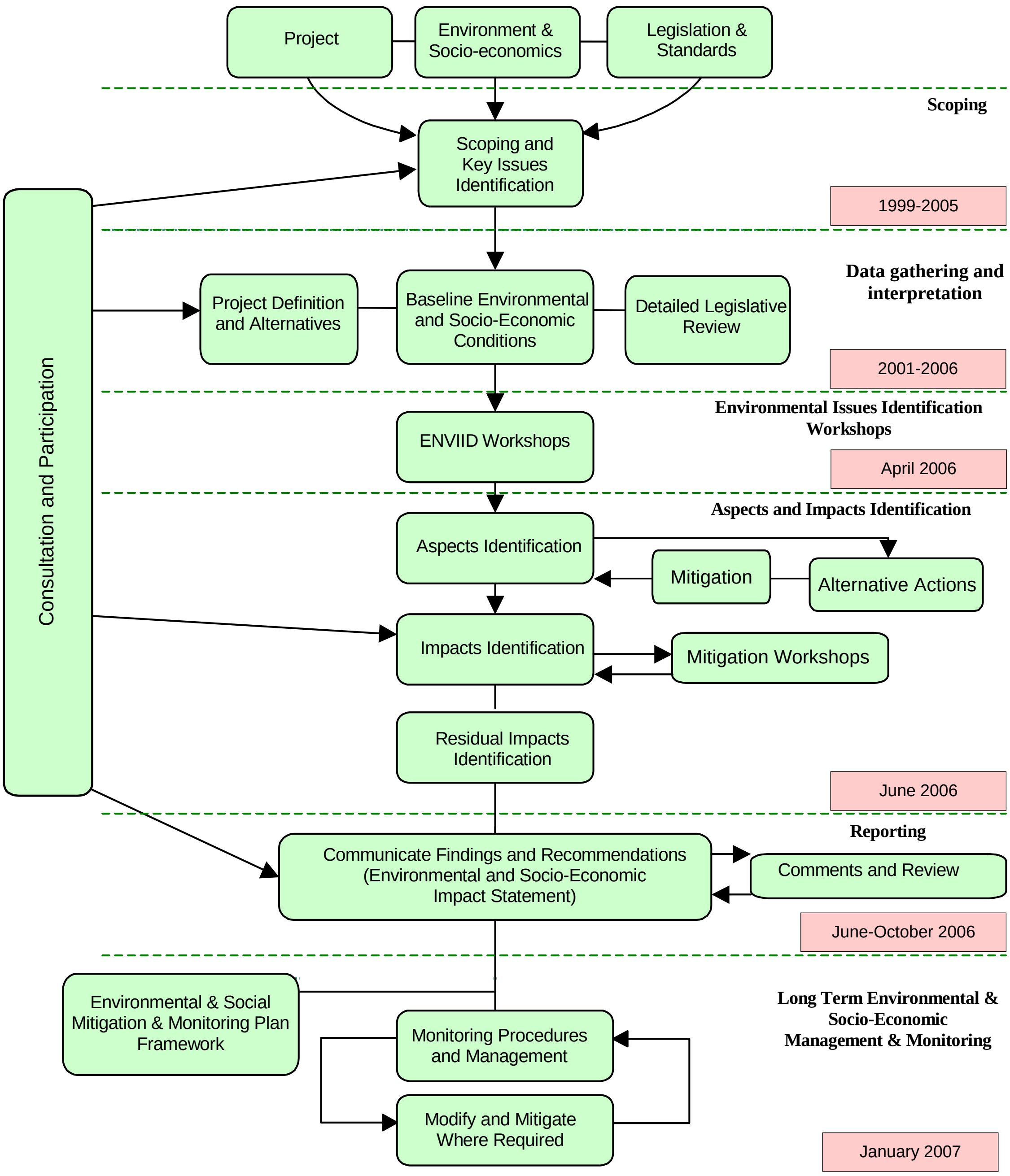
3.1 Introduction

The Environmental and Social Impact Assessment (ESIA) process for the Azeri, Chirag, and Gunashli (ACG) Full Field Development (FFD) Produced Water Disposal (PWD) project incorporated a number of key steps as illustrated in Figure 3.1. The assessment process adopted for the project was built on a systematic approach to the evaluation of the project in the context of the natural, regulatory, and socio-economic environments of the area in which the development is proposed, as developed and adhered to during Phases 1, 2, and 3.

Figure 3.1 The ACG FFD Produced Water pipeline ESIA project development process



Note: The Environmental and Social Mitigation and Monitoring Plan is also commonly referred to as the Environmental and Social Action Plan.

The remainder of this chapter shall provide description of each of the assessment process steps illustrated in Figure 3.1.

3.2 Scoping

The first step in the ESIA was to define the proposed project activities and the natural, regulatory (i.e., legal), and socio-economic environments in which these activities would occur. This was achieved through Scoping, which is identifying activities that have a potential to interact with the environment. Scoping was conducted early in the ESIA process so that a focus on the priority issues (i.e., those that have the greatest potential to affect the natural and/or socio-economic conditions) was established for the rest of the ESIA process.

The ACG FFD PWD project scoping exercise consisted of the following key elements:

- Gathering and review of environmental and socio-economic data relevant to the proposed development area (concentrating on the area in the vicinity of the existing Sangachal Terminal, onshore fabrication yards, and the offshore environment in the vicinity of the proposed pipeline route).
- Gathering and review of existing engineering design definition. All project elements were considered in this review, including fabrication, transportation, construction and installation, commissioning, operations, maintenance, and decommissioning. Routine (normal operating conditions), planned non-routine (abnormal operating conditions, e.g., planned start-up/shutdown activities) and unplanned (i.e., accidental) events were considered.
- Verification of relevant legislative requirements, environmental standards and guidelines (national and international) identified during the earlier Phases of the ACG development (Phase 1, 2, and 3), as well as Azerbaijan International Operating Company (AIOC) partner policy and standards.
- Consultation with project stakeholders and other potentially interested and affected parties at the scoping stage (Chapter 8).

The Scoping of the ACG FFD PWD project also assisted in the identification of gaps in the environmental, socio-economic and engineering information that needed to be addressed to allow an informed impact assessment later in the ESIA process.

3.3 Detailed data gathering and review

Following Scoping, assembled legislative requirements, engineering, environmental, and socio-economic data were assessed in greater detail to ensure that all of the proposed activities and their consequences were considered in full.

3.3.1 Existing environmental and socio-economic conditions

In order to identify any potential impact on and potential change to the natural and socio-economic environments, it is essential to have a thorough understanding of the nature of the existing environments prior to commencement of the proposed activities. This translates as a need to characterise the existing baseline environmental and socio-economic conditions including establishing the prevailing conditions for a range of media as follows:

- Natural environment media such as air, water, soil and groundwater, flora, and fauna; and
- Socio-economic media such as demographics, economic activity, and service provision.

A significant amount of data already exists for the region through fieldwork, desk-based data gathering and interpretation, and other studies conducted as part of the ACG FFD Phase 1, 2, and 3 ESIAs. Within these studies, the existing environmental and social conditions were achieved by completing the following main tasks:

– Conducting a detailed review of all secondary data sources (i.e., existing documentation and literature). Significant environmental data acquisition surveys and studies have been carried out in the Sangachal area and in the vicinity of the ACG PSA Contract Area offshore during the Phase 1 and 2 ESIAs. This information was assembled and reviewed to provide an environmental and social baseline.

– Reviewing the environmental and socio-economic baseline data gathered during the ACG FFD Phase 3 ESIA. This reflects changes to the Sangachal and offshore development areas during project construction and installation associated with ACG FFD Phase 1 and 2.

– Review of the onshore construction yard data presented in ACG FFD Phase 3 ESIA and amendment to reflect the current status at these yards.

Both existing secondary sources and results of the new studies were analysed and presented in the Environmental Description (Chapter 6) and Socio-economic Baseline (Chapter 7). To reduce the amount of repetition of information presented in each ESIA associated with the phased development of the ACG Project, the chapter concentrates on new or modified data, referencing previous reports where data is unchanged.

3.4 Consultation and disclosure

Project stakeholder consultation is a vital component of the ESIA process. Consultation should inform the Project decision-making process and therefore should be commenced sufficiently early in the ESIA process to ensure that it forms an integral component of decision-making.

The consultation process focuses on providing information on the proposed project in a manner that can be understood and interpreted by the relevant audience. It seeks comment on key issues and concerns, sourcing accurate information, identifying potential impacts, and offering the opportunity for alternatives or objections to be raised by the potentially affected parties: non-governmental organisations, members of the public, and other stakeholders. Key objectives of consultation and disclosure are to promote a sense of stakeholder ownership of the project and to communicate transparently how issues raised by stakeholders have been addressed, as appropriate, in the ESIA and project decision-making process.

The ACG FFD PWD project developed a Public Consultation and Disclosure Plan (PCDP). This PCDP aligns with the ACG FFD Phase 3 project PCDP, and will be available with the Phase 3 plan at http://www.bp.com/subsection.do?categoryId=9006656&contentId=7013370. The ACG FFD PWD PCDP details:

- The consultation methods employed for ESIA;
- A list of stakeholders consulted during previous ESIAs; and
- List of meetings.

Further details of consultation are presented in Chapter 8.

3.5 Project options and definition

An important step in defining a project is to identify, at a conceptual level, viable alternatives to the project so that a viable project design may be realised. Consideration of project alternatives occurs at two levels as follows:

- Development as a whole, including the “no development option”; and
- Engineering alternatives for the selected Project Design.

Chapter 4 presents a summary of the option selection and design refinement processes that informed the selection design for the ACG FFD PWD project. A brief outline description of the options assessed together with the option assessment findings are presented in Chapter 4, while the selected Project Design and detailed Environmental and Social Impact Assessment of the selected Project Design are presented in Chapters 5 and 9, respectively.

ESIA environmental engineers worked alongside the ACG FFD PWD project team to gather and interpret relevant engineering design information for the project. Information gathered for the proposed project was reviewed, assessed and used by the impact assessment team.

The continuous interaction between the various project team components allowed the impact assessment team to identify and feedback to the design engineers in areas where there was a requirement for greater definition on the programme and the mitigation measures that are proposed as part of the project design.

3.6 Policy, regulatory, and administrative review

The legislative context of the ACG FFD PWD project is described in Chapter 2. The definition of relevant national and international standards and requirements has ensured that the project development has been assessed against all relevant existing environmental regulations and guidelines as well as AIOC environmental and other national and international policies and standards.

3.7 Environmental and Socio-economic Impact Assessment (ESIA)

3.7.1 Definition of aspects

The International Standard Organisation’s standard for Environmental Management Systems (EMS), ISO 14001, defines an environmental aspect as:

“*An element of an organisation’s activities, products, or services that can interact with the environment*.”

This definition has been used in the identification of the proposed project’s environmental, legal and socio-economic aspects.

3.7.2 Environmental and Socio-economic Issues Identification (ENVIID)

To identify project environmental and socio-economic aspects of all proposed activities, Environmental and Socio-economic Issues Identification (ENVIID) workshops were held between the ACG FFD PWD project team and the ESIA Consultants on March 1, 2006, in London and April 25, 2006, in Baku. The ENVIID workshops were focused to identify the potential environmental and socio-economic issues (i.e., risks and opportunities) associated with each proposed activity and participants included key project engineers and Health, Safety, and Environment (HSE) advisors.

Proposed project activities were considered in terms of their potential to:

- Interact with the natural environment including its physical and biological elements;
- Breach the PSA, relevant international, national, industry, and operator standards, and operator/partner policy; and
- Interact with the existing socio-economic environment.

Assessed activities included:

- Planned routine activities (activities occurring during normal operating conditions);
- Planned but non-routine activities (activities that are planned to occur outside desired normal operations but within operational design parameters); and
- Unplanned (accidental) events (events that are outside design parameters, suggesting an operational failure or a result of third party intervention).

The workshops focused on specific areas as follows:

- Onshore transport, fabrication, and construction of the pipeline and associated onshore facilities;
- Installation, hook-up, testing, and commissioning of onshore facilities;
- Preparatory shoreline works, installation, hook-up, and testing of the pipeline;
- Onshore operation and processes (Sangachal Terminal);
- Offshore operation and processes;
- Subsea pipeline and facility fabrication, transport, construction, installation, commissioning, and operation; and
- Decommissioning.

In addition to the above, concerns and issues raised by members of the community and/or project stakeholders during Scoping and subsequent consultation were included in the process.

The ENVIID workshops provided the opportunity to:

- Confirm the definition and understanding of the project design;
- Identify and define with the design engineers project activities that could interact with the environment and social environment; and
- Jointly determine the level and importance of those interactions to focus project design on areas of concern with a view to mitigation.
- Evaluate possible alternatives and options, and consider any known mitigation measures.

This information was used in the compilation of the project description (Chapter 5) and in the impact assessment for the ESIA (Chapter 9).

3.8 Environmental and socio-economic impact identification

3.8.1 Definition of impacts

ISO 14001 defines an environmental or social impact as:

"Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products, or services."

3.8.2 Determining impact significance

Once all project environmental aspects were identified (using the information provided by the ENVIIDs), the level of impact that may result from each of the activity-receptor interactions was assessed. An environmental or socio-economic impact may result from any of these identified project aspects. Activities proposed under the ACG FFD PWD Project were assessed in terms of their potential to:

- Contribute to environmental or socio-economic stresses and therefore impacts;
- Result in transboundary or cumulative impacts, either in their own right, or due to the other development projects currently operating.

In assessing the level of impact that an activity may cause, two key elements were considered:

- **Consequence:** the resultant effect (positive or negative) of an activity's interaction with the regulatory, natural, and/or socio-economic environments; and
- **Likelihood:** the likelihood that an activity will occur.

When assigning a level of consequence to the project activities, full consideration was given to the mitigation or design known as incorporated into the ACG FFD PWD project. For example, previous Phases of ACG FFD have developed and implemented a range of management plans to mitigate the impacts predicted with those projects. These plans form the baseline for the ACG FFD PWD project and will be implemented after first being updated based on lessons learned during these earlier projects.

3.8.3 Consequence

Criteria were defined to assign a level of consequence to each environmental and socio-economic impact. The level of consequence for each identified impact was determined by examining a number of factors relating to the activity including:

- The ability of the natural environment to absorb the impact based on its natural dynamics and resilience (Chapter 6);
- The ability of the socio-economic environment to absorb the impact based on cultural and economic dynamics and resilience (Chapter 7);
- Community and stakeholder issues and concerns raised (Chapter 8); and
- Level of potential non-compliance with legislation, policy, and/or adopted project standards.

The environmental and socio-economic consequence criteria are presented in Tables 3.1 and 3.2, respectively. A ranking of "4" represents the most severe consequence going down to '1' as the lowest and '+' as a positive impact/benefit.

Table 3.1 Categories and definition of consequence levels for natural environment impacts

Ranking	Definition
4	▪ Impacts on a unique habitat > 2 km, or national scale (>20 km) impact resulting in: – Long term (> 5 years) change, and/or damage to the natural environment and its ecological processes; – Impairment of ecosystem function; – Reduction in regional habitat and species diversity; and/or – Direct loss of habitat for endemic, rare, and endangered species of fauna and/or flora and for species' continued persistence and viability (i.e., availability of necessary resources) nationally and regionally (for species unable to disperse). ▪ Natural habitat restoration time 5 + years and requiring substantial intervention. ▪ Continuous breach of environmental regulations and company policy and/or exceedance of international, national, industry, and/or operator standard for an emission parameter. ▪ Public outrage, multiple complaints, and/or negative adverse international/national media attention. ▪ Critical financial loss and loss to Company value (>$5 million).
3	▪ Impacts to a unique habitat <2 km/or regional scale (2-20 km) impact resulting in: – Medium term (2-5 years) change and/or damage to the natural environment and ecological processes; – Direct loss of habitat crucial for species' (including listed species) continued persistence and viability (i.e., availability of necessary resources) in the project area (for species unable to disperse); – Introduction of exotic species of fauna and invasive floral species replacing resident 'natural communities' within the project area; and – Environmental stress lowering reproductive rates of species within the project area. ▪ Restoration time 2 to 5 years and may require intervention. ▪ Potential breach from planned/non-routine activity of regulations and company policy and/or 50 to 100 percent contribution of international, national, industry, and/or operator standards for an emission parameter. ▪ Public frustration, complaints from communities, authorities, NGOs, and/or local media attention. ▪ Large financial loss ($500K to $5 million).
2	▪ Local scale impact (<2 km) resulting in: – Short term (<2 years) change, and/or damage to the local natural environment and its ecological processes; – Short-term (<2 years) decrease in species diversity in selected biotopes/areas within the project area; and/or – Increased mortality of fauna species due to direct impact from project activities. ▪ Restoration within 2 years requiring minimal or no intervention. ▪ Within international, national, industry, and/or operator standards for an emission parameter. ▪ Public concern and/or local complaints from individuals/community. ▪ Moderate financial loss ($100K to $500K).
1	▪ Disturbance to the environment in the immediate area (<2 km) but the impact is largely not discernable within the project area. ▪ Recovery within 6 months without intervention. ▪ Within international, national, industry, and/or operator standards for an emission parameter. ▪ Public perception only and/or no complaints from individuals/community. ▪ Minimal financial loss (<US$100K).
+	▪ Activity has net positive and beneficial affect resulting in environmental improvement, for example: – Ecosystem health; – Increase in magnitude or quality of habitat for rare and endangered species of fauna and flora, as well as for those species known to naturally occur in the area; and – Growth of 'naturally occurring' populations of flora and fauna. ▪ Positive feedback from stakeholders. ▪ Potential financial gains.

Table 3.2 Categories and definition of consequence levels for socio-economic impacts

Ranking	Definition
4	▪ Critical financial loss to Company value (>$5 million). ▪ Permanent adverse impacts on livelihoods or income generation source. ▪ No sourcing of manpower from Azerbaijan labour market. ▪ No sourcing of supplies and services from Azerbaijan supplier network. ▪ Irreversible impact on health and safety (e.g., fatalities). ▪ Permanent or irreversible loss of access or damage to social infrastructure.
3	▪ Large financial loss to Company (>$500K to $5 million). ▪ Long-term (i.e., year(s)) adverse impact on the livelihoods and income generation source of between 51 and 100 households. ▪ Only limited sourcing of manpower from Azerbaijan labour market (i.e., 1-29 percent of total employment). ▪ Only limited sourcing of supplies and services from Azerbaijan supplier network (i.e., 1-9 percent of total value). ▪ Long-term (i.e., year(s)) adverse reversible impact on health and safety of local, regional and/or national population. ▪ Long-term impact either restricting access to or incurring significant damage to social infrastructure or facilities used by between 51 and 100 households.
2	▪ Moderate financial loss to Company ($100K to $499K); ▪ Medium-term (i.e., month(s)) adverse impact on the livelihoods and income generation source of between 11 and 50 households. ▪ Only moderate sourcing of manpower from Azerbaijan labour market (i.e., 30-49 percent of total employment). ▪ Only limited sourcing of supplies and services from Azerbaijan supplier network (i.e., 10-19 percent of total value). ▪ Medium-term (i.e., month(s)) reversible impact on health and safety or local, regional and/or national population. ▪ Medium-term impact either restricting access to or incurring some damage to social infrastructure or facilities used by between 11 and 50 households.
1	▪ Minimal financial loss to Company (<$100K). ▪ Short-term (i.e., days or weeks) adverse impact on the livelihoods and income generation source of between 1 and 10 households. ▪ Only considerable sourcing of manpower from Azerbaijan labour market (i.e., 50-69 percent of total employment). ▪ Only considerable sourcing of supplies and services from Azerbaijan supplier network (i.e., 20-29 percent of total value). ▪ Short-term (i.e., days or weeks) reversible impacts on health and safety of local, regional and/or national population. ▪ Short-term adverse impact either restricting access to or incurring limited damage to social infrastructure or facilities for between 1 and 10 households.
+	▪ Potential financial gains to the Company. ▪ Beneficial impacts on livelihoods and income generation activities of local, regional and/or national population. ▪ Extensive sourcing of manpower from Azerbaijan labour market (i.e., +70 percent of total workforce). ▪ Extensive sourcing of supplies and services from Azerbaijan supplier network (i.e., +30 percent of total value). ▪ Improvements to health and safety situation at a local, regional and/or national level. ▪ Beneficial impacts (i.e., improvements) to social infrastructure or facilities at a local, regional, and national level.

3.8.4 Likelihood

Likelihood in this assessment is the probability of an activity occurring. To assign likelihood to each activity, four criteria were defined and ranked. The criteria for likelihood are shown in Table 3.3. Level four represents the highest likelihood that an activity will occur.

Table 3.3 Likelihood categories and rankings

Ranking	Definition
4	The activity/event is certain to occur under normal operating conditions.
3	The activity/event is likely to occur at some time (1-10 years) under normal operating conditions.
2	The activity is unlikely to, but may, occur at some time (10-25 years) under normal operating conditions.
1	The activity is very unlikely to occur (>25 years) under normal operating conditions, but may occur in exceptional circumstances.

3.8.5 Residual significance

As the mitigation measures known as emplaced within ACG FFD Phase 3 were considered in the impact assessment, it was possible to determine residual significance for all of the projects proposed activities. Residual impacts are impacts that remain after mitigation measures, including those incorporated into the project's design and those developed in addition to the base design.

The residual impact significance is expressed as the product of the consequence (which considers the effectiveness of mitigation) and likelihood of occurrence of an activity, and is expressed as follows:

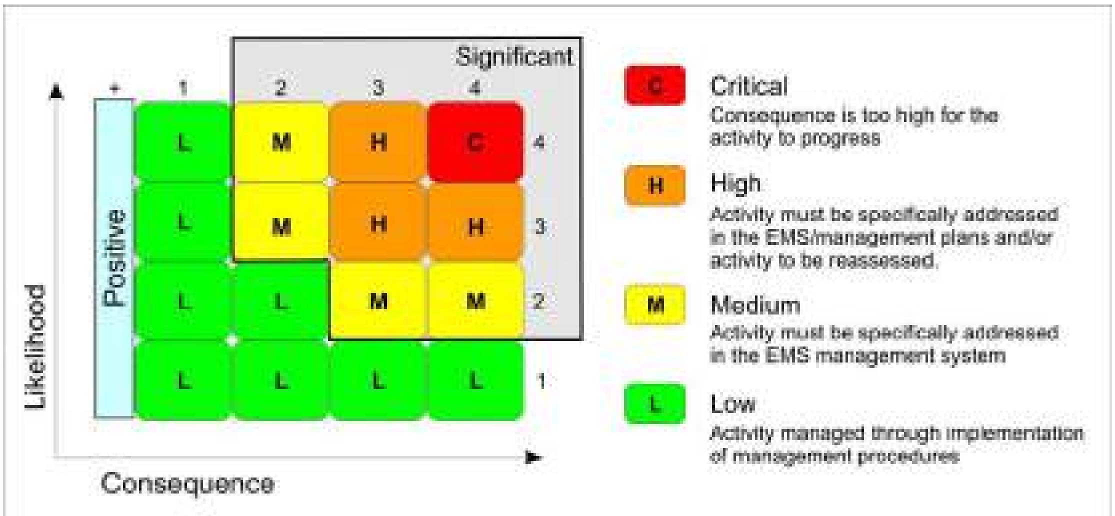
Residual Significance = Consequence x Likelihood

To assist in determining and calculating the significance of an impact, impact assessment matrices (Appendix IV) were developed listing activities on the y-axis and receptors on the x-axis. Two columns were created for each receptor; one for consequence and one for likelihood. Drop-down menus containing the criteria levels were entered into the cells in these columns.

A second matrix was then compiled to calculate the overall significance of each of the identified potential impacts. In the 'significance' impact matrix, each receptor has only one column in which the significance of the impact (i.e., consequence x likelihood) is calculated. From this matrix, those impacts that fall into the "critical" (i.e., >16) and "high" (i.e., 9-16) were identified.

Based on its consequence-likelihood score, each environmental and socio-economic aspect was ranked into four categories or orders of residual significance. Figure 3.2 illustrates all possible product results for these four consequence and likelihood categories and rankings.

Figure 3.2 Residual Impacts Significance Ranking



The results of the environmental and socio-economic impact assessment processes are presented in summary tables in Chapter 9. The impacts requiring further analysis in terms of identifying additional mitigation measures are discussed in detail and mitigation measures designed to further reduce identified residual impacts are presented in Chapter 10.

3.8.6 Cumulative impacts

The December 1998 IFC "Procedure for Environmental and Social Review of Projects" states that that an environmental assessment should also address cumulative impacts (draft Guidance Note # [G]; OP 4.01). The objective of the cumulative impact assessment is to identify those environmental and/or socio-economic aspects that may not on their own constitute a significant impact but when combined with impacts from past, present, or reasonably foreseeable future activities associated with this and/or other projects, result in a larger and more significance impact(s). Examples of cumulative impacts include:

- The recurring loss of habitat in areas that are disturbed and re-disturbed over an extended period;
- Additional emissions as a processing plant is extended and expanded over a period of time, and
- Positive impacts from the ongoing development of employment opportunities and enhancement of local labour skills base.

3.8.7 Transboundary impacts

The World Bank Operating Procedure (OP) 4.01 stipulates that transboundary impacts (impacts that cross the border of Azerbaijan into neighbouring countries) should be considered during the ESIA process. The assessment of transboundary impacts for the ACG FFD PWD project is related mainly to atmospheric emissions and the possibility of accidental releases.

3.9 Mitigation and monitoring

3.9.1 Mitigation

As discussed, many mitigation measures are already included in the project design and these were taken into consideration during the impact assessment process. Impacts that are identified as having a residual significance ranking of “high” or “critical” have been further analysed to identify additional mitigation measures that are potentially available to eliminate or reduce the predicted level of impact. These mitigation measures consider the reduction or avoidance of impacts from ACG FFD PWD project both as a stand-alone project, and together with the potential for transboundary or cumulative impacts identified for the project.

The results of the mitigation analysis are presented in Chapter 10 for the natural and socio-economic environments, respectively.

3.9.2 Monitoring

During the ACG FFD PWD project, it will be necessary to monitor and audit project development and operation. Monitoring will provide the information necessary for feedback into the environmental management process and will assist in identifying where additional mitigation effort or where alteration to the adopted management approach may be required.

The monitoring commitments under the ACG FFD PWD project will be implemented through the Integrated Environmental Monitoring Plan (IEMP) that BP developed to align all environmental studies required to support the development and operational practices of BP’s Azerbaijan Business Unit (AzBU). The IEMP focuses on areas in which the ACG FFD Project, the Shah Deniz Project, EOP, and future upstream operations are (or will be) active, and is discussed in detail in the ACG FFD Phase 3 ESIA (Section 10); it is not repeated here. Monitoring specific to the proposed ACG FFD PWD project is discussed in Chapter 10.

3.10 Long-term Environmental and Socio-Economic Management (ESMS)

As the latest component of the ACG FFD, the PWD project will be within the existing ACG project Environmental and Social Management System (ESMS). This describes the various environmental management strategies and generic procedures for their implementation. It identifies the management roles and responsibilities for ensuring that monitoring is undertaken, and that the results are analysed and any necessary amendments to practices are identified and implemented in a timely manner. The ESMS is discussed in detail in the ACG FFD Phase 3 ESIA (Chapter 11) and is not repeated here.

4 Options Assessed for the Azeri, Chirag, and Gunashli (ACG) Full Field Development (FFD) Produced Water Disposal (PWD) Project

Contents

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Tables

4.1 Introduction

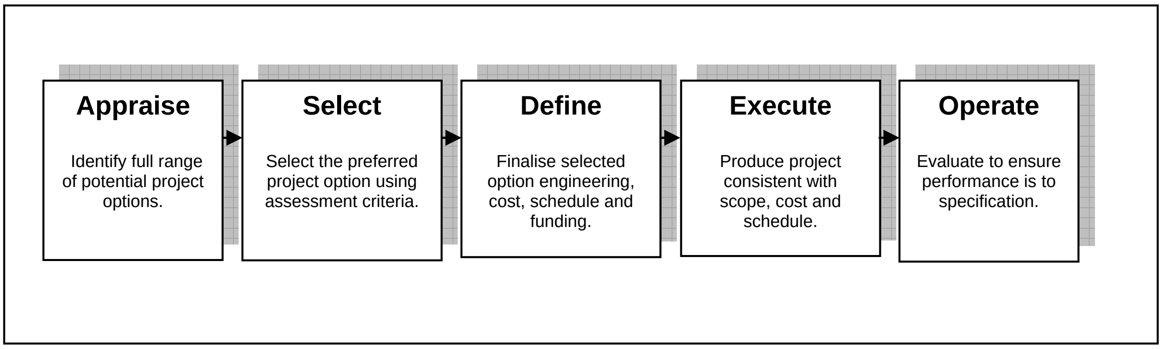
The objective of this project is to identify, design, install and operate an appropriate solution for the disposal of volumes of Produced Water in the long term, for the Produced Water separated at Sangachal Terminal throughout the life of the Azeri, Chirag, and Gunashli (ACG) Full Field Development (FFD). Studies to consider various Produced Water Disposal (PWD) options began in 1999 and have involved numerous BP and independent technical experts. These studies resulted in a number of potential project solutions being developed and considered.

This chapter discusses these options and the decision making process used in their evaluation. These options were appraised by a process following the stages of the BP Capital Value Process (CVP) from Appraise through to Define stage of assessment. The information on each option is provided and advantages and disadvantages were identified following assessment against the CVP criteria. The recommended option that was taken forward is explained and an evaluation of this option provided.

4.2 Project assessment process

BP's CVP was followed as the mechanism to sanction the project at a number of different stages, which closely follow the stages of engineering design. Figure 4.1 presents the stages of CVP that all project development decisions must pass through.

Figure 4.1 BP Capital Value Process (CVP)



The following subsections explain the objectives of each of the stages of the BP's CVP.

4.2.1 Appraise

The Appraise stage considers project concepts in terms of their feasibility to provide an acceptable solution. At this stage, it is important that a wide range of options be considered to give the best chance of accessing the correct solution. Analysis of options within Appraise aims to identify if they are feasible by considering the technical engineering detail known at the time.

Options under consideration in Appraise and Select stages are evaluated in terms of how they meet the following set of five established criteria:

- **Technical** – this considers technical availability, capability, and operability of the option. The option needs to be technically capable of delivering the specification required, proven in the field, and reliable to ensure minimum downtime, and the appropriate skills to operate must be available.
- **Safety** – the option needs to achieve appropriate safety levels that will not put people or process plant at risk.

- **Environmental and socio-economic** – the option needs to meet the environmental and socio-economic standards that the project has set. Impacts should be considered as direct impacts as well as the potential for perceived impacts that may introduce risks to reputation.
- **Reputation –** the option needs to meet the project standards for public reputation. The option is assessed for the potential to result in negative publicity and associated cost.

Cost – the capital expenditure (CAPEX) of each project concept is calculated for comparison. This includes CAPEX estimates for the cost of manufacture, construction, and installation. A cost estimate for each project was identified within one of the following ranges:

- <$100 million;
- $100 - $200 million;
- $200 - $300 million;
- $300 - $400 million; and
- >400 million.

Operational or decommissioning costs of each option were not included within this evaluation (decommissioning is discussed in Section 5.6)

During Appraise, less desirable options are generally removed from consideration on a single overriding criterion, whereas in Select a more thorough analysis is necessary to identify a preferred option (the options being closer to equal in their quality), using more engineering information to make the decision. Those that are considered feasible after assessment within the Appraise phase will be recommended to move forward to the Select stage for further assessment.

4.2.2 Select

The Select stage evaluates in detail the options that move forward from the Appraise stage in terms of the five criteria identified in Section 4.2.1. At this point, each option is considered on an equal basis with the other options going through the review process, and the Select option analysis will result in a range of specific issues that require evaluation between options to identify the Best Practicable Environmental Option (BPEO). This will be the preferred option for the project, the option that will move into the Define stage.

4.2.3 Define

Within Define, the preferred option is developed to provide more definition of the project (Chapter 5). This work continues to develop technical definition, cost, schedules, safety, environmental evaluation, and socio-economic evaluation for the preferred option.

4.2.4 Execute

The Execute stage is when detailed engineering of the preferred option occurs and when the design team develops the engineering, schedule, and cost details identified in the Define stage. Construction work is also started during this phase. The project then moves to the Operate stage.

4.2.5 Operate

The Operate stage implements the preferred option. During this stage, a process evaluation of project performance is carried out to check that it is meeting the required specifications. At this stage, the project management is moved from the Projects to Operations team.

4.3 Options assessed

This Section provides a summary of all of the project options assessed to manage the long-term disposal of volumes of ACG FFD Produced Water from Sangachal Terminal. Twelve project concepts were identified in Appraise, seven of these remained in Appraise and five were carried forward to Select. Of these five options, one was identified as the preferred option and this moved into Define. Table 4.1 lists all project options including the final stage of the CVP that each reached.

A description of all options considered for the ACG FFD Produced Water project is provided in the report Sections referenced in Table 4.1. Project options that did not move out of Appraise into Select are discussed in Section 4.4. Those options that moved into Select are discussed in Section 4.5. A summary of the outcome of the Select stage project assessment against the Select criteria is provided in Section 4.6. A detailed project description of the preferred option is provided in Chapter 5.

Table 4.1 Project options summary

Section	Project Option	CVP Stage reached
4.4.1	No development option	Appraise
4.4.2	Clean-up using process equipment (MPPE) and discharge to Caspian Sea	Appraise
4.4.3	Evaporation pond	Appraise
4.4.4	Clean-up using reed bed treatment and discharge to Caspian Sea	Appraise
4.4.5	Treatment and reuse as irrigation water	Appraise
4.4.6	Cement plant	Appraise
4.4.7	New Produced Water injection platform	Appraise
4.5.2.1	Produced water injection at Lokbatan (including enhanced separation offshore)	Select
4.5.2.2	Produced water injection at Mishovdag (including enhanced separation offshore)	Select
4.5.3	Produced water biological treatment then discharge to sea (including enhanced separation offshore)	Select
4.5.4.1	Produced water offshore pipeline for Injection (including enhanced separation offshore)	Select
4.5.4.2	Produced water offshore pipeline for Injection (without enhanced separation offshore)	Define

4.4 Project options rejected during CVP Appraise stage

As already described, all options that have been considered for the disposal of Produced Water were subject to the CVP of selection. This Section presents descriptions of the seven Appraise stage options that did not move forward into Select and provides the reasons for this within the Rejection Rationale section for each option.

4.4.1 No development option

To understand fully why it is necessary to develop a project solution the scenario of a no development option was considered. This option is to do nothing and aim to manage Produced Water for the long term using the current facilities. The no development option was rejected as a viable solution for the ACG FFD PWD project for following reasons:

1. Produced Water volumes over the long-term will exceed the disposal capacity of the short-term disposal option and the storage capacity of Sangachal Terminal. The result is a waste stream for which no disposal option has been provided.

2. A lack of disposal option for Produced Water would mean that oil production would have to be reduced and eventually stopped to reduce or stop Produced Water production.

4.4.2 Clean-up using Macro-Porous Polymer Extraction (MPPE) and discharge to Caspian Sea

4.4.2.1 Process description

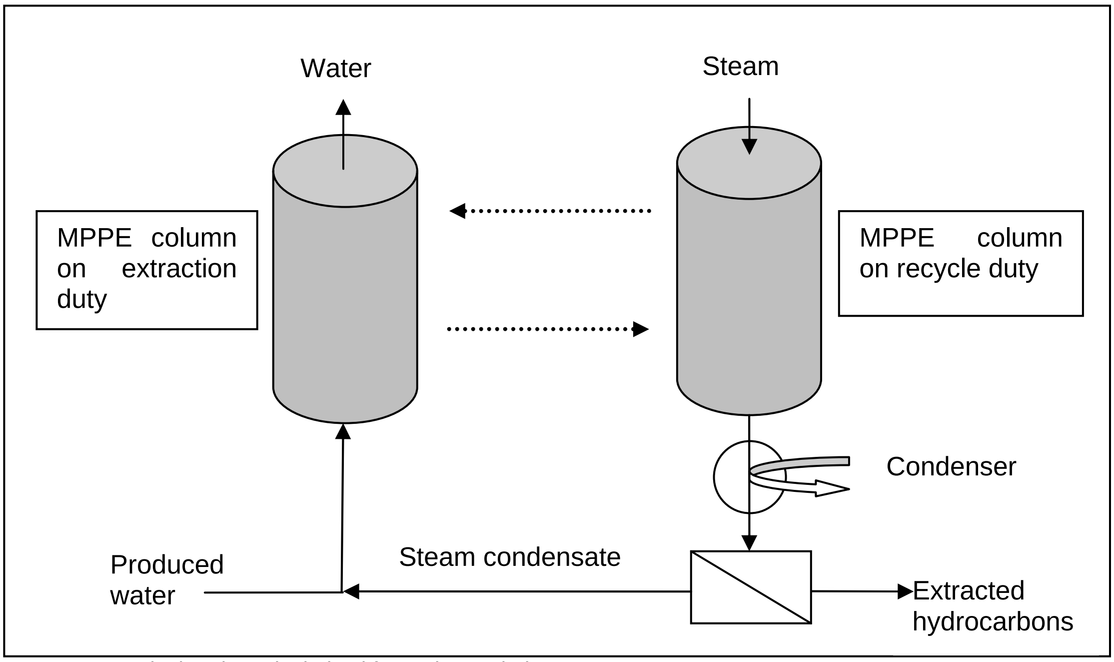
The principle behind this option is the assumption that if the Produced Water were treated to an acceptable standard, then it could be discharged via an outfall pipeline into the Caspian Sea, outside the area of Sangachal Bay. Such treatment would require the reduction of oil in water (OIW), total dissolved solids (TDS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), and heavy metals to comply with an effluent discharge. The standards this project has set regarding specification for treatment of Produced Water to be discharged are to best international practice and national legislation; these are presented as Appendix III.

Various treatment options were assessed as possibilities for treatment prior to discharge through an outfall pipeline to sea. These included biological treatment (Section 4.5.3) and reed bed treatment (Section 4.4.4).

Within Appraise, the option of an onshore treatment process that used Macro-Porous Polymer Extraction (MPPE) technology for dissolved organics removal, prior to discharge to the Caspian, was considered. Two variations of this process were evaluated, both of which involved a pre-treatment to soften the water and to remove heavy metals, which is required for the MPPE process to function correctly.

MPPE is a process that uses porous polymer beads that contain an extraction liquid. The extraction liquid removes specific hydrocarbons from the Produced Water. However, only certain specific hydrocarbons are removed and some may remain in the water. The organics that are removed are those with a higher affinity for the extraction liquid than for the water. These include aliphatic and aromatic hydrocarbons as well as halogenated hydrocarbons. Figure 4.2 presents a schematic diagram of the MPPE process.

Figure 4.2 Schematic overview of Macro-Porous Polymer Extraction (MPPE) process



Note: Data in the Figure is derived from Akzo Nobel MPP Systems 2004.

4.4.2.2 Rejection rationale

The use of MPPE, in combination with additional onshore treatment process, followed by discharge to the Caspian Sea was rejected as a viable solution to treat and dispose of the ACG FFD PWD project for the following reasons:

1. Operational performance of the MPPE technology is not proven for the chemical composition or flow rate of the ACG FFD Produced Water. If the technology failed to meet the required treatment specification, it presents environmental concerns if combined with discharging the treated Produced Water to the Caspian Sea.

2. The higher flow rate of ACG FFD Produced Water would require multiple MPPE units to meet the treatment performance for this project. Installation of the multiple MPPE trains would create a large equipment footprint.

3. The MPPE process will generate a hazardous waste stream, which requires appropriate disposal.

4.4.3 Evaporation pond

4.4.3.1 Process description

Evaporation ponds were considered within the Appraise stage. These have historically been the favoured method for Produced Water disposal (PWD) in Azerbaijan and there is much evidence of this form of treatment near to the BP ACG terminal and construction activities (Lokbatan and Bibi-Heybat). This option requires Produced Water to be pumped into a large lagoon where the water is left to evaporate, leaving behind salt and various other contaminants. This creates a highly saline sludge that would periodically require collection from the evaporation pond and disposal to landfill. The evaporation ponds must also be lined to protect against seepage of contaminants to subsurface layers.

This method has been used to varying degrees of success since the inception of oil extraction activities in Azerbaijan, Evaporation ponds are easy to construct and uncomplicated to operate in comparison to other options. Little power is consumed in the disposal process; however, they require a very large surface area and favourable climate conditions for adequate evaporation.

4.4.3.2 Rejection rationale

Evaporation ponds were rejected as a viable solution for the ACG FFD PWD project for the following reasons:

1. The annual evaporation rates at Sangachal are not sufficient to provide a reliable disposal of the Produced Water volumes associated with the long-term disposal requirement of the ACG FFD project. There is risk that the annual evaporation could be overestimated leading to a requirement to increase the size of the ponds.

2. Local evaporation rates may result in periods where the Produced Water will have a long residence time in the ponds. This increases the potential for odour problems close to the evaporation pond, which is considered a concern for the ACG FFD Produced Water as it contains fatty acids that are volatile and malodorous in nature.

4.4.4 Clean-up using reed bed treatment and discharge to Caspian Sea

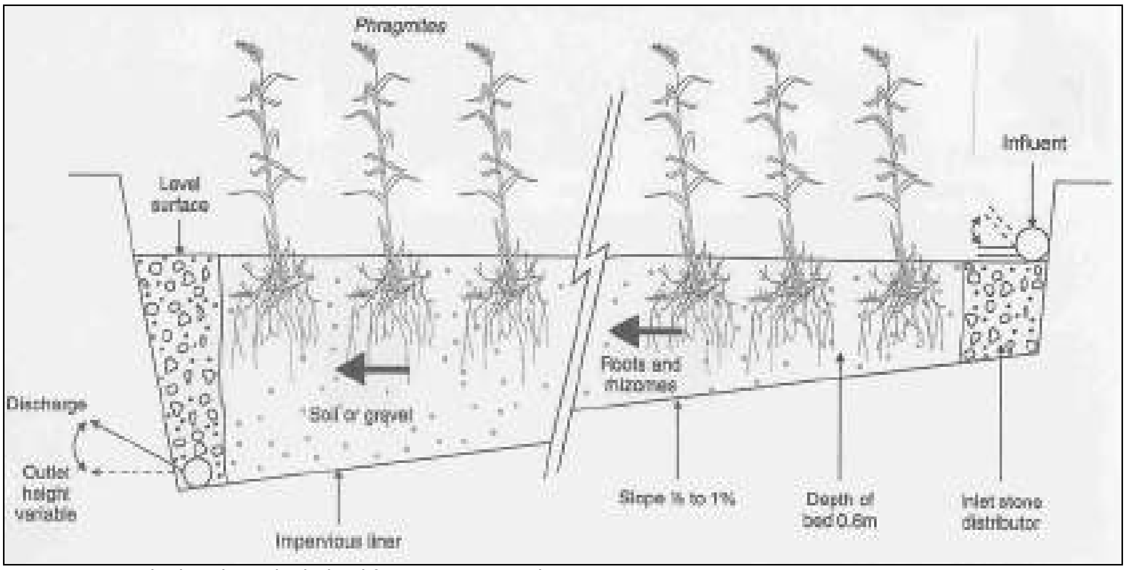
4.4.4.1 Process description

As explained in Section 4.4.2.1, the principle behind this option is the assumption that if the Produced Water were treated to an acceptable level, it could be discharged via an outfall pipeline into the Caspian Sea outside the area of Sangachal Bay. Reed beds were considered as a treatment option within Appraise since they are used successfully in a number of different industries for effluent clean up, e.g., BP has a number of small reed beds at petrol stations in the UK that treat the contaminated water run-off from gasoline station forecourts.

The concept of this option is for Produced Water to be flowed into the reed bed by pipeline. After spending some residence time in the porous matrix of the bed (Figure 4.3) the water flows out of the reed bed by means of a drain. Either this drainage water then finds its way into the environment, by draining onto nearby land or water, or it can be piped to a disposal location far removed from the development site.

The reed bed technology is a bioremediation process that uses plants to promote degradation of hydrocarbons through microbial processes and adsorption of heavy metals while evaporating some of the Produced Water by transpiration. Bacteria around the reed roots and on the porous matrix biodegrade the hydrocarbons. Other chemical components of the water, including metals, are adsorbed by the soil. The effluent from the reed bed can be considered for irrigation, depending on the quality of the water that is being processed (URS, 2002b).

Figure 4.3 Schematic diagram of reed bed wastewater treatment system



Note: Data in the Figure is derived from Cooper, et al., 1996.

4.4.4.2 Rejection rationale

Reed bed treatment systems were rejected as a viable solution for the ACG FFD PWD project for the following reasons:

1. There are technical problems associated with potential blockages of reed bed filtering channels, reducing the performance of the system. This results in monitoring and maintenance issues over the life of the project.

2. Reed bed treatment systems are extremely area demanding. It is estimated that up to 50 acres (over 20 ha) of reed beds would be required to treat the volumes of ACG FFD Produced Water requiring disposal from the Sangachal Terminal.

3. A reed bed option still requires the disposal of wastewater after it has been through the system. The disposal route depends on the effectiveness of the reed bed system and its reliability in treating the Produced Water to the required discharge quality standard. Produced Water not reaching this standard would require additional treatment.

4. The use of treated water for irrigation brings a number of concerns. These are discussed in Section 4.4.5.2.

5. Specialist vendors could not confirm that a reed bed system would work effectively with the high salinity Produced Water from the Sangachal Terminal.

4.4.5 Treatment and reuse as irrigation water

4.4.5.1 Process description

The project investigated the possibility of removing hazardous substances from Produced Water by means of a treatment plant, prior to use of water for irrigation of local crops such as cotton, barley, olive trees, or pasture for cattle.

The salinity of the treated Produced Water is an important consideration for this option as Produced Water from the treatment systems discussed in 4.4.2 would be highly saline. It would therefore be necessary to add additional desalination facilities to these treatment options to remove the salt from the water and, therefore, avoid salinisation of the soil and potential negative effects on crop growth.

The TDS concentration of the Produced Water is at least a factor of 10 higher than that allowable by the Azerbaijan standard for municipal wastewater reuse for irrigation. Similarly, the BOD is at least 20 times higher than the standard and the COD is at least 16 times higher. In addition, the concentration of boron is at least 6 times higher than generally recommended for irrigation purposes. In order to meet the TDS standard for irrigation water, up to 250 tonnes of dissolved solids per day would have to be removed from the Produced Water stream and disposed of appropriately.

4.4.5.2 Rejection rationale

Produced Water treatment and reuse in irrigation was rejected as a viable solution for the ACG FFD PWD project because of the following reasons:

1. Desalination technology or large volumes of blend water (e.g., river water or sewage water) would be required to reduce the Produced Water salinity to a suitable level to provide irrigation to the crops studied (URS, 2002c).

2. Any success of crop irrigation would be limited to the operational lifetime of the ACG FFD. Therefore, any dependency on water supplies from the Terminal would have impacts on the industries requiring the water for their continued operation if the water supply was interrupted or when the supply stopped at the end of the project.

4.4.6 Cement plant

4.4.6.1 Process description

This option involves the transfer of Produced Water from Sangachal Terminal to the “Garadagh” Cement Plant for use in the cement-making process. Cement production requires water either for cooling heavy equipment and exhaust gases, or for preparing slurry in wet process kilns.

This option has been used as part of the short-term solution for ACG FFD PWD and Produced Water, mixed with various associated water from Sangachal Terminal has been transferred from the Terminal to the cement plant in road tankers. To consider this option for the long-term transfer of Produced Water it would be necessary to install a dedicated PWD pipeline between the Terminal and the “Garadagh” Cement Plant to mitigate the potential incremental safety risks associated with the increased number of road tankers that would be required to handle the greater volumes predicted in the long term.

4.4.6.2 Rejection rationale

The use of “Garadagh” Cement Plant was rejected as a viable long-term solution for the volumes associated with the ACG FFD PWD project for the following reasons:

1. The cement plant has a limited capacity to receive and use disposed Produced Water, and the Produced Water predicted to arrive at the Terminal in the future will exceed the capacity at “Garadagh”.

2. “Garadagh” Cement Plant has acceptance limits for salinity of received Produced Water. The ACG FFD Produced Water is projected to be highly saline and therefore the high salinity volumes may not meet the applicable criteria in the long term.

4.4.7 New Produced Water injection platform offshore

4.4.7.1 Process description

This option is to construct a new platform offshore, positioned adjacent to and bridge-linked to the existing Compression and Water Injection Platform (CWP) at Central Azeri (CA) as an independent facility to separate out Produced Water to achieve BTC export pipeline specifications in the oil of 0.3-0.5 percent WIO offshore for immediate re-injection into the ACG reservoir. This would be a stand-alone platform with electrostatic coalescers and pipelines from the production platforms at CA, West Azeri (WA), and East Azeri (EA). Additional pipelines would be required to the Main Oil Line (MOL) pumps on CA, WA, and EA for export of separated oil and to the CWP injection pumps to facilitate re-injection of the Produced Water.

4.4.7.2 Rejection rationale

The construction of new offshore facilities dedicated to Produced Water was rejected as a viable solution for the ACG FFD PWD project because of the following reasons:

1. The installation of new inter-linking pipelines and risers required for this project option would cause a significant impact to production and this has cost implications for the project through lost revenue. Installation would require a shutdown extending to 150 days and it would be necessary to cut into the export lines, and insert tee-and-valve assemblies to divert the oil to the new platform.

2. A dedicated platform would handle the oil from the EA, CA, and WA platforms, which introduces a risk of interruption to the oil production from the ACG fields. If the dedicated injection platform were required to shutdown, then the three production platforms would also be required to stop production.

4.5 Project options taken forward to CVP Select stage

Options that were considered during Appraise and identified as having potential to dispose of the volumes of ACG FFD Produced Water over the long term were carried forward to Select for further analysis. Five of the original options identified in Appraise have been carried forward into Select. This Section provides details of the evaluation of these options against the Select assessment criteria discussed in Section 4.2.1, i.e., technical, safety, cost, environmental, socio-economic, and reputation.

Each subsection presents the issues relating to specific criteria that have been identified for each of the Select stage options followed by a brief assessment summary. The overall Select options assessment summary has been presented in Section 4.6.

4.5.1 Enhanced offshore separation

The purpose of the enhanced offshore separation process is to improve the separation of Produced Water from product offshore to enable more direct offshore re-injection. This will reduce the amount of Produced Water transported onshore. Enhanced offshore separation is not a stand-alone disposal option, as the available enhanced separation equipment cannot reduce the water in oil (WIO) content to an adequately low level for export to the BTC pipeline; in order to achieve the BTC export pipeline specifications, additional Produced Water treatment at Sangachal Terminal will be required whether enhanced separation occurs offshore.

None of the Select stage options, except for the offshore pipeline for Produced Water re-injection, are viable without enhanced offshore separation. The pipeline offshore for Produced Water re-injection option has been assessed with and without the inclusion of enhanced offshore separation to ensure equal assessment between reinjection and the other options under consideration (Section 4.5.4).

Enhanced separation of Produced Water could be achieved by allowing more residence time in the separators. This would require very large separators or additional equipment to aid in the separation process. The following two different kinds of additional equipment were considered for this project to enhance offshore separation:

- Electrostatic coalescers – requiring the addition of facilities offshore
- Vessel Internal Electrostatic Coalescers (VIEC) – requiring modifications to existing offshore facilities

The addition of coalescers to platform facilities would be carried out on the CA-Production, Drilling, and Quarters (PDQ) platform, and on both WA and EA. As the CA-PDQ platform and the production platform at WA are already operational, any modifications would need to be performed during a shutdown of the relevant platforms. However, it still would be possible to install facilities on EA prior to sail away.

The Select stage criteria assessment for each coalescer option is presented in Section 4.5.1.1 and 4.5.1.2.

4.5.1.1 Electrostatic coalescers

Technical
Electrostatic coalescers work on the principle that water conducts electricity and oil does not. When an electric field is created in a vessel containing an emulsion, the water droplets in the emulsion become dipoles (electrically charged) and this enables the water droplets to overcome repulsive forces, thus allowing water droplets and oil to coalesce (mass together) separately. An electrostatic coalescer would be installed after the Low Pressure (LP)

separator and before the MOL pumps. This would allow for better separation of the Produced Water from the oil.

An electrostatic coalescer should achieve a separation of 1-2 percent water in oil (WIO), compared to the design case of 5 percent without the equipment. The downtime expected for the coalescer to be fitted on each platform is 19 days resulting in lost production. Therefore, fitting EA platform with a coalescer prior to sailaway would minimise production downtime.

Safety
Space and weight required to install this equipment is a major concern since the additional equipment required will weigh 700 tonnes. The lifting activity required to install electrostatic coalescers to the platforms already offshore presents a safety concern. In addition, the inclusion of the electrostatic coalescer offshore will result in a greater oil inventory of 280 tonnes on each platform at any one time. The platform safety analysis of this option identified that the design proposal would exceed the safety requirements for the platforms as it currently stands and enhancements to reach the safety standards would be required.

Environmental and socio-economic
Electrostatic coalescers require the addition of chemical to improve separation performance; this introduced an environmental risk of marine contamination in the event of a chemical spill. This risk would be managed appropriately using existing operational procedures for chemical management; therefore, the risk to the environment is low.

There are no socio-economic impacts with this option.

Reputation
There are no reputation concerns with this option.

Cost
The cost to purchase three electrostatic coalescers and install one of each on CA, WA, and EA is in the range of $100-200 million. However, this does not include cost associated with the shutdown required to allow for installation.

4.5.1.2 Vessel Internal Electrostatic Coalescers (VIECs)

Technical
VIECs operate on the same basic principle as the description given for electrostatic coalescence in the technical section of 4.5.1.1. However, this option involves the installation of internal components into the LP separators already in place.

VIEC systems are currently installed and operating on North Sea production platforms. However, Azeri field crude has a different composition to North Sea crude as Azeri crude contains more sand and wax. This presents the concern that sand and wax present in the Azeri crude may cause clogging of the VIEC’s internal plates, thus reducing separation performance.

Pilot trials were necessary to assess if the VIEC can reduce the amount of Produced Water in oil to required levels. In previous applications of the technology including the addition of chemicals, a stream with 7-10 percent WIO was reduced to 2 percent WIO.

Safety
One of the advantages of this system is that it does not require large pieces of equipment to be added to the platform and it does not increase the platform oil inventory. This makes VIEC a more favourable safety option compared to electrostatic coalescers.

Environmental and socio-economic
As with electrostatic coalescers, the only environmental concern with this option is the risk of marine contamination in the event of a chemical spill. This risk would be managed appropriately using existing operational procedures for chemical management; therefore, the risk to the environmental is low.

There are no socio-economic impacts with this option.

Reputation
There are no reputation concerns with this option.

Cost
The cost to purchase VIECs and install them on CA, WA, and EA is less than $100 million. However, this is only the CAPEX cost, and does not include cost associated with the shutdown required to allow for installation.

4.5.1.3 Assessment summary

A comparison of the electrostatic coalescers and VIECs options identifies that both are considered equal in terms of environmental, socio-economic, and reputation assessment. Use of VIECs is a more favourable option than use of electrostatic coalescers in terms of safety and cost but presents some uncertainty related to its technical performance with Azeri field crude compared to electrostatic coalescers.

Further study on enhanced separation continues and a dedicated project has been set up to assess opportunities to reduce the amount of WIO coming onshore. This includes testing the degree of separation that could be achieved if VIEC were installed in the LP separator. This will involve using Azeri crude in a test separator with the VIEC installed to simulate the LP separator process.

The issues identified for electrostatic coalescers have been included in the overall option assessment summary (Section 4.6) for consideration of the disposal options requiring enhanced separation (i.e., all except pipeline offshore).

4.5.2 Onshore injection

This Section describes two onshore injection options for disposal of Produced Water. Both options will require coalescers to be included to reduce the amount of Produced Water coming onshore before onshore injection is a viable option.

In 1999, BP reservoir geotechnical and engineering specialists, in conjunction with the State Oil Company of the Azerbaijan Republic (SOCAR), reviewed 25 oil fields within a 30 km radius of Sangachal Terminal to identify depleted field aquifers that may be suitable for the injection of ACG FFD Produced Water. Of the 25 fields, the most suitable subsurface location identified was Lokbatan (approximately 10 km southwest of Baku, 23 km northeast of Sangachal Terminal). During this study, the depleted reservoir at Lokbatan was identified as having a potential capacity to receive Produced Water coming onshore from ACG. This resulted in Produced Water injection at Lokbatan being presented as the base case solution for disposal in the ACG FFD Phase 1 ESIA.

Since 1999, another field, Mishovdag (approximately 50 km southwest of Sangachal Terminal), was identified as a potential ACG FFD PWD site since the operating company, Karasu, initiated an Enhanced Oil Recovery (EOR) program using water injection.

The locations of Lokbatan and Mishovdag oil fields are shown in Figure 4.4.

Figure 4.4 Map indicating locations of Lokbatan and Mishovdag in relation to Sangachal Terminal and the ACG Contract Area

4.5.2.1 Produced Water injection at Lokbatan

Technical

Lokbatan is a SOCAR operated site with an estimated area of 30 km^2 that has been producing oil since the 1920s. The site is located northeast of the Sangachal Terminal as illustrated in Figure 4.4. The suitability of injecting the Produced Water into the producing onshore Lokbatan oil field has been evaluated with regard to the water production profile over time. The evaluation has been conducted using previous technical studies combined with new study work (during 2005-2006) that looked at the uncertainties and risks of reinjecting Produced Water into an already producing field.

The subsurface team considered two different areas for injection in the Lokbatan field:

- Shallow water injection (SWI) into a shallow reservoir near the injection site and;
- Deep Water Injection (DWI) into a deep offshore reservoir by deviated drilling from the same onshore injection site.
- Both SWI and DWI options will result in pressurisation of the selected reservoirs.

The SWI option was not carried forward to Select stage owing to the risks associated with potential contamination of the groundwater table, possible surface wellhead leakage from poorly cemented field wells, and potentially the lack of formation capacity.

Early reservoir studies concluded that DWI would be a more suitable disposal option. The reservoir associated with this option has a larger capacity and is situated at an increased distance from the onshore producing wells. The deeper offshore reservoir also has a wider well spacing distance to the Lokbatan wells, reducing the potential for interference between the wells. Thus, the option of injection into the deeper offshore reservoir option was moved from Appraise to Select to allow further feasibility studies to be undertaken.

This project option is to pump ACG FFD Produced Water through a pipeline of approximately 23 km from Sangachal Terminal to Lokbatan. The option would require that a minimum of two new injection wells be drilled to the south flank of the onshore field. The pressure needed to reinject the water is 500 barg, therefore water pumps would be located at the Lokbatan site and power would be supplied from the national electrical grid. A substation and power cable would need to be constructed and laid to provide the power. The drilling rig required for this option would likely be sourced external to Azerbaijan and brought in through the Volga-Don canal system. The active status of Lokbatan and presence of third party operators means that the disposal of Produced Water and operation of the disposal route cannot be exclusively controlled by BP.

The technical issues associated with the operability of this option centre on the availability of the pumps that will be required to transport the water from Sangachal Terminal to Lokbatan and the availability of the injection pumps located at Lokbatan. Availability studies show that the export and injection pumps should allow 95 percent availability of this method of transport. The remaining 5 percent can be mitigated by the inclusion of additional storage capacity for Produced Water at the Terminal. If there were a failure with either the export pumps or the injection pumps then this could require offshore wells, particularly those with a high water-cut, to be shut-in, potentially curtailing production.

To progress the technical definition of this project option, the BP subsurface team worked in collaboration with SOCAR-based groups, including SOCAR Lokbatan Field Development Group, GiproMorNefteGaz Data Centre’s technical resource group, and SOCAR Reservoir Modelling Centre subsurface technical group. The objective of this work was to acquire available seismic survey information and various types of well data (production, geological, and well construction, etc.), to refine the deterministic geological model to allow a complete new reservoir model to be built. The team also worked to assess current well and surface environmental conditions within the Lokbatan field area.

Field information combined with a “foot Global Positioning System” survey of the area, using satellite navigation data, identified that many wells were leaking, or had leaked reservoir fluids to the surface in years past (Figure 4.5). These observations illustrated to the team that in some places there is currently adequate subsurface pressure to support fluid flow to the surface. Therefore, given the poor mechanical condition of some of the abandoned wells it is likely that injection into the reservoirs at depth would exacerbate this problem. Produced Water injection could therefore leak out of the injection zone resulting in resurfacing of Produced Water to land or to the Caspian Sea (through wellheads located in the shallow marine zone) causing contamination of the environment.

Figure 4.5 Photograph of leaking wellheads at Lokbatan

Safety

One of the concerns with this option is the safety hazard that arises from the use of pumps operating at 500 barg. The risk arising from these pumps is complicated by the fact that Lokbatan is an open site and much of the site allows access to third parties. The installation of a security fence around the pumps could mitigate this risk, although this mitigation would in turn require security personnel to ensure the integrity of the site.

Environmental and socio-economic

As illustrated by Figure 4.5 the over ground conditions of the Lokbatan facilities are environmentally degraded. Lokbatan has both abandoned wellheads and oil producing wells, the integrity of which are uncertain. It is therefore not possible to ascertain whether injected Produced Water could flow from abandoned wellheads or force reservoir fluids (oil, gas, and water) to the surface by re-pressurising parts of the reservoir. Produce Water flow back would add to the existing environmental contamination, and this is an environmental concern for this project.

The option requires at least two new wells to be drilled at this site, which will impact the environment and generate drill cuttings waste. An additional environmental consideration is the installation of the 23 km (or longer) pipeline that would be required to transport the Produced Water from Sangachal Terminal to Lokbatan. The construction of this would impact the local environment, and any accidental pipeline leaks when the pipeline is in operation would also cause environmental damage.

There are additional socio-economic impacts associated with the construction phase to lay the pipeline and install facilities at Lokbatan. Appropriate procedures would be in place to ensure impacts are limited and ongoing operations are well managed to minimise impact.

Reputation

The possibility of further environmental damage occurring at Lokbatan while the ACG FFD PWD project is supplying Produced Water to Lokbatan, e.g., from well leakage, poses a direct risk to BP's reputation.

An additional concern is that injection into this mature reservoir increases the possibility of elevated production of Produced Water out of Lokbatan wells. Therefore, injection of ACG FFD Produced Water at this site could lead to increased SOCAR Produced Water levels. If the reservoir cannot accept the entire volume of Produced Water for injection, another means of disposal will be required. If ACG FFD Produced Water re-injection was perceived to be associated with increased water production, this would be a risk to reputation.

Cost

The cost of this option to pump Produced Water to Lokbatan via a dedicated PWD pipeline, including the cost of the electrostatic coalescers required to make the option viable, is in the range of $300- 400 million.

Assessment summary

Consideration of the issues identified did not provide a sufficient level of confidence that this would be a viable solution for disposal of ACG FFD Produced Water long-term volumes and it was not selected as the preferred option.

4.5.2.2 Injection at Mishovdag

Technical
The Mishovdag Oil Field is a historical oil field (operating since 1956) currently managed by the Karasu Operating Company (KAOC) under a 25-year Rehabilitation Production Sharing Agreement (RPSA). The field is the subject of a loan by the European Bank for Reconstruction and Development (EBRD) to remediate the environmental damage at the site through an Environmental Action Plan with the site operating under its RPSA.

The Mishovdag oil field in Ali Bayramli extends over approximately 24 km^2 and is located southwest of Sangachal Terminal (Figure 4.4). This is a mature, pressure-depleted field that requires water for injection to maintain and increase oil production, i.e., EOR. Water is currently supplied from within the Mishovdag field, by pipeline from neighbouring fields operated by Salyan Oil and Shirvan Oil, from a nearby canal, and from a dedicated aquifer well drilled by Karasu north of the Mishovdag field.

The initial assessment conducted for this option considered PWD over the short-term only. This required an understanding of the integrity of the Mishovdag field in terms of the potential for injected Produced Water to resurface. The BP reservoir team worked with Karasu to analyse their subsurface models, confirm reliability of water requirement forecasts, and assess flow-back risk. The risk of potential flow-back to surface was considered minimal, as a planned programme of well surveillance and abandonment was emplaced to mitigate this risk. The assessment concluded that this option was suitable for the short-term disposal of volumes of Produced Water from Sangachal.

The Mishovdag onshore injection was moved into the Select stage, requiring further consideration and extended analysis for this option to be used to dispose of e volumes of Produced Water in the long-term. The aim of this work was to better define the subsurface geological model and enable a more accurate prediction of the subsurface capacity through a new reservoir model. Additional reservoir capability assessment indicated that there is insufficient reservoir capacity for the Produced Water volumes that require disposal over the long-term. BP and Karasu have since engaged in a 12-month joint subsurface study that will produce a new geological model (e.g., reservoir maps) to be used as input to a new reservoir model and better predict the reservoir performance and water injection capability over time.

The site has constructed new water storage tanks to provide a total storage capacity of 20,000 m^3 at the water reception facility and a further 2,800 m^3 at the injection site. This onsite storage is the main form of mitigation for any potential downtime of the water injection pumps.

Transfer of Produced Water from Sangachal Terminal was also assessed. The use of road tankers was identified as a reliable means of Produced Water transfer for short-term volumes, subject to the condition and availability of the road network. The Produced Water profiles predict that daily volumes in the future will exceed the capacity for transfer by road tankers; therefore, transfer of Produced Water in rail cars or a dedicated pipeline has been considered as possible transfer alternatives.

Safety
As with all rail transportation, the condition of the infrastructure and rolling stock, as well as availability of rail cars, required assessment. In addition, the training and competence of the rail drivers and availability of emergency response equipment in the event of an accident along the railway route also required evaluation. This assessment was compared with transfer through a dedicated 60 km Produced Water pipeline from the Terminal to Mishovdag. Both options were deemed acceptable subject to the emplacement of appropriate controls during the transfer operations.

Environmental and socio-economic
The Mishovdag site is funded by the EBRD, and site upgrades to facilities are visible. The subsurface assessment for Produced Water injection for volumes over the long-term identified that there is potential for these to affect aquifers. The potential for injected Produced Water to

leak to the surface and cause environmental damage if the long-term volumes are disposed within the field presents environmental concerns. The commissioned subsurface study to produce a new reservoir model will help provide better understanding of this risk.

The construction of the pipeline would impact the local environment and any accidental pipeline leaks when the pipeline is in operation would also cause environmental damage.

There are socio-economic impacts associated with the construction phase to lay the pipeline from Sangachal Terminal to Mishovdag. However appropriate procedures would be in place to ensure impacts are limited and ongoing operation are well managed to minimise impact.

Reputation
This site and the injection process would not be under the direct control of BP, which limits their influence over operations. As with the Lokbatan option, even if BP was not responsible either directly or indirectly for leakage to surface and subsequent damage of the local environment, there would be an association with the operation of the Mishovdag site and potential impact on BP's reputation.

Cost
The cost of this option to pump Produced Water to Mishovdag through a dedicated PWD pipeline, including the cost of electrostatic coalescers that are required to make the option viable, is in the range of $200-300 million.

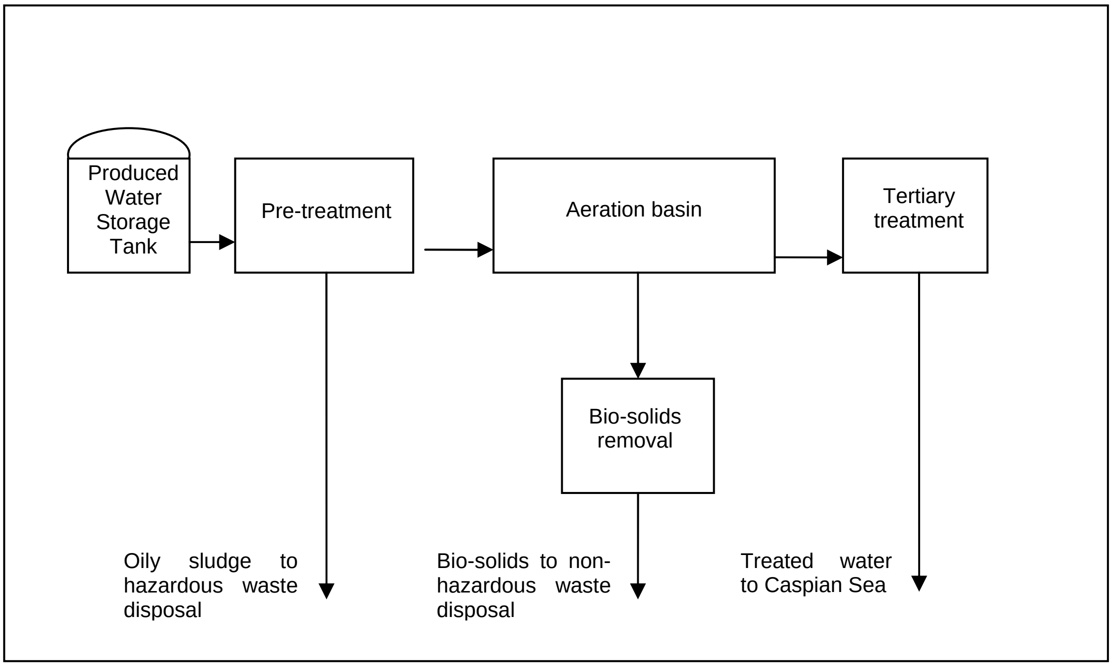
Assessment Summary
Consideration of the issues identified did not provide a sufficient level of confidence that this would be a viable solution for disposal of ACG FFD Produced Water volumes in the long-term and it was not selected as the preferred option.

4.5.3 Biological treatment and discharge to Caspian

Technical
Produced Water contains organic compounds that by their nature can be broken down by naturally occurring bacteria to produce carbon dioxide (CO_2) and a sludge waste. This system is dependent on the Produced Water being kept resident in the system for a suitable time to allow the bacteria to degrade the waste. Biological treatment was studied as a potential means to clean ACG FFD Produced Water prior to discharge. As discussed in Section 4.4.2.1, treatment of Produced Water prior to discharge may require the reduction of OIW, TDS, COD, BOD, and metals to an effluent specification according to best international practice and national legislation.

The concept of this option was that the Produced Water coming ashore at Sangachal Terminal would be processed through a biological treatment plant with additional tertiary treatment facilities being considered, if necessary (Figure 4.6). After treatment, the option included the discharge of the water via an 8 km outfall pipeline into the Caspian Sea beyond the shelf of Sangachal Bay to ensure adequate dispersion of the saline water.

Figure 4.6 Biological treatment processes



Assessment of the biological treatment option has been ongoing since 2002. Initially laboratory trials were undertaken using Chirag Produced Water that gave positive results and the analysis continued with a full pilot trial undertaken at Sangachal Terminal. Further detailed performance data on two types of biological treatment were obtained during these pilot trials between February and June 2005. One pilot unit was a membrane bioreactor (MBR), operated by DHV Water. The other was a bioreactor using both fixed and suspended biomass, operated by Ondeo Industrial Solutions (OIS).

There is a high degree of uncertainty regarding the size of the plant that would be required for ACG FFD Produced Water treatment, because of uncertainties in Produced Water production rates and variability in the organic loading. One of the significant issues associated with the operation of a biological treatment plant is any fluctuation in water flow rates and organic loading; both of these parameters are key to the design of the plant. During periods of upturn or increased water volumes, the flow rate may be too great, reducing the residence time of the Produced Water in the system, with the result that the treatment will be deficient unless sufficient water storage capacity is built into the system design. Conversely, during downturn in flow rate, there may be insufficient water, or contaminants to sustain the bacteria in the system and this can result in the process failing. Fluctuating organic loading could result in the process not achieving the specified effluent standard because of high loading (rather than any fault in the process) and would require recycling of the Produced Water.

The results of the pilot trials identified that both biological treatment technologies performed well, despite a 100 percent increase in COD of the inflowing Produced Water during the trial period. The basis of design for the treatment plan was 16g/l COD at 25,000 bwpd which would require two processing trains covering an area of 24,000 m^2. Wet Air Oxidation, UV Treatment and Ozone treatment were considered as possible tertiary stages. The outfall pipeline for the treated effluent was designed to run 8 km into the Caspian Sea, beyond the Sangachal Bay shelf. At this distance from shore the water is 11 m deep, which aids in the dispersion of the effluent. The pipeline would be designed with a diffuser at the end of the pipe to enhance the dispersion of the effluent.

Safety

Considering the performance of the pilot trials and the Produced Water throughput it is estimated that this process will generate approximately 50 tonnes of non hazardous waste and 1 tonne of hazardous waste per day. Approximately three trucks a day would be required for the disposal of the non-hazardous waste, with additional trucks required to transport the hazardous waste.

Environmental and socio-economic
Currently there is not a uniform worldwide effluent discharge regulation for Produced Water with regard to metals and other dissolved constituents, as most focus on the reduction of free and dispersed oil in water. As a result, the project developed guidance PWD standards based in part on World Bank onshore standards and relevant ACG PSA HSE Standards.

As this option involves the discharge of treated Produced Water to the Caspian Sea, BP conducted an Environmental Risk Assessment (ERA) using marine dispersion modelling and ecotoxicology predictions to assess the potential environmental effect of this discharge. This approach included Caspian Specific Toxicity testing that focused on the prediction of treated Produced Water ecotoxicity, and subsequent modelling of the Predicted No-Effect Concentration (PNEC, i.e., concentration that is not likely to harm organisms in the receiving water). The pipeline was designed in conjunction with marine dispersion modelling using the Visual Plumes (VP) modelling system from the US EPA Centre for Exposure Assessment Modelling (CEAM) to achieve good dispersion of the treated Produced Water. The final diffuser design had multiple ports to aid dispersion of the effluent in the surrounding environment. The ERA predicted the no-effect concentration to be achieved within 70 m from the diffuser using OECD and OSPAR safety factors to calculate the predicted no-effect concentration of the treated Produced Water.

As already discussed, this option will generate hazardous waste that requires disposal. The likely final destination is to landfill, which is an environmental concern, as this option would add large volumes to landfill.

Produced Water compositional data are currently limited for ACG, and future variations in volume, composition, and quantity of production chemical additives are difficult to predict. This can prevent accurate prediction of treatment performance and subsequent modelling of effects. Monitoring of the treated effluent prior to leaving the Terminal and monitoring periodically at the discharge location would have to be undertaken as part of the monitoring plan for this option.

Reputation
There is a negative perception surrounding any discharges to the Caspian Sea, based on concerns about the overall sensitivity of the ecosystem and potential effects on vulnerable populations. As such, there is a reputation risk when proposing to routinely discharge treated Produced Water over the 25-year project lifetime. The future status of developing regional agreements by the Caspian Littoral States aimed at reducing discharges to and the pollution levels of the sea is likely to add further limitations on discharge to the Caspian. In view of such agreements, proposing a discharge option may have reputation risks beyond Azerbaijan as it may attract attention from international environmental groups.

During operation, any pollution events or impacts observed in the area of the discharge may be believed to be the result of the discharge of treated Produced Water and it would be difficult to demonstrate otherwise to the satisfaction of the public.

The disposal of the hazardous waste at a third party disposal facility is outside of BP's control but presents potential to damage BP reputation from the association of BP's operations at this site. This could result if the waste is mismanaged, giving rise to an accidental event such as spillage during transportation or leakage/seepage from the landfill site.

Cost
The cost of this option to purchase and install a biotreatment plant within Sangachal Terminal, including the cost of the electrostatic coalescer that is required to make the option viable, is in the range of $300-400 million.

Assessment summary
Consideration of the issues identified concludes that biological treatment may be a viable solution for disposal if further testing with Azeri field Produced Water was possible. However, existing technical uncertainty and reputation issues linked to future legislative change placed this as a less favourable option than pipeline offshore for injection.

4.5.4 Produced Water pipeline to offshore for injection offshore

This option is for Produced Water arriving at Sangachal Terminal to be separated and piped offshore through a dedicated Produced Water pipeline to be re-injected offshore. As discussed previously, this is the only option design identified that would be feasible without additional separation offshore. Therefore, two variations of this option were assessed, one of which included enhanced separation offshore using electrostatic coalescers (4.5.4.1) and another that did not include electrostatic coalescers (4.5.4.2).

4.5.4.1 Produced Water pipeline offshore including enhanced separation offshore

Technical
This option includes the installation of electrostatic coalescers offshore to reduce the volume of Produced Water coming onshore. The Produced Water arriving at the Terminal from offshore in the oil pipeline would be separated from the oil, and separated oil would be recycled back into the oil production system. Produced water would be routed to a Produced Water storage tank and then to a deoiler package, which would include a skimmer, hydrocyclone, and induced gas flotation to achieve a standard of 5 -10 ppm OIW.

The Produced Water would then pass through a chemical management skid for dosing with biocide, oxygen scavenger, corrosion inhibitor, and a filter aid prior to being pumped back offshore through a dedicated PWD pipeline from Sangachal Terminal to the CA-CWP platform (ACG FFD Phase 1 location) for injection. At the CWP platform, the Produced Water pipeline would be tied into the Produced Water manifold and reinjected into the ACG reservoir, along with the additional Produced Water that is separated offshore.

The option would require three export pumps each with capacity to pump 50 percent of the total volume (50 percent redundancy would be built into the system).

Safety
Safety issues arise from the installation of the pipeline and tie-ins to existing facilities. These safety risks can be managed in line with the existing ACG HSE standards, as this will be the sixth pipeline to be installed by BP, running from offshore installations to onshore facilities. This background expertise means that risks are mitigated through the use of established procedures.

There is a long-term risk of loss of containment of the pipeline either through corrosion or through mechanical damage to the pipe, e.g., through vessel grounding in the shallow nearshore waters of Sangachal Bay or from a dragged anchor. Corrosion management studies identified the chemical dosing requirements and an operational philosophy was established on the basis of the predicted Produced Water properties. The risk of pipeline damage from direct impact has been subject to a Quantitative Risk Assessment (QRA) and would be mitigated by trenching the pipeline in the nearshore zone in water depths of less than 11 m and by the concrete coating surrounding the pipeline in deeper waters. This is consistent with the pipelines installed for ACG FFD Phases 1 and 2, and SD stage 1.

This option also has the safety issues associated with the handling and transportation of hazardous waste, as discussed under the Safety header in Section 4.5.3.

Environmental and socio-economic
The environmental impact of disturbance to the seabed during pipelay operations will be minimal since the pipeline follows the existing pipelines corridor and landfall location of the EOP, ACG, and SD lines. The landfall and onshore portions of the pipeline have yet to be reinstated following installation of the earlier ACG FFD and SD pipelines. Therefore, pipeline landfall construction would be conducted within an existing brownfield area (UK definition applied).

During onshore separation, oil would be recycled and solids would be removed from Produced Water and sent for hazardous waste disposal. Additional hazardous waste is generated from pigging of the pipeline, which is conducted to reduce the risk of corrosion. The volume of hazardous waste estimated would be considerably less than that generated for the biotreatment option.

There is a possibility of environmental impact should the pipeline be breached, either through corrosion or through mechanical damage. Should such an event occur, and depending on the severity of the breach, export of Produced Water through the pipeline from Sangachal Terminal to CA-CWP would cease until the breach is repaired.

Reputation
This option is expected to have positive reputation enhancement potential as it demonstrates BP's commitment to minimising discharges to the Caspian Sea and removes the issue of onshore PWD. In addition, the indication from the direction of future regional agreements (Chapter 2) and possible future legislation regards discharges to the Caspian Sea, identifies that this option will be most positively received externally.

An additional benefit in this process is that there is no reliance on any third party for this disposal option, other than hazardous waste disposal.

Cost
The cost of this option, including the cost of electrostatic coalescers, is more than $400 million.

4.5.4.2 Produced Water pipeline offshore without enhanced separation offshore

Technical
The concept of this option is similar to that described in Section 4.5.4.1. The only difference is that this option does not include the addition of electrostatic coalescers offshore to enhance separation. As a result, larger volumes of Produced Water will require handling at Sangachal Terminal.

Safety
The safety assessment for this option is more favourable as no enhanced separation facilities will be installed; therefore, less risk is introduced for the offshore work required.

Environmental and Socio-economic
The assessment for this option is identical to the option including enhanced separation (Section 4.5.4.1).

Reputation
The reputation assessment for this option is identical to the option including enhanced separation (Section 4.5.4.1).

Cost
This option costs in the range of $300-400 million and does not include electrostatic coalescers.

4.5.4.3 Assessment summary

Both Produced Water pipeline options were shown to have identical issues associated with their construction and operation for the disposal of volumes of Produced Water in the long term. However, the concept including electrostatic coalescers has additional issues specific to electrostatic coalescer installation and cost, which make this a less favourable option. The option of a pipeline offshore for re-injection of Produced Water without installation of electrostatic coalescers offshore to provide enhanced separation was identified as the preferred option.

4.6 Select stage option assessment summary

This Section provides a summary of the detailed evaluation of Select stage options described in Section 4.5. Table 4.2 presents key assessment issues for each of the options taken through to the Select stage including details of how they were ranked overall. The table uses a colour coding system. Issues considered to:

- have low negative impact are coloured green;
- have medium negative impact are coloured yellow; and
- have high negative impact are coloured red.

Both of the onshore injection options (Section 4.5.2), i.e., at Lokbatan and Mishovdag, were ranked fifth and fourth position, respectively (the least favoured options), for long-term PWD. This ranking was mainly because of the capacity uncertainties with the site’s ability to accept the Produced Water volumes predicted for the ACG FFD for the long-term. This has linked environmental, socio-economic, and reputation concerns in addition to safety issues related to transportation options for the transfer of Produced Water over the long term. Lokbatan was considered less favourable than Mishovdag because of the current poor environmental condition of the surface of this site.

The biological treatment option (Section 4.5.3) was ranked third as there is still sufficient concern over public perception and perceived environmental impact to weaken this option as a favoured choice. There are also concerns over the size of the plant that will need to be designed to accommodate the variabilities in flow and organic loading over the lifetime of the project. The predicted volumes of hazardous waste associated with this option are also a disadvantage.

The option ranked second was the PWD pipeline for offshore injection with additional electrostatic coalescers facilities offshore for enhanced separation. The number one ranked option was the pipeline offshore for Produced Water re-injection without additional offshore separation. The reason this was favoured above the second-ranked option was because of the additional issues specific to electrostatic coalescer installation and cost, which render this a less favourable option.

Table 4.2 Summary of Produced Water disposal (PWD) options assessed and ranking

Section	Option	Technical	Safety	Environmental and socio-economic	Reputation	Cost Range	Ranked position
4.5.2.1	Produced Water injection at Lokbatan including electrostatic coalescers offshore for enhanced separation	There is insufficient capacity to take all the Produced Water for the long term volumes. The operability is dependent upon pump availability, although this may be mitigated to some degree by additional storage at Sangachal.	Pumps operating at 500 barg. Risk of abandoned wells leaking. Electrostatic coalescers installation and increased oil inventory issues.	The ground surface is already degraded and there is a concern that operation in this area may lead to accusations of BP polluting the area, even if BP is not responsible. Potential for Produced Water to leak directly to the ground or Caspian Sea through nearshore wells.	Poor public reputation issues through potential for leakage, association with historically contaminated site. Possible reputation issue if producing wells experience an increase in Produced Water.	\$300-400 million	5th
4.5.2.2	Produced Water injection at Mishovdag oil field including electrostatic coalescers offshore for enhanced separation	There is insufficient capacity to take all the Produced Water for the long term volumes. Operability is dependent upon availability of injection pumps.	Electrostatic coalescers installation and increased oil inventory issues.	Potential impact on aquifers for long-term disposal only.	Poor public reputation issues through potential for leakage and association with third party site if poorly managed.	\$200-300 million	4th
4.5.3	Biological treatment including electrostatic coalescers offshore for enhanced separation	There is evidence that the systems that have been studied will perform the function required to a satisfactory level.	Risk element from the transportation and disposal of large volumes of waste. Electrostatic coalescers installation and increased oil inventory issues.	ERA shows no predicted harm to the environment. Monitoring would be required throughout the life of the plant.	Discharge to the Caspian is not desirable.	\$300-400 million	3rd
4.5.4.1	Offshore Pipeline for Offshore Injection including electrostatic coalescers offshore for enhanced separation	Availability and operability are good. There is a dependence on export pumps but redundancy is built in.	Installation and tie-in issues, mitigated by tried and tested procedures. Electrostatic coalescers installation and increased oil inventory issues.	Few environmental issues – only in the event of a pipeline breach and leak to the Caspian Sea.	Public reputation is good. No discharge to the Caspian, no onshore disposal issue, no direct contact with open environment.	> \$400 million	2nd
4.5.4.2	Offshore Pipeline for injection (no electrostatic coalescers)	Availability and operability are good. There is a dependence on export pumps but redundancy is built in.	Installation and tie-in issues, mitigated by tried and tested procedures	Few environmental issues – only in the event of a pipeline breach and leak to the Caspian Sea.	Public reputation is good. No discharge to the Caspian, no onshore disposal issue, no direct contact with open environment.	\$300-400 million	1st

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5 Project Description

Contents

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5.1 Introduction

Offshore facilities can remove 95% produced water from oil for re-injection offshore therefore 5% produced water is sent onshore co-mingled with oil. This Produced Water, separated out of the product at the platform, is re-injected offshore, and the percent remaining in the oil not separated offshore is received at Sangachal Terminal through platform-to-shore oil pipelines. At the Terminal the Produced Water is further separated by means of two stage separators followed by electrostatic coalescers to achieve the water in oil (WIO) specification required for delivery to the Baku-Tbilisi-Ceyhan (BTC) export pipeline. The Produced Water that has been separated from the oil at Sangachal Terminal needs to be disposed of in a manner that meets the project assessment criteria (as discussed in Section 4.2.2). The ACG FFD Produced Water Disposal (PWD) project will deliver this solution for the long-term disposal of Produced Water.

This project description outlines the design of the option selected for the treatment and disposal of the Produced Water arriving at Sangachal Terminal. The selected option is a pipeline from the Terminal to the offshore Compression and Water-injection Platform (CWP) at Central Azeri (CA), where it will be re-injected into the ACG reservoir with Produced Water that is separated offshore. The project is scheduled to be operational in 2008 (Figure 5.2).

Produced water arriving at Sangachal Terminal currently and in the mid-term (until 2008 when the long-term option will be operational) will be disposed of appropriately and in agreement with the Azerbaijan Ministry of Ecology and Natural Resources (MENR). The short-term and mid-term PWD from Sangachal Terminal are not within the scope of this Environmental and Socio-economic Impact Assessment (ESIA). Options assessed in Chapter 4 Options Assessed for the ACG FFD PWD Project and rejected for the long-term solution for PWD may be the chosen option for short- to mid-term disposal. Therefore even though this option may be acceptable for the short- to mid-term, the reasons for rejection of this option for long-term disposal are given in Chapter 4. Generally, the increased volumes of Produced Water predicted to be received at Sangachal Terminal after 2008 has been a deciding factor in some of the options under consideration.

The amount of Produced Water that Sangachal Terminal is predicted to receive between 2005 and 2025 is shown in Figure 5.1. This figure identifies the design profile for the predicted Produced Water production over the life of field. The figure also shows the oil production rate over the life of field, with the Produced Water peak rate occurring at the same time as the oil peak production in 2009, followed by a decline in Produced Water volumes. To ensure there will be sufficient capacity in the pipeline for any changes to the Produced Water profile, the design specification for the pipeline was sized for 80,000 bbl/d (horizontal line on Figure 5.1), which will allow for additional PWD capacity.

This project description has been separated into the following three sections: Sangachal Terminal facilities (Section 5.2), pipeline from the Terminal onshore to offshore (Section 5.3), and offshore platform system (Section 5.4). The wastes and emissions that are attributable to the construction, installation, and operations of this project are also addressed (Section 5.5).

Figure 5.1 PW long-term profiles

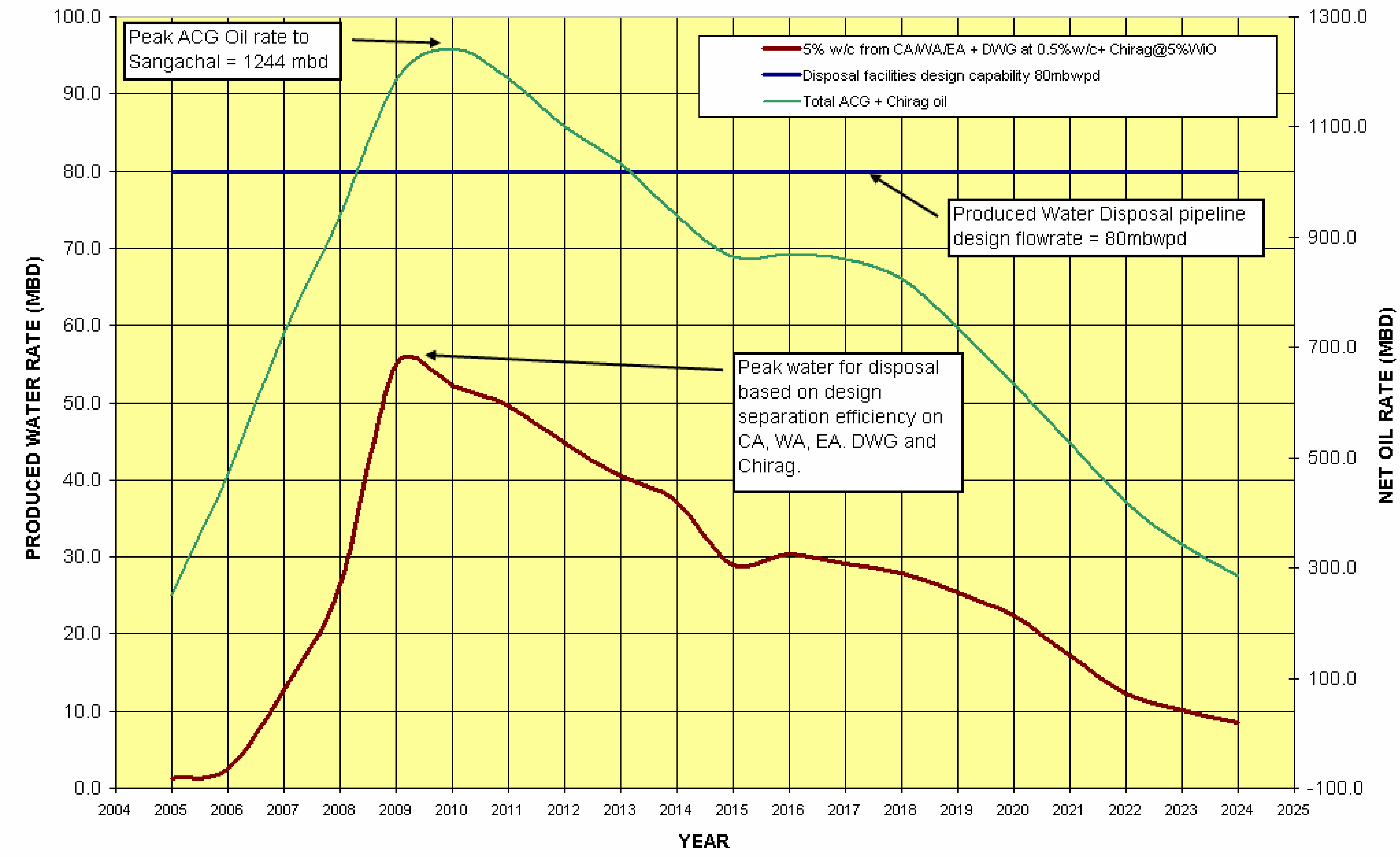
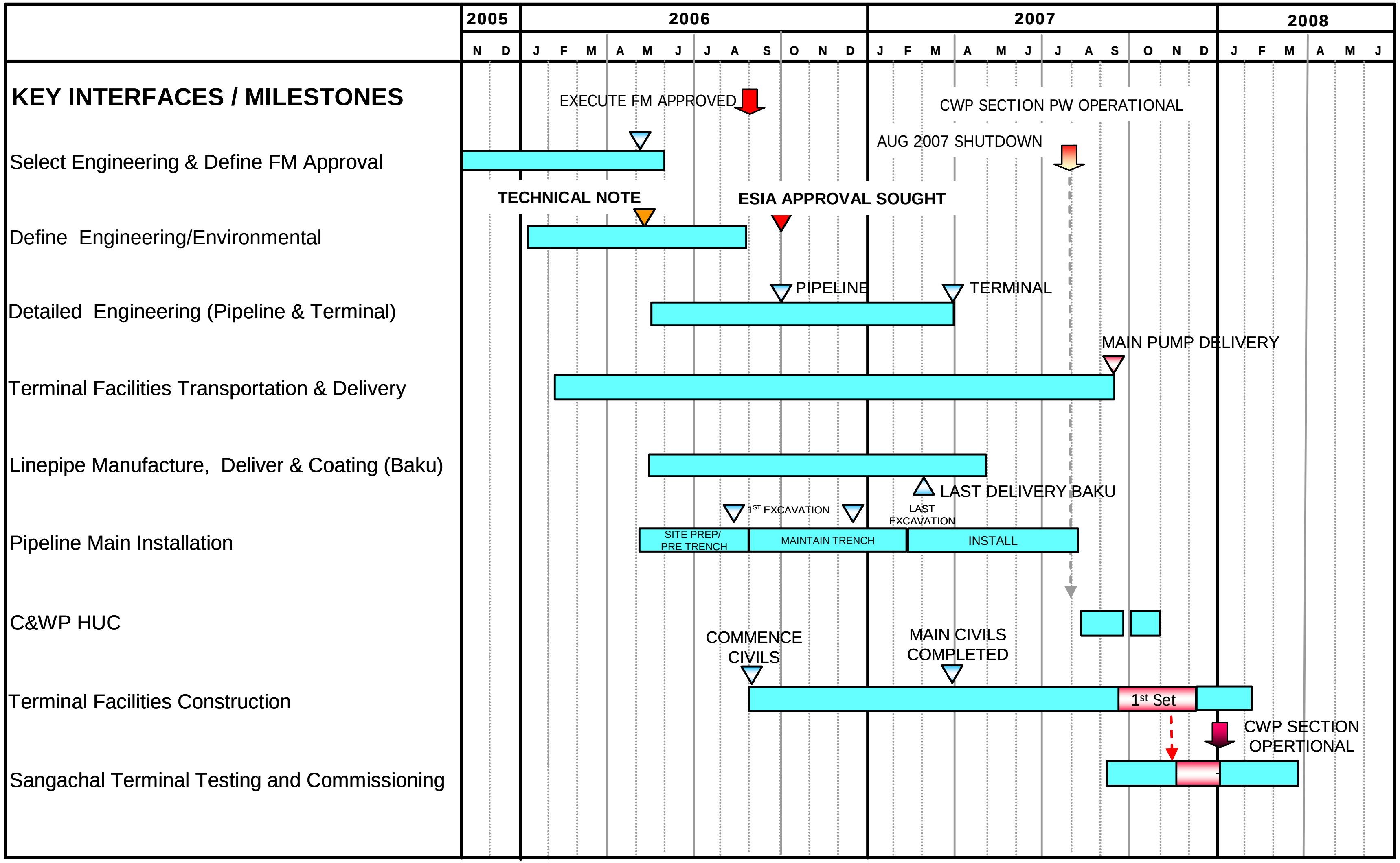


Figure 5.2 Project schedule



5.2 Sangachal Terminal facilities

5.2.1 Overview

The Produced Water coming ashore through the oil pipeline is currently mixed with crude oil, i.e., “wet crude,” and is predicted to be 5 percent of the total fluids within the incoming pipeline. At Sangachal Terminal the wet crude is heated and stabilised in Medium Pressure (MP) and Low Pressure (LP) Separators. The heated wet crude is dehydrated by electrostatic coalescers to reduce water content in the oil to roughly 0.3-0.5 percent WIO, the required specification of the BTC export pipeline.

The Produced Water that is separated from the oil is pumped to PWD storage tanks. Under the ACG FFD PWD project, the Produced Water from the storage tanks will be further treated to remove oil and solids. This will reduce the corrosion potential of the Produced Water in the pipeline and prevent re-injection problems offshore. The Produced Water then will be cooled and chemically inhibited to further reduce the chance of corrosion. Following these processes, the Produced Water then will be ready to be pumped into the proposed ACG FFD PWD pipeline.

5.2.2 Produced Water onshore treatment

This section summarises the basis of design for the Produced Water treatment system. The specifications for the Produced Water treatment are:

- Design Flow: 80,000 bbl/d
- Free Oil Removal: less than 10 mg/l
- Solids Removal: 98 percent removal of particle size > 30 microns
- Temperature: 45-75°C

The Produced Water separated from the oil at Sangachal Terminal will need to be processed prior to being pumped offshore through the pipeline. The new facilities that will be required at the Terminal are oil skimming and solids removal, followed by chemical dosing, cooling, and pumping. To mitigate corrosion in the system and in the offshore pipeline air ingress must be prevented. Therefore any sources of water that are exposed to the atmosphere will be diverted away from the ACG FFD PWD storage tank. This includes segregation of the open drains system that is currently routed to ACG FFD Phase 1 PWD storage tank. The PWD storage tanks are blanketed with fuel gas to prevent air ingress.

Therefore the onshore facilities for the ACG FFD PWD system will include:

- De-oiling package
- Filter package to remove sand and solids
- Transfer pump package
- New PWD storage tank
- Cooler package
- Export pump package
- Chemical injection package
- Pig launcher

Produced Water that is separated from the oil is pumped to the ACG FFD PWD storage tanks. Skimmers are provided in the tanks to remove hydrocarbon liquids and sands. From the PWD storage tanks the Produced Water will be routed through process equipment to remove any residual oil down to 10 mg/l and filtered to remove solids greater than 30 microns. The skimmed oil will be returned to the process through the closed drains system; any resulting solids will be disposed of as hazardous waste. There is also the facility to cool the Produced Water to less than 70°C prior to export in the pipeline.

The processes involved in oil and solid removal can be divided into three main categories based on the achievable oil and solids specification of each: primary, secondary, and tertiary treatment. Table 5.2 presents the design objective and the required oil in water (OIW) and solids removal specification for each of the stages, from primary to tertiary Produced Water treatment.

Table 5.1 Produced Water treatment design process stages and specification

Treatment	Design Objective	Specification	
		Oil in Water	Solids Removal
Primary Treatment	Remove large hydrocarbon droplets, large solid particles and oil slugs. Absorb flow surges and to provide a steady feed to the downstream stages.	200-400 mg/l dispersed OIW	Removal of 95 percent of 40 µm and larger solids
Primary and Secondary Treatment	Removal of small hydrocarbon droplets (10 µm and larger) and small solid particles.	25-40 mg/l	Removal of 95 percent of 2 µm and larger solids
Primary, Secondary, and Tertiary Treatment	Removal of small hydrocarbon droplets (98 percent of 2-5 µm and larger) and small solid particles. Backwashing of filters to minimise level of hydrocarbons and solids in the feed.	<10 mg/l dispersed OIW	Removal of 98 percent of 2-5 µm and larger solids

Note: Minimum solids and oil concentration and oil droplet sizes are approximate only. They depend on the feed oil concentration and droplet size distribution.

The facilities associated with each stage of treatment will be designed to meet the specifications identified in Table 5.1. A number of technologies were considered to identify the most appropriate type to fit these design specification (Table 5.2).

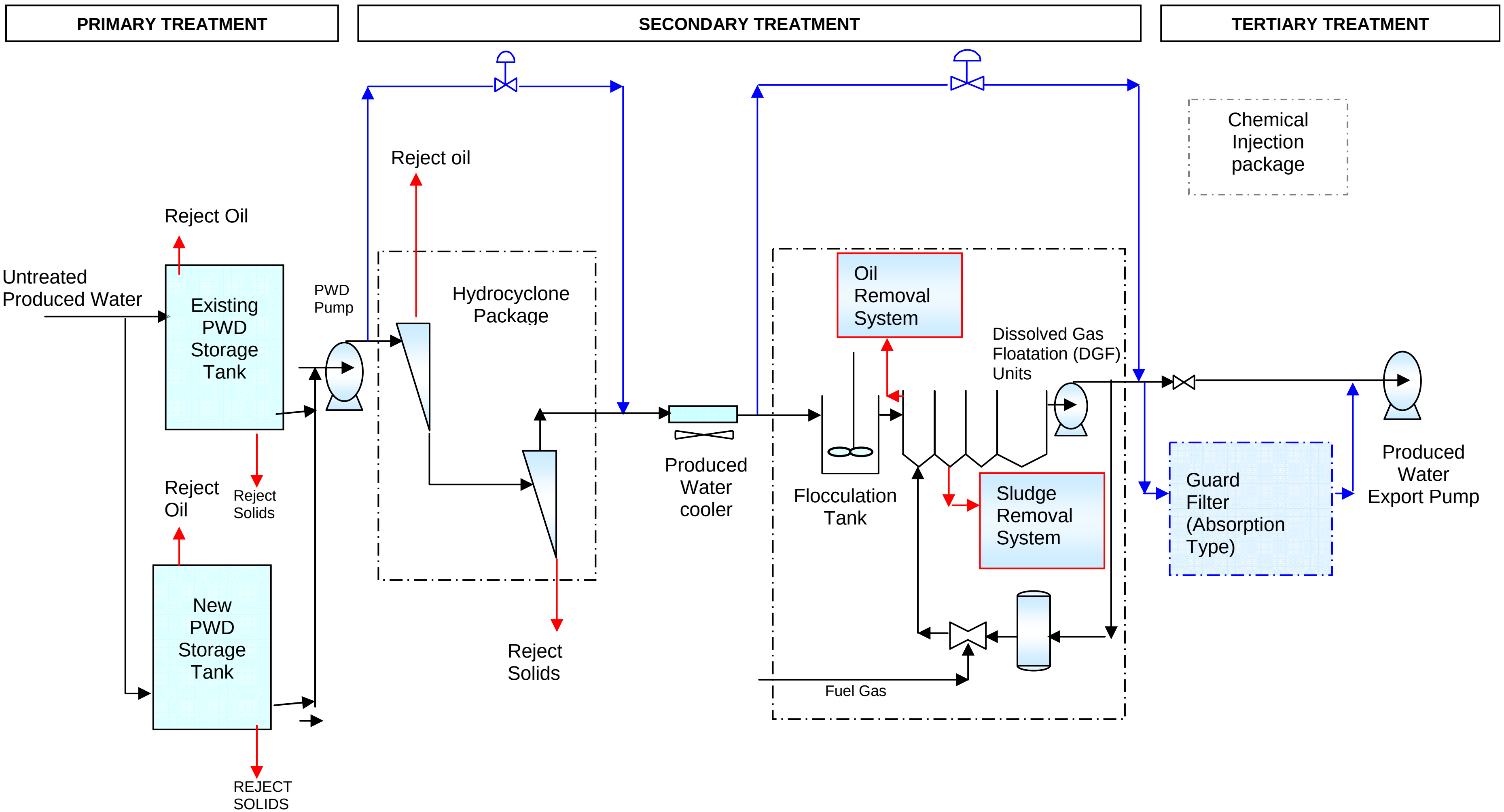
Table 5.2 Produced Water treatment technologies used in each treatment stage

Stage	Primary	Secondary	Tertiary
Technologies Used	Gravitational Settling	Separation processes	Filter
Examples of technologies	• Skimming Tank • API Separators • Tilted Plate Separators (TPS) • Parallel / Corrugated Plate Interceptor	• Hydrocyclones (static and rotary) with a degasser • Induced Gas Flotation (IGF) • Centrifuges • Fine coalescers	• Sand and Dual media filters • Nutshell filters • Cartridge filters • Pre-coat filters • Membranes

The Produced Water treatment process also involves cooling and addition of chemicals prior to the Produced Water entering the pipeline through the export pumps at Sangachal Terminal.

Figure 5.3 presents a schematic of the onshore facilities required for storage, solids removal, oil removal, chemical injection, and pumping. This section describes the processes that are required to achieve each stage of Produced Water treatment. A key focus of the project design has been to mitigate corrosion in the onshore system and in the offshore pipeline. To achieve this air ingress must be prevented. Therefore the design of the system has focused on ensuring any sources of water that are exposed to the atmosphere will be diverted away from the PWD storage tank and all ACG FFD PWD systems are kept oxygen free.

Figure 5.3 Schematic of ACG FFD PWD facilities onshore



5.2.2.1 ACG FFD PWD storage

A new PWD storage tank will be installed that is similar in sign to the existing ACG FFD PWD tank. The new tank will have the capacity to hold 130,000 bbl and the vapour space in the PWD tank will be blanketed with fuel gas to avoid oxygen ingress into the tank. This tank and the existing ACG FFD Phase 1 tank are required to provide sufficient holding volume in the event that Produced Water cannot be pumped offshore for re-injection. This could be as a result of downtime of the water re-injection pumps offshore or the shut down of any critical element of the ACG FFD PWD system.

The new PWD tank will be built adjacent to the existing tank and will be contained within a lined bunded area that will be designed to contain 110 percent of the volume of the tank in the event of a tank failure.

A positive pressure is maintained in the tank to avoid a vacuum caused by thermal inbreathing and Produced Water outflow to the Produced Water treatment process. Any fuel gas that is emitted as part of the filling and emptying operations of the tank will be routed to the Early Oil Project (EOP) flare. The total capacity of PWD storage at the Terminal with the two PWD storage tanks will be equivalent to approximately 3 days based on 80,000 bbl/d of Produced Water. This is in the event that Produced Water cannot be re-injected offshore due to maintenance shutdown or downtime of any critical element in the ACG FFD PWD system.

Some solids and oil removal will be achieved within these tanks as described in Sections 5.2.2.2 and 5.2.2.3. Transfer pumps will be used to transfer the Produced Water from the storage tanks to the Produced Water treatment packages, which consist of sub packages to further reduce the solids and oil content of the Produced Water.

5.2.2.2 Solids removal

Solids are removed from the Produced Water to reduce the corrosion potential of the Produced Water in the pipeline and prevent re-injection problems offshore. The design specification of the project is 98 percent removal of particle size greater than 30 microns. Any solids will be disposed as hazardous waste.

Gravity settling
The first stage of solids removal is achieved within the PWD storage tanks. These tanks work by allowing enough time for the solids to settle (by gravity) to the bottom of the tank. The large and relatively dense particles are easy to remove by this process, e.g., sands. These solids are removed for hazardous waste disposal.

Solid-liquid hydrocyclones
The next stage of solids removal is achieved by the use of solid-liquid hydrocyclones. These work by converting pressure energy to centrifugal motion in order to increase the applied gravitational force field. Increasing the gravitational force increases the settling rate of the solids, and particles of a smaller diameter can be separated due to the higher g-force generated by the solid-liquid hydrocyclone. The oil is routed to the top of the hydrocyclone and returned to the process, and the solids are rejected through the bottom of the hydrocyclone and sent for hazardous waste disposal.

Mechanical filtration
The final stage of onshore solids removal is achieved by passing the Produced Water through guard filters. This will achieve mechanical filtration, which is required for solids that are too small to be efficiently removed by the previously described solid removal processes. This project will use media absorption filters. As contaminants build up on or in the filter, the pressure drop increases, and the flow rate decreases. Hence, periodically filtration equipment must be replaced and spent filters disposed as hazardous waste.

5.2.2.3 Suspended oil removal

Prior to pumping offshore and re-injecting in the reservoir, the oil is required to be removed to a specification of < 10 mg/l. This also allows the oil to be returned to the process and adds to overall oil production volumes. Oil removal is achieved in stages from primary bulk removal to final polishing. The number of stages required is a function of the type of oil in the stream, the size distribution of oil droplets, the concentration of oil, and level of removal required for the application. Many of the oil removal processes are very similar to suspended solids removal processes.

Skimmers
The skimmers separate oil droplets simply by allowing enough retention time for the droplets to rise to the oily layer at the surface. The larger and lighter density droplets are easy to remove by this process. The skimmers in the PWD storage tank perform this primary separation of the oil. Any oil removed is returned to the process.

Liquid hydrocyclone
Hydrocyclone technology can be used to separate suspended oil from Produced Water. Liquid-liquid hydrocyclones work by converting pressure energy to centrifugal motion in order to increase the applied gravitational force field. Increasing the gravitational force increases the settling rate of the oil droplets, requiring only smaller and lighter equipment to process. In addition, separation is more efficient in terms of smallest droplet that can be removed.

5.2.2.4 Produced Water cooler

The Produced Water requires cooling after the solids and oil removal, and prior to chemical injection and pumping offshore. This is to ensure that the potential for corrosion is minimal. The Produced Water will be arriving at a temperature of about 70°C and will be cooled to 46°C prior to entering the Dissolved Gas Flotation (DGF) units. The cooling system will be fin fan electrically driven air coolers.

5.2.2.5 Dissolved Gas Flotation (DGF)

The DGF process removes residual amounts of the small oil droplets and oil-coated solids from Produced Water. This unit allows fuel gas to be introduced to a tank, the gas causes the small droplets of oil and oil-coated solids to float to the top of the chamber and be removed. This process ensures the contaminants float to the surface much faster to ensure the Produced Water reaches the required specification with the predicted flow rates through the system. Prior to the main DGF unit a tank will have flocculent added to aid in the flocculation process (where fine particles stick together to create larger, easier-to-segregate particles) for greater removal capability. The DGF package includes solids removal and sludge handling facilities. The oily sludge removed will be further treated to recover any oil and route back to the process; any solids will be dewatered and sent for hazardous waste disposal.

Mechanical filtration
The smallest oil droplets are required to be removed by mechanical filtration. As stated previously the filtration used for this application will be absorption filters. The media used will be disposable; as the contaminants build up on or in the filter, the pressure drop increases and the flow rate decreases. Hence, periodically, filtration equipment must be replaced. The filter media will be disposed as hazardous waste.

5.2.2.6 Chemical treatment skid

It is important, given the corrosive nature of Produced Water, that the pipeline is protected to ensure its 25-year design life; therefore, a corrosion management programme will be implemented. This will include the requirement to inject chemicals from a chemical injection skid at various stages in the onshore Produced Water treatment process.

The chemical injection skid will contain high-reliability injection pumps with automated alarms, in addition to spare pumps in parallel to ensure the continuous delivery of chemicals, daily reporting on chemical usage, and sufficient spare parts. The requirement will be to stop Produced Water pumping if the chemical treatment system fails for an extended time.

5.2.2.7 Pigging

The running of Pipeline Inspection Gauges (PIGs) along the pipeline is another important part of the corrosion management programme and key to maintaining the life span of the pipeline. Pig traps will be installed to ‘pig’ the pipeline on a regular basis, using clean-up pigs every 2 weeks, and inspection/intelligent pigs when required (initially believed to be every 2-3 years). In periods of low flow, appropriate operating procedures will be employed for the pigging to ensure the continued flow of the pig. Make-up water will not be used if the Produced Water production rate is kept low, as this will introduce oxygen along with the make-up water into the pipeline. Any potential corrosion from stagnation will be handled by the use of chemicals. Pigging will take place from onshore to offshore and any pigging waste arriving at CWP will be collected into sealed containers and shipped to shore for hazardous waste disposal.

5.2.2.8 Export pumps

The Produced Water will be pumped offshore using 3x50 Percent Electrically Driven Centrifugal Pumps; that is three pumps that together can deliver 150 percent of the peak flow, which ensures that if one of the export pumps is unavailable there is a standby pump that can be used. With each pump being capable of pumping 50 percent of the peak flow (as opposed to 100 percent) the pumps will not be required to be turned down excessively low in periods of low flow, and can remain in their design operating regime. These pumps will use power from the ACG main electrical terminal that is produced by power turbines (Rolls Royce RB211s). The pumps will be variable frequency drive (VFD) to ensure turndown can be achieved efficiently at the varying Produced Water rates over the life of the field.

5.2.2.9 Leak detection

A flow meter totaliser will be provided as a means of detecting leaks in the pipeline. A flow meter will be provided onshore downstream of the export pumps and a flow meter will be provided offshore on the platform. The two will be continuously monitored for differences that could indicate a leak in the pipeline. Due to the less complex nature of water in relation to oil, leak detection of 1 percent or less of total flow may be achieved.

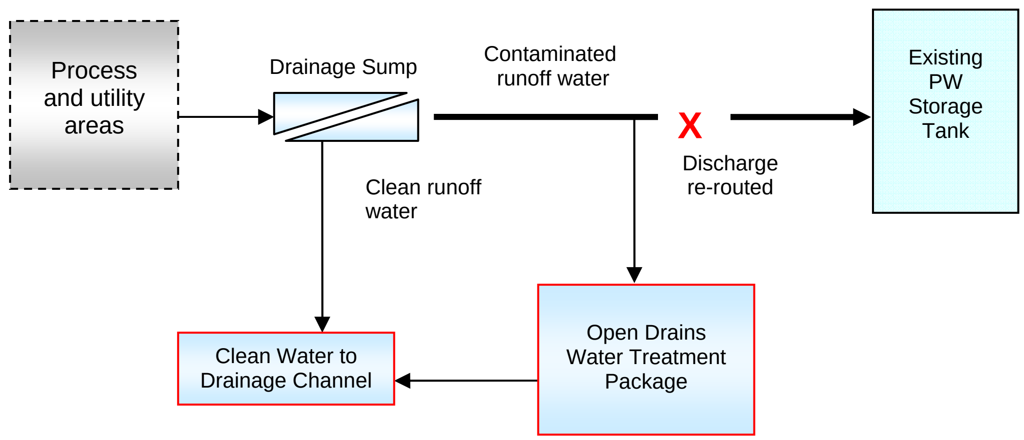
5.2.2.10 Open drains system

Open drains exist at Sangachal Terminal to capture rainwater run off from process areas. The current Sangachal Terminal design routes any contaminated run-off water to the existing PWD storage tank. This drainage will have been exposed to the atmosphere and therefore introduce air to the tank which gives the potential for corrosion for the Produced Water treatment system. To remove this risk, the project redesigned the existing open drains system to ensure the open drains system will be segregated from the ACG FFD PWD system.

Figure 5.4 presents a schematic of the open drains at Sangachal Terminal. The red cross marks the piping that will be re-routed to a suitable treatment plant. After treatment the clean effluent will be discharged to the outer drainage channel prior to discharge into the surrounding environment. Open drains water will consist of mainly rainwater run-off and the treatment plant will ensure any spilt chemicals, in ppm concentrations, will be treated or removed prior to any discharge into the environment.

The redesign of the treatment plant will ensure all discharges previously routed to the PWD tank will be treated to the required onshore discharge limits specification (Appendix 4).

Figure 5.4 Open drainage system at Sangachal Terminal



5.2.3 Terminal construction activities

All construction activities required at Sangachal Terminal for the ACG FFD PWD project will be done within the existing construction areas at Sangachal Terminal. Civil works have begun as identified in the project schedule (Figure 5.2).

The construction of the process vessels, pipework, and equipment will be manufactured outside of Azerbaijan and will be imported by railroad or riverboat through the Russian canal system. Construction materials will, however, be sourced from local Azerbaijani suppliers wherever possible.

Typical activities involved during construction programme are the establishment of underground services such as drains and the firewater systems; earthworks to establish foundations, plus surface pipework, tank and facility construction, and tie-in. Construction methods will be based on those already established for previous phases of Sangachal Terminal. It may be necessary to carry out ‘hot work’ at times adjacent to producing plant as the Terminal will be in operational mode during the ACG FFD Phase 3 construction phase.

Operation at Sangachal Terminal will carry on throughout the construction phase of the ACG FFD PWD project, but the area under construction will be fenced off and permits will be required for access to ensure the safety of personnel entering the area.

Utilities required during the ACG FFD PWD Terminal construction phase will be provided by existing facilities at the Sangachal Terminal. This includes both power generation requirements and sewage and wastewater arrangements. All diesel fuel required for construction plant and equipment operation will be supplied from the existing storage areas. Diesel storage and refuelling facilities will be located on areas of hard-standing flooring (concrete) to avoid potential contamination of the soil.

5.2.4 Tie in and commissioning

The PWD system will be fully integrated with the current ACG FFD onshore operations. The existing ACG utilities plant will supply power and other required utilities. The integrated control and safety system (ICSS) for the PWD system will be fully compatible with the existing ACG plant ICSS. Any gas that is required to be vented shall be routed to the existing EOP flare system to be flared (rather than vented). The expected amount of gas to be flared will be from the fuel gas blanketing on the PWD storage tanks and will only be flared during times that the tank is filling. Some gas is also expected from the DGF oil removal process. Tank filling will not be the normal operation. Continuous export of Produced Water down the pipeline will be the normal operating condition with no rise in the levels in the PWD tanks.

The Sangachal Terminal section of the pipeline will be hydrotested with potable water dosed with a bio-friendly volatile corrosion inhibitor (VCI). The hydrotest water will be reused in different sections whenever possible. When testing is complete the water will be discharged to a holding pond for chemical degradation prior to discharge into the Terminal outer drainage channel.

5.2.5 Sangachal Terminal operations

The Terminal operations will be responsible for the running and maintenance of the facilities described in Section 5.4.1 throughout the operational life of the project. Appropriate operating procedures will be established during the Operate stage of the project when projects are handed over to operations.

An availability study of the entire ACG FFD PWD system, from the onshore treatment plant, export pumps, pipeline and offshore water injection treatment, control system and water injection pumps, was undertaken to assess any potential problems with disposal of the Produced Water. This study was based on the design availability of 92 percent for the overall ACG FFD PWD system, which means that the PWD system is estimated to be fully operational 92 percent of the time; therefore during 8 percent of the time a part of the system is predicted to be offline.

The results of the study determined that an extra ACG FFD PWD storage tank would be required in the event of the entire system not functioning, i.e., in a case where all the ACG FFD PWD pumps offshore were not available for re-injection. This extra storage would ensure none of the treated Produced Water from the onshore Terminal would be discharged to the Caspian Sea. In the event that the ACG FFD PWD water injection (WI) system is non-operational offshore the Produced Water at Sangachal Terminal would be routed to either of the PWD storage tanks for as long as the problem took to resolve. The study showed that only during the peak production of 4 years (see Figure 5.1) the downtime offshore would be sufficient to cause the PWD storage tanks at Sangachal Terminal to both fill up.

A study of the corrosion management requirements for the specified ACG FFD PWD treatment facilities and pipeline identified a number of control measures that will be essential to manage during operation. Table 5.3 presents the control measures to be handled by operations to sufficiently achieve corrosion management of the entire Produced Water treatment system. These include oil and solids removal facilities, injection of chemicals, and pigging. By adhering to the recommended operating procedures, the design life of the pipeline should be adequate for the task it is to perform, corrosion should be limited, and the pipeline should not be compromised early.

Table 5.3 Operational corrosion management control measures

Control measure	Initial implementation frequency	Key performance indicators	Notes
Corrosion inhibitor injection	Continuous at 25 ppm.	On-line corrosion monitoring. Corrosion coupon retrieval Injection rates and chemical usage.	Design to deliver 100 ppm at max water rate. Monitor corrosion at inlet and outlet of pipeline.
Biocide injection	Likely combination of continuous and weekly batch treatment at up to 500 ppm.	Sessile bacteria coupons or side stream biostud inspected quarterly. Water samples checked for planktonic bacteria quarterly. Injection rates and chemical usage.	Treat whole volume during periods of low flow. Treat storage tanks as well as pipeline. Monitor bacteria at inlet and outlet of pipeline.
Oxygen scavenger injection	Likely continuous at 2 ppm.	On-line oxygen monitoring, crosschecked with monthly chemical measurement. Injection rates and chemical usage.	Monitor oxygen throughout processing facility not just as pipeline inlet.
Scale inhibitor injection	To be determined	Reduction of scale forming in the pipeline	Monitor during pigging
Exclusion of oxygen from the system	Continuous	On-line oxygen monitoring, crosschecked with monthly chemical measurement. Injection rates and chemical usage.	Tanks to be blanketed. Drains water to be disposed of separately. Ingress of oxygen at pumps etc to be monitored.
Flocculent	To be determined	To aid in separation of oil from water in the dissolved gas flotation unit	
Coagulant	To be determined	To aid in removal of solids in the dissolved gas flotation unit	
De-oil Produced Water	Continuous.	Target < 10 ppm oil in water.	Need to keep line as free from oil as possible to prevent “Schmoo.”
Filter Produced Water	Continuous.	Target <30 microns.	Onshore and offshore packages.
Filter Aid	To be determined on selection of filter	Filter aid to reduce blockages during filtration process	
Maintenance pigging	Once every two weeks from onshore to offshore.	Number of pigging operations versus plan. Amount of solids returned.	Pig to maintain line cleanliness and increase inhibitor and biocide efficiency.
Inspection pigging	Once every three years from onshore to offshore.	Corrosion rates indicating that the line is under control.	Optimise inspection interval based on state of line.

5.3 ACG FFD PWD pipeline

5.3.1 Overview

The ACG FFD PWD pipeline will be tied into a riser on the CWP platform and follow the existing ACG FFD production pipeline route to onshore. At the onshore "landfall" (or beach) site the pipeline will run to the northeast of the EOP outfall pipeline and continue to follow this route to the tie in point at Sangachal Terminal. The pipeline will have a diameter of 14-inch and be approximately 189 km in length from the Terminal boundary to the CWP tie in.

The offshore section of pipeline will be situated on the seabed from the platform to the 11 m water depth mark. In waters less that 11 m the pipeline will be buried to allow for seabed coverage of 0.5 m Top of Pipe (TOP). The onshore section of pipeline is 1.8 km and the entire onshore length will be buried to a depth of 0.5 m TOP.

This section describes the design, construction, installation, commissioning, and operation activities relating to the pipeline. This will include details on project schedule and the pipeline, fabrication, route selection, and material specification.

5.3.2 Schedule

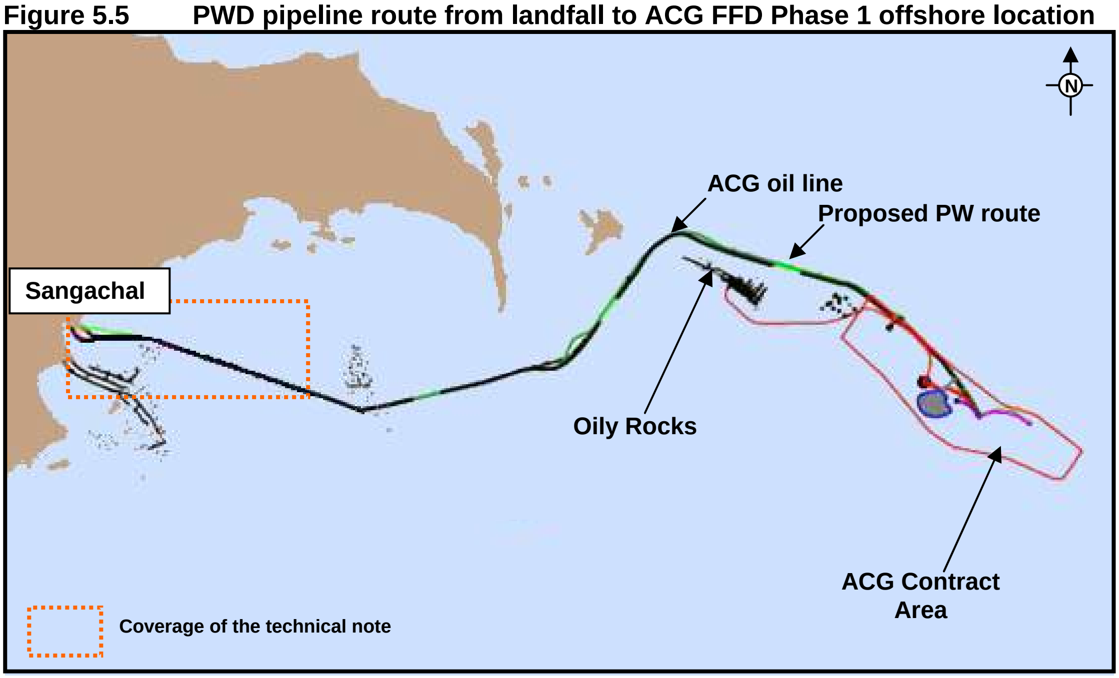
Seasonal constraints and vessel activity schedules meant that it was necessary to undertake early works to prepare the installation of the ACG FFD PWD pipeline in Sangachal Bay and the onshore section to Sangachal Terminal to ensure the predicted Produced Water coming to shore can be disposed of appropriately (Figure 5.2). The detail of this early preparation work was presented in a Technical Note (TN) to the Azerbaijan MENR in May 2006. The work identified within the TN was carried out within existing brownfield construction areas (Figure 5.5). Details of the information provided within the TN have been integrated into this ESIA.

Pipeline installation will be completed during the first and second quarter 2007 (Figure 5.2)

5.3.3 ACG FFD PWD pipeline route

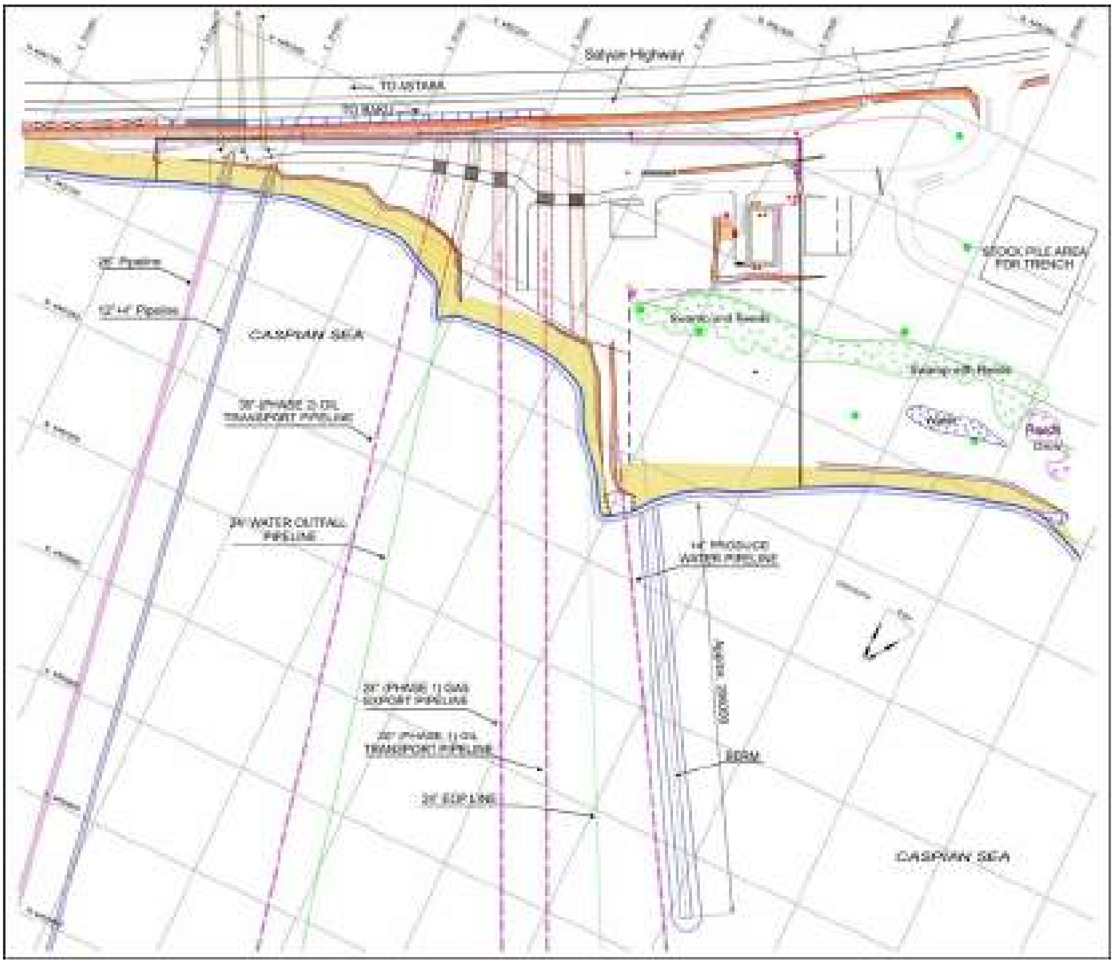
The project team evaluated a number of pipeline options prior to selection of the chosen pipeline route. Figure 5.5 illustrates the selected route for the 189 km pipeline from the landfall site to the CWP in the ACG FFD Phase 1 portion of the Contract Area.

Figure 5.5 PWD pipeline route from landfall to ACG FFD Phase 1 offshore location



From CWP the pipeline will be laid along the seabed following the existing ACG FFD production pipeline route to a water depth of 11 m. In water depths less than 11 m the pipeline will be buried. The route will run northwest to the EOP outfall and be brought ashore within the existing landfall site. The shore approach of the ACG FFD PWD pipeline and other pipelines coming ashore here are shown in Figure 5.6.

Figure 5.6 SD and ACG FFD PWD pipeline shore approach at landfall site



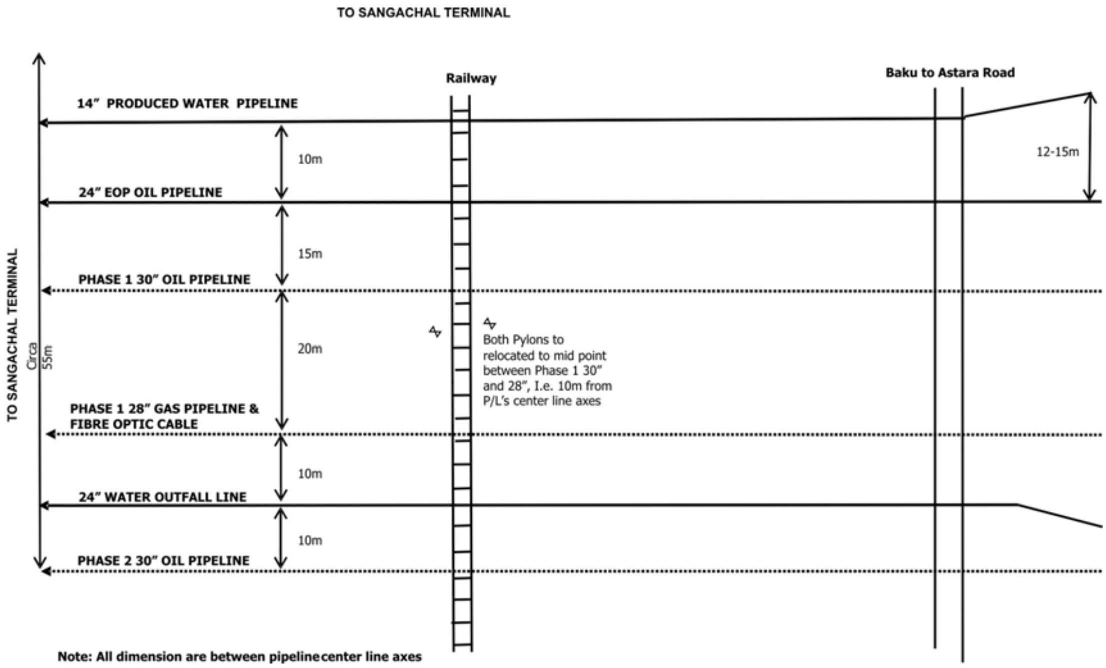
From the landfall the pipeline route will run directly to Sangachal Terminal onshore for a distance of approximately 1.8 km. There are 21 foreign facilities for the pipeline to cross including:

- 1 road crossing (the Salyan or Baku-to-Astara highway);
- 1 railway track crossing; and
- 19 utility crossings of third party pipelines/service lines and facilities.

Within the onshore route to Sangachal Terminal the ACG FFD PWD pipeline will be routed within the existing pipeline right of way (ROW) established for the earlier ACG FFD and Shah Deniz Gas Export (SDGE) oil and gas lines. This ensures that the minimum safe distances for separation are maintained between the lines (Figure 5.7).

The route selection for the ACG FFD PWD pipeline has taken into account prior construction within the Caspian and onshore ROW to minimise the cumulative impacts of pipeline construction activities. The environmental benefits of the route selected are discussed in Chapter 9.

Figure 5.7 ACG FFD PWD pipeline onshore ROW (Salyan Highway to Sangachal Terminal)



5.3.4 Pipeline design

The pipeline has been designed for a pressure of 300 barg. It will be made of Carbon Steel that has been tested to the American Petroleum Institute (API) 5L standard. This standard covers seamless longitudinally and spirally welded steel pipe. Other pipeline properties are listed in Table 5.4.

Table 5.4 ACG FFD PWD pipeline properties

Pipeline Property	Description
Length	189 km
Material	API 5L Carbon Steel
External diameter	14-inch
Wall thickness	22.2 mm
Density	7,850 kg/m^3
Internal coating	None
External coating	50 mm concrete coating for the total length of the pipeline 3-layer Polypropylene or Polyethylene (2.0-2.5 mm) coating between the external pipe wall and the concrete weight-coat

5.3.5 Fabrication

The ACG FFD PWD project will follow the BP Procurement and Supply Chain Management system in place for the ACG FFD Phase 1, 2, and 3 projects.

Pipeline sections will be sourced from outside of Azerbaijan and transported to Baku by ship and rail services. The pipe sections will be stored at EUPEC where they will be coated with a concrete outer layer and internally blasted to assist in corrosion protection.

5.3.6 Installation

The pipeline will be installed in the route described presented in Figure 5.5. In accordance with other ACG FFD and Shah Deniz (SD) pipelines, the ACG FFD PWD pipeline will be laid directly on the seabed in water depths exceeding 11 m and in water depths of less than 11 m, the pipeline will be laid in a 1 m deep trench. This will ensure a 0.5 m TOP cover depth is achieved. Pipelay operations will begin Trenching has been scheduled to be carried out in advance of the pipelay operations as explained in Section 5.3.2. The company TKAZ will construct the onshore pipeline section; this Contractor also installed the ACG FFD and SD onshore pipeline sections.

5.3.6.1 Offshore installation

The offshore section of pipeline will be laid using the Pipeline Lay Barge (PLBG) "*Tofiq Ismailov*" as part of the present campaign for the ACG FFD and SDGE Projects. The PLBG will require minor upgrading to the pipe rollers and tensioners on the vessel, as well as performing an overhaul of all other equipment to ensure appropriate performance prior to commencing the installation of the PWD pipeline. Upgrading of the pipelay vessel will take place at the SPS yard. The PLBG equipment will also carry out welding, ultrasonic testing of welds, and recoating of welded joints with foam and tape.

The PLBG is a dumb barge (positioned in place by support vessels) and is held in position by 8-10 anchors. The vessel requires a minimum of 5 m water depth allowing for a light ship draft and a 1 m clearance to safely pass over other pipelines on the seabed. The following support vessels will service the PLBG:

- 3 anchor handling vessels
- 1 supply vessel
- 4 pipe-haul vessels
- 1 support Survey Vessel
- 1 diving support vessel (DSV)

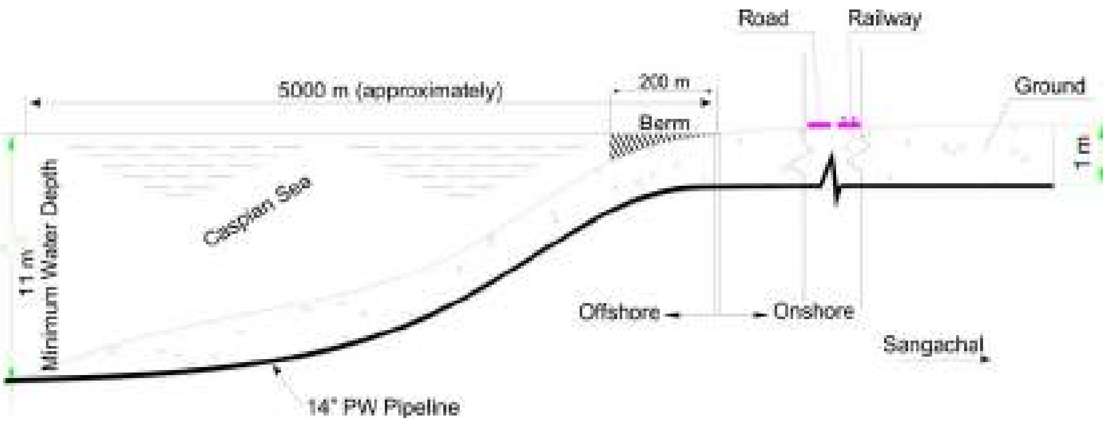
During installation, exclusion buoys will be placed around the PLBG installation area to indicate that the area is an exclusion zone, ensuring that other vessels do not encroach upon the area of activity. As pipelaying progresses the exclusion buoys will be moved along the route. During installation the pipeline will be deployed from the stern of the PLBG in a continuous deployment as each pipeline section is welded and checked onboard the vessel. The concrete coating described in Table 5.4 will provide stability for the pipeline sections that are laid directly on the seabed.

Pipelaying can either begin offshore or from the nearshore area. A project constructability scheduled fourth quarter 2006 will define where pipelay will begin. When the pipeline is laid down at the CWP location by the PLBG, the DSV will be used to tie-in the connecting spools between the pipeline end and the CWP existing riser.

5.3.6.2 Near shore installation

Beach haul
The PLBG will approach the shore to a point of around 1.2 km distance from the landfall point where it will anchor due to water depth restrictions in Sangachal Bay. The remainder of the pipeline will then be made up on the barge and pulled to shore until the tie-in point. Pipeline pull onshore will occur from the lay-barge using a shore-based winch. The pipelines are kept afloat during this shore-pull exercise by means of floatation pontoons attached to the pipelines. This means that the pipelines can only be pulled until they are grounded. Figure 5.8 provides a representation of a typical shore approach.

Figure 5.8 Typical pipeline shore approach



Existing access to the shore is present at the site, although there may be the requirement to upgrade areas of the site to ensure the area is capable of withstanding all construction loads (materials, equipment, and vehicles) required for landfall operations.

Berm

A temporary finger pier "berm" will need to be constructed to provide access for an excavator to trench from the 3 m water depth to shore. The temporary berm will be installed in the same way as for the previous pipeline shorepulls by placing a rock base covered with compacted finer material in the shallow marine zone to achieve the required clearance above local sea level. Figure 5.9 provides an illustration of the berm dimensions.

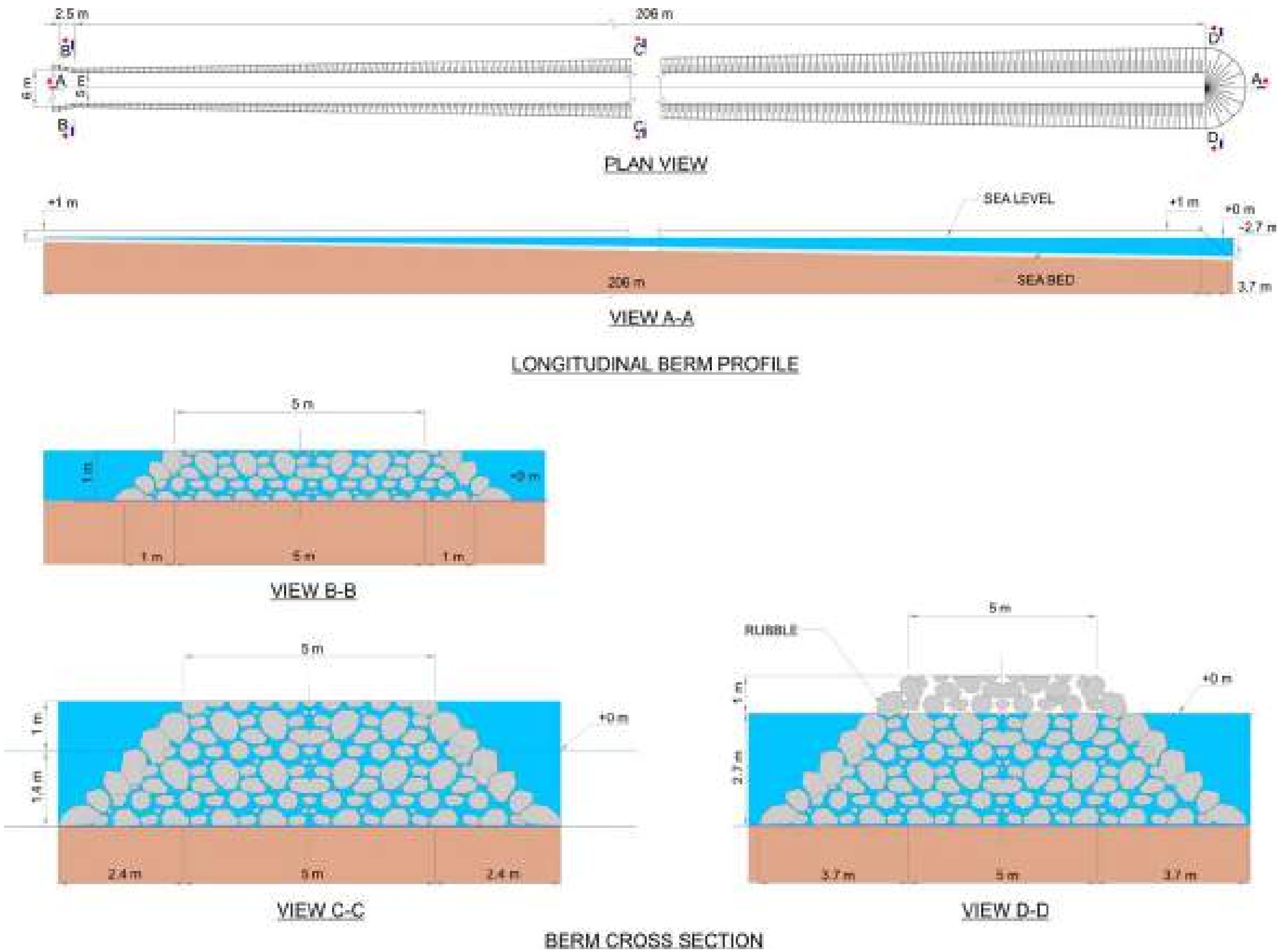
The berm will be approximately 200 m long (to extend to the 3 m water depth contour), approximately 5 m wide at the surface and will taper in the width of the base from 12.5 m wide at the shore to 7 m wide at the seaward end. The position of the temporary berm in relation to the pipeline is illustrated in Figure 5.6. The berm will be removed after pipeline installation is complete and any materials deposited at the area (aggregate, sheets piles, and other material) will be removed from the site to a designated disposal area.

Trenching

The nearshore section of the PWD pipeline will be trenched to afford some protection to the pipeline from vessel activity and to assist in the pipelaying operation, since the pipeline can only be pulled ashore while floating. In order to ensure the maximum distance the pipe can be pulled, a 1 m deep trench will create the necessary depth of water. The base case plan for trenching is to excavate a trench to the 11 m water depth mark (approximately 5 km offshore, but dependant on the natural fluctuation of the Caspian Sea level).

Overall, the trench will be no more than 3 m wide and will be left to naturally backfill. The trenching work has been scheduled in advance of pipeline installation and will be kept open until the installation of the pipeline.

Figure 5.9 Berm dimensions



5.3.6.3 Onshore installation

The onshore section of the PWD pipeline from the shoreline to Sangachal Terminal is 1,800 m. This will be buried to a nominal depth of 0.5 m from Top of Pipe (TOP), or a total 1 m trench depth. All topsoil removed from the trench to be excavated will be placed aside and stored so that it may be used for later reinstatement of the route, maintaining the environmental characteristics of the area. Every effort will be made to avoid disturbance to this soil while it is stored during pipelay operations.

As noted earlier in 1.4.2 the onshore pipeline route will make 21 crossings including a road, a railway track, and various third party pipelines/service lines. The crossing of the Salyan (Baku-to-Astara) Highway will require excavation works as the geology of the site prohibits directional drilling under the road. The method employed will consist of hand and machine excavation of part of the highway, installation of the pipe sections, and road restoration prior to continuing on the second half of the highway.

Directionally drilling and a non-conductive casing will be used for the installation of the PWD pipeline under the rail crossing. Once the pipeline is pulled through the casing the annulus between the pipeline and boring/casing will be sealed.

Where the pipeline crosses existing services, reinforced concrete protective slabs shall be placed over the pipelines at the crossing point. These will extend beyond the pipe for at least 150 mm on both sides, and at least 3 m either side of the service being crossed, which shall be separated from the pipeline by at least 150 mm of fine-grained material. Slab settlement will be minimised by careful selection of backfill material and through sufficient material compaction. On completion of backfilling operations, permanent surface warning tiles shall be placed on the pipelines to indicate their points of intersection with other services.

At Sangachal Terminal the ACG FFD PWD pipeline will depart the Sangachal Terminal Expansion Programme (STEP) area and be connected with a typical expansion tie-in spool arrangement.

5.3.7 Commissioning

The pipeline is installed air filled, and will only initially be water filled in the event of a pipeline buckle. The normal operation after installation is that the pipeline is flooded with seawater and pigged to remove debris prior to being hydrotested with inhibited seawater. The inhibited seawater will be discharged to sea near the CWP.

The ACG FFD PWD pipeline from Sangachal Terminal to the beach-pull site, which is to be installed by the Terminal construction team, will be hydrotested with firewater. A bio-friendly VCI will be added to the test water; this water will be disposed to the holding pond for chemical degradation. The water will be tested periodically until sufficiently degraded prior to discharge to the outer drainage channel.

The ACG FFD PWD pipeline to offshore will be flushed with inhibited seawater to remove any debris – a small amount of this water will be discharged at the riser base along with any debris from the pipeline construction process such as swarf and welding rods. The pipeline will then be hydrotested with the same inhibited seawater that has been used and approved for ACG FFD Phase 1 and 2, and SD pipelines. This hydrotest water will then be discharged to sea near the CWP

5.3.8 Operation and maintenance

The operations and maintenance management of the pipeline will be the responsibility of operations and is already covered in Section 5.2.5.

5.4 Offshore platform system

5.4.1 Overview

This section describes the offshore modifications required on the CWP to allow Produced Water to be re-injected offshore. CWP was developed as part of ACG FFD Phase 1 and is located in the CA portion of the ACG Contract Area (Figure 5.11). The ACG Contract Area is approximately 120 km south east of Baku and covers an area of 432 square kilometres in water depths ranging from 100 m to 400 m.

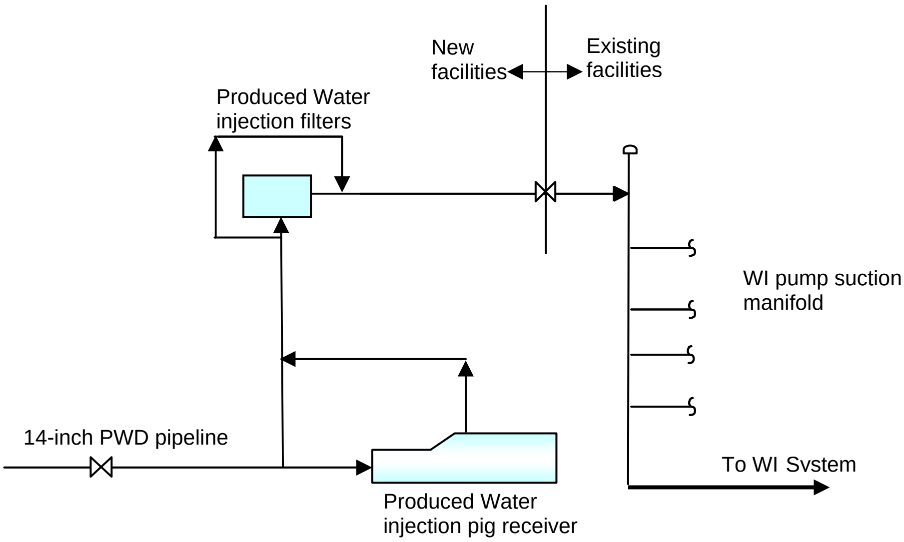
Figure 5.10 Compression and Water-injection Platform (CWP) (on the right)

Produced Water will be received continually on the CWP platform from the ACG FFD PWD pipeline where it will be co-mingled with the existing de-aerated seawater and treated Produced Water from the offshore Produced Water treatment package and re-injected into the platform WI wells on CA-Production, Drilling, and Quarters (PDQ) platform. The offshore modifications will require: connection to a riser, addition of filters, installation of a pig receiver, and pipework for connect to water injection manifold. Figure 5.11 is a schematic presentation of the offshore modifications and facilities.

The CWP platform will receive Produced Water through the 14-inch ACG FFD PWD pipeline that will be connected to an existing riser on CWP (Section 1.3.1.1). From there the Produced Water will be routed to the platform WI system through online filters, which will remove particulates prior to injection (Section 1.3.1.2). The Produced Water will be treated with biocide and corrosion inhibitor prior to re-injection in to the reservoir formation. Produced Water will be received at the riser at a pressure of 30 barg. The whole system up to the shut down valve will be designed to 300 barg pressure, while the downstream system will be designed to 49 barg (the downstream pipework being protected by a fast-acting high-integrity relief valve set at 49 barg). In the unlikely event of a shutdown system failure, a relief valve has been built into the design to ensure an over-pressure occurrence does not happen.

In the event that the water injection system offshore is non-operational for either maintenance or an emergency shutdown or trip; the Produced Water that is being pumped from onshore will be stopped, the Produced Water will be line-packed in the pipeline as much as possible, and the PWD tanks at Sangachal Terminal will start to be filled (see Section 5.2.5 for an overview of availability). The onshore Produced Water that is delivered to CWP through the pipeline will be re-injected at CWP preferentially over both the seawater and the Produced Water that has been separated offshore, due to the chemical addition in the Produced Water from shore.

Figure 5.11 Schematic of offshore ACG FFD PWD system



Scraper and intelligent pigs will be routinely sent down the line for corrosion management and monitoring; the intention is for scraper pigs to be used every 2 weeks and intelligent pigs every 2-3 years, depending on the results of the pigging. A pig receiver will accommodate the pigs that arrive on the platform with any effluents and pigging waste draining to the hazardous open drains. The non-hazardous open drains system will receive drainage from the ACG FFD PWD injection filters and surge relief will go to the seawater discharge caisson. Solid pigging waste will be collected from the pig receiver and placed in drums offshore prior to transfer onshore for hazardous waste disposal. The existing water injection system on the platforms will perform the work of conditioning the Produced Water (biocide and corrosion inhibitor dosing) prior to re-injection in the reservoir.

5.4.1.1 Risers

The CWP has an existing designated PWD riser rated to 520 barg, which will be welded to the new 14-inch pipeline. The risers will be protected by external anti-corrosion coatings along the entire pipe length and by a protective Neoprene sleeve down to 16 m depth.

5.4.1.2 Filters

Before water injection the Produced Water passes through the ACG FFD PWD injection filters specified for 98 percent removal of particles greater than 50 microns. A hard-piped spare filter package will be provided. The filters will be designed to handle up to 50 lbs of pigging waste, the expected amount to be produced from each pig run (carried out every 2 weeks).

There will be a differential pressure indicator across the filters to detect filter blockage. A facility will be in place to manually reroute the pigging water to the alternative filter in the event of a blockage. The differential pressure transmitter across the filters is linked back to the Central Control Room, which will give an indication that the filter being used is beginning to block. The two-filter arrangement will avoid any pressure surge in the system leading to Produced Water needing to be relieved to the seawater dump caisson.

Immediately upstream of the filter package there is a high integrity shut down valve activated by a high high-pressure transmitter and a pressure relief valve set at 49 barg. In the event of a blockage in the filter and the switch-over to the other filter not occurring, the pressure relief valve will relieve any surge pressure from the blockage to the seawater discharge caisson until the shutdown valve closes at which point the ACG FFD PWD receiving system will be shut in, pigging will stop, and discharge to the seawater caisson will stop. The time taken to shut this valve is expected to be approximately 2 seconds.

After each pigging operation the waste will be removed from the filter and will be disposed of in drums that will be sealed prior to transport to shore for appropriate disposal. Filter clean up and disposal will be through a closed system to prevent ingress of oxygen into the water injection system. Any effluent water from the filters will drain to the non-hazardous open drains. Cartridge filters will be installed to efficiently clean up the pigging waste and to avoid excessive manual intervention.

5.4.1.3 Pig receiver

On the CWP platform there will be a pig receiver that will be designed to receive both scraper pigs and intelligent pigs on a regular basis. The pig receiver area will be contained within a plated deck area with a bund that will have a valved drain point routed to the hazardous open drains system. The pig receiver will be rated to 300 barg.

5.4.1.4 Leak detection

Flow meters and a totaliser will be installed on the platform topsides and at the Terminal to give the project warning of a leak in the pipeline or topsides equipment. This detection equipment will be as sensitive as possible and due to the less complex characteristics of water in comparison to oil is expected to be significantly more accurate than detection systems on oil pipelines. Leak sensitivity is expected to be 1 percent or less of total flow with minimal false alarms being encountered during steady state conditions.

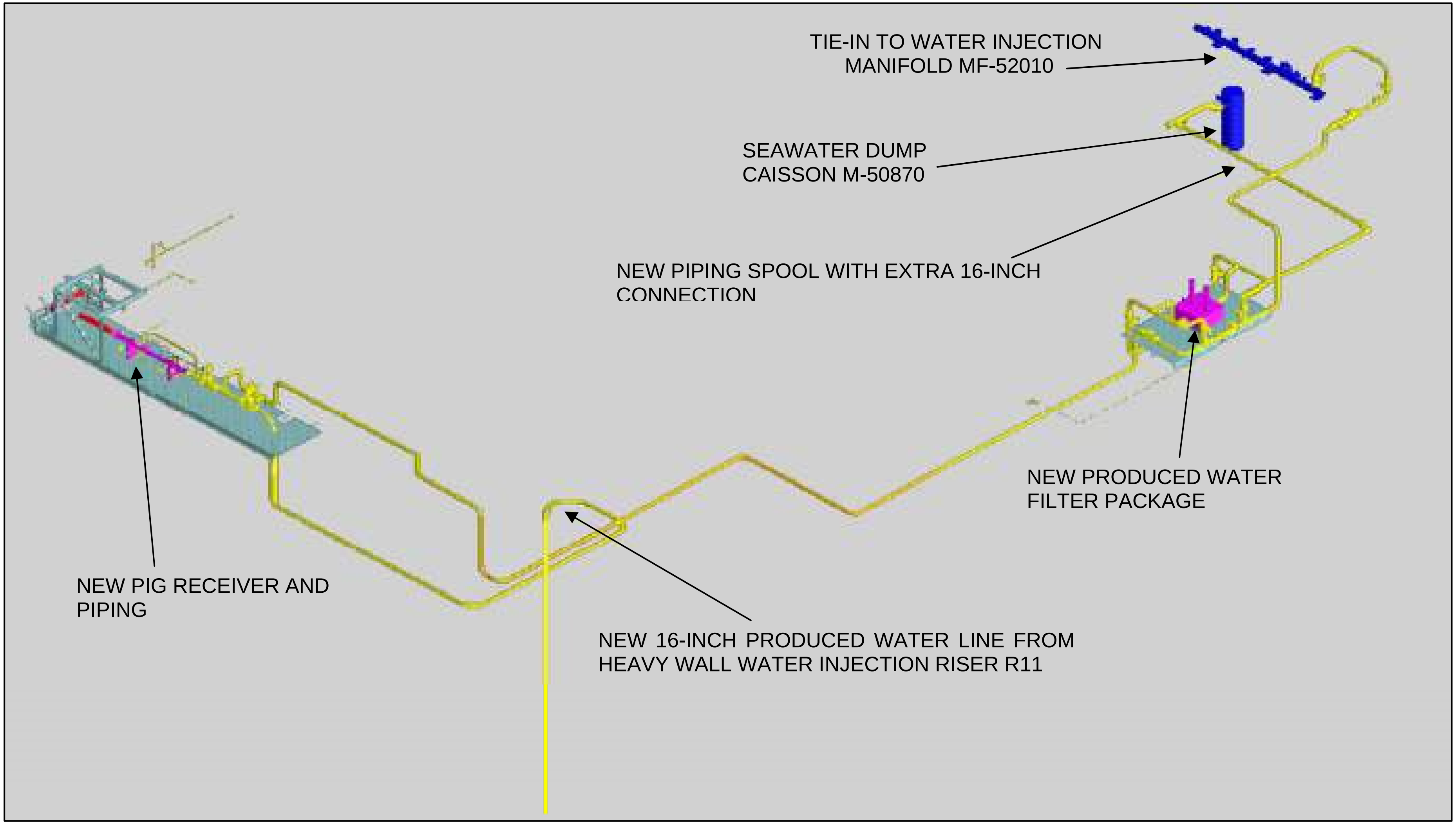
5.4.2 Construction and installation

The offshore receiving and distribution facilities for CWP will need to be installed and commissioned offshore. A lot of these activities will occur during a planned shutdown of the platform due to the lifting and welding activities required to install the equipment, as shown in the schedule Figure 5.2.

The structural deck extensions for CWP will be constructed and installed by the end of 2006. The under deck pipework will be installed during 2007. During the planned shutdown in mid-2007 the tie-ins will be completed to the WI manifold, drains system, and utilities. At this time the pipeline will be hooked up to the existing riser on the platform. Then the packages will be installed. It is intended to use the CWP crane to lift the packages; hence if the shutdown window cannot be achieved, the packages can be installed whilst CWP is operating. It is not crucial to install these packages during a shutdown.

The piping and equipment will need to be hydrotested to confirm that there are no leaks, and it is expected that this will be carried out with inhibited seawater that will be discharged to sea near the CWP.

Figure 5.12 Offshore package for Produced Water



5.5 Emissions and wastes inventory

This section details the wastes, effluents, and emissions associated with the construction, installation, and operation of the Produced Water project.

5.5.1 Emissions to air

The following sections present the atmospheric emissions and their derivation for the construction, installation, hook-up and commissioning (HUC), and operations phases of the ACG FFD PWD project. It includes pollutant emission factors, general assumptions, and emissions data for the various atmospheric emissions contributors for the previously mentioned phases of the facilities including offshore, pipeline, and onshore.

Emissions are calculated using internationally accepted Emission Factors, calculated based on real time data collected over time. The following sources of emission factors have been used to calculate the emissions during construction using mobile equipment and diesel power generators, installation and hook up using seagoing vessels, and operations including combustion and flaring:

- Pollutant emission factors for general plant and equipment have been sourced from the EMEP/CORINAIR Atmospheric Emission Inventory Guidebook, Third Edition, October 2002, Technical Report No. 30.
- Pollutant emission factors for power generators have been sourced from the US EPA AP-42, Section 3.4. (Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume 1: Stationary Point and Area Sources; US EPA, January 1995).
- Pollutant emission factors for sea-going vessels have been sourced from the E&P Forum Report No. 2.59/197 (Methods for Estimating Atmospheric Emissions from E&P Operations, Report No. 2.59/197; The Oil Industry International E&P Forum, September 1994).
- Guidelines on Atmospheric Emissions Inventory; UK Offshore Operators Association, Ltd. (UKOOA); July 1995.

The methodology and assumptions used to calculate the emissions for the different phases are discussed in the following sections. Different emission factors are used depending on the phase of the project (construction, installation, or operations), the type of equipment, vessels, and plant used for the duration of the activity.

Emissions to air from the ACG FFD PWD project are presented in a format consistent with the sections previously described in the project description:

- Onshore: including Sangachal Terminal and pipeline construction, installation, and operations (Section 5.5.1.1);
- Offshore: including pipeline installation and commissioning, and offshore facilitates installation (Section 5.5.1.2).

5.5.1.1 Onshore

Construction and installation

This section presents the pollutant emission factors, general assumptions and emissions data for the various atmospheric emissions contributors for the onshore construction phase of the ACG FFD PWD project. This includes construction within Sangachal Terminal and the onshore section of pipeline.

Construction of the onshore pipeline includes the use of construction equipment, e.g., excavators. The main air emission sources are the earth moving operations, construction and delivery vehicles, power generation, and both welding and paint fumes.

Emissions Factors
Table 5.5 provides the emission factors used for the different types of construction equipment used at the Sangachal Terminal.

Table 5.5 Emission factors for ACG FFD PWD construction equipment

Item	Emissions (g/hr)					
	CO_2	CO	HCs	NO_x	SO_x	PM
Tractor	51,161	350	100	580	41	60
Excavator	45,314	310	80	770	65	60
Crane	87,704	600	1,260	3,600	4,390	250
Truck	119,132	815	140	1,890	205	120
Minibus	98,669	450	185	930	101	154
Sideboom	87,704	600	1,260	3,600	4,390	250
Generator	43,852	300	140	1,440	2	110

Note: Data from the CORINAIR atmospheric emission inventory guidebook.

To calculate non-methane VOCs (NMVOCs) and methane from these emission factors, it is assumed that 85 percent of THC are NMVOCs and 15 percent of THC is methane.

Assumptions
It was assumed that construction equipment is used continuously for 10 hours per day and 24 days per month. Table 5.6 presents the types of equipment that will be in use, the number required and for how long.

Table 5.6 Construction equipment to be assigned to ACG FFD PWD project

Item	Number	Duration (months)
Cranes	4	12
Excavators	1	5
Trucks	12	12
Cars	5	12

Emissions
Table 5.7 presents the calculated emissions due to the onshore construction work. These assumptions have been based on the actual equipment that has been used for the previous phases of construction at Sangachal Terminal.

Table 5.7 Emissions due to onshore construction

Item	Emissions (tonnes)							
	CO_2	CO	HCs	NO_x	SO_x	PM	CH_4	NMVOC
Cranes	1,010	7	15	41	51	3	2	12
Excavators	54	0	0	1	0	0	0	0
Trucks	4,117	28	5	65	7	4	1	4
Minibus / cars / pick ups	1,421	6	3	13	1	2	0	2
Auxiliary Plant	0	0	0	0	0	0	0	0
Sub-totals	6,603	42	22	121	59	9	3	19
Generators	0	0	0	0	0	0	0	0
Sub-totals	0	0	0	0	0	0	0	0
Camp Generator	0	0	0	0	0	0	0	0
Sub-totals	0	0	0	0	0	0	0	0
Total	**6,603**	**42**	**22**	**121**	**59**	**9**	**3**	**19**

Carbon dioxide will be the main emission during this phase, showing here as 6,603 tonnes of CO_2 for the duration of the construction phase for all types of equipment used.

5.5.1.2 Operations

Emissions

Emissions to air from the onshore Produced Water plant will be part of the emissions from the ACG Sangachal Terminal main power plant, RB211. The power requirements for the Produced Water pumping facilities at the Terminal are according to the profile presented for the life of the field in Figure 5.13. The pumps are electrically driven and the electricity will be taken from the power turbines (RB211) currently installed at Sangachal Terminal.

Table 5.8 presents tonnes of emissions per tonne of fuel used that have been used in the calculation of combustion emissions due to operations.

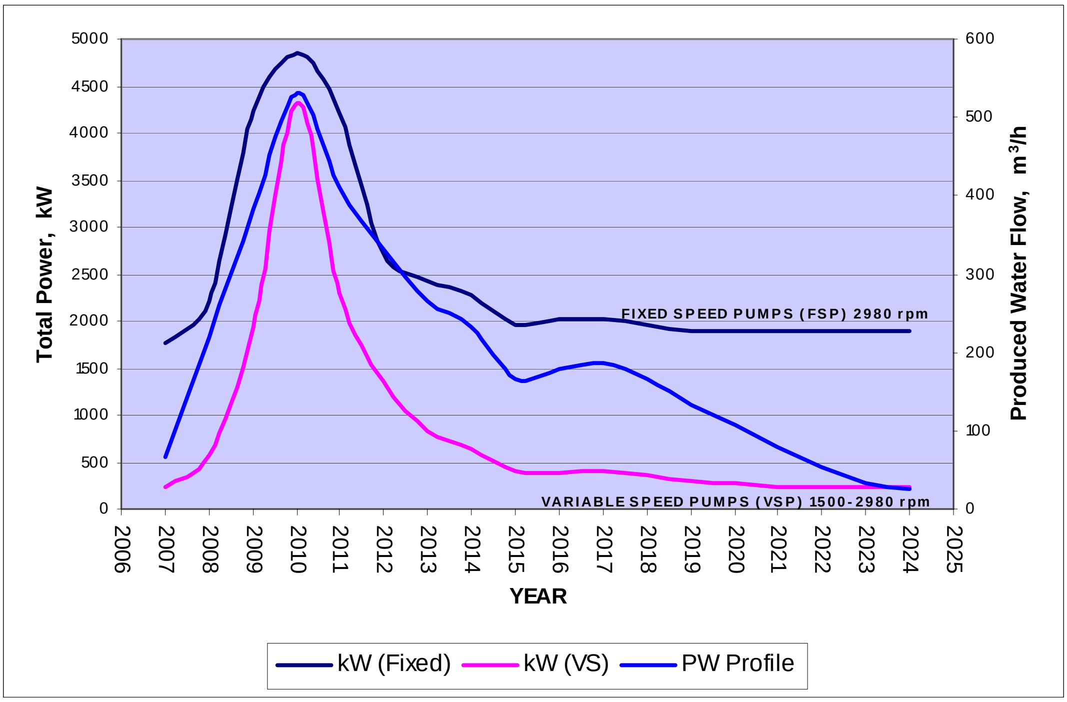
Table 5.8 Emission factors showing emissions per tonne of fuel used

Pollutant	Emission Factor Tonnes of pollutant/tonne of fuel used
CO_2	3.2
CO	0.008
NO_X	0.059
SO_X	0.008
CH_4	0.00027
VOC	0.0024

Note: Data referenced from E&P forum report number 2.59/197.

Figure 5.13 shows the Produced Water profile in blue at the bottom of the graph. The purple line is the power profile if VFD pumps are used and the dark blue line at the top pf the graph is the power profile required if fixed-speed drive (FSD) pumps are used. FSD pumps will use more power owing to the need to recycle and inability to turn down the pump speed during periods of low flow, which will occur at the beginning of the life and after the initial 4 years peak production of Produced Water when the flow will be reduced for the rest of the life of field. The project will use VFD pumps to reduce the amount of CO_2 that would be produced from FSD pumps. VFD pumps are more expensive and technically more complicated to operate.

Figure 5.13 Produced Water export power profile



There will also be the intermittent emissions from the PWD storage tank blanket gas. Fuel gas will be routed to the EOP flare and therefore combustion emissions of CO_2, NO_x, CO, VOCs, and unburnt hydrocarbons will be emitted.

Figure 5.14 shows the emissions of CO_2 attributable to VFD and FSD over the life of field of the ACG FFD PWD project. It shows clearly that FSD produce greater than 200,000 tonnes more of CO_2 over the life of the field than the VFD option.

Figure 5.14 Estimated emissions of CO_2 for variable frequency drive and fixed speed drive pumps during the operation of ACG FFD PWD project facilities

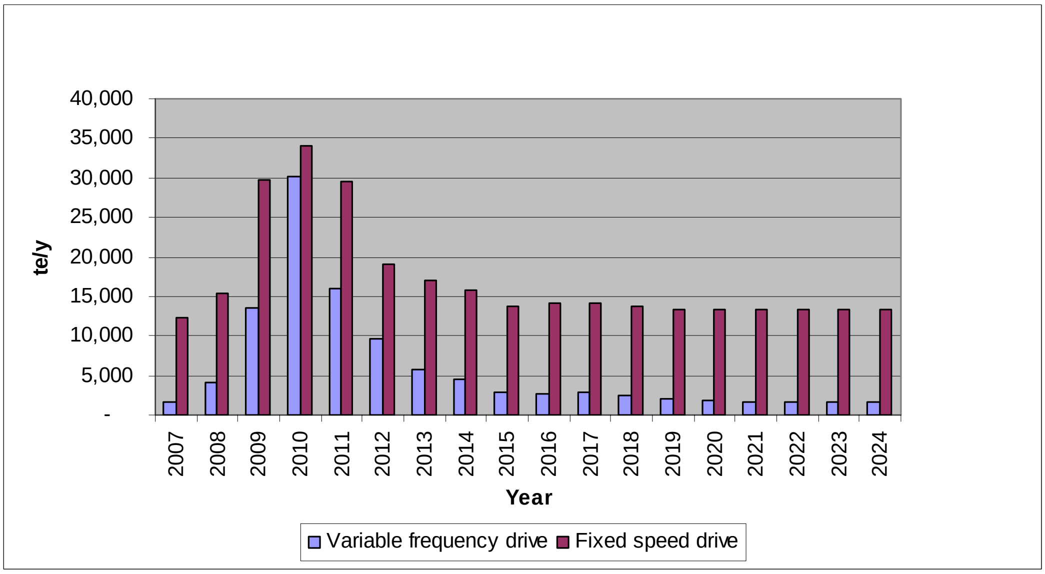


Figure 5.14 shows that CO_2 emissions will be greatly reduced with the use of VFD pumps that have been selected within the design. Further emission estimates use only VFD in the calculations.

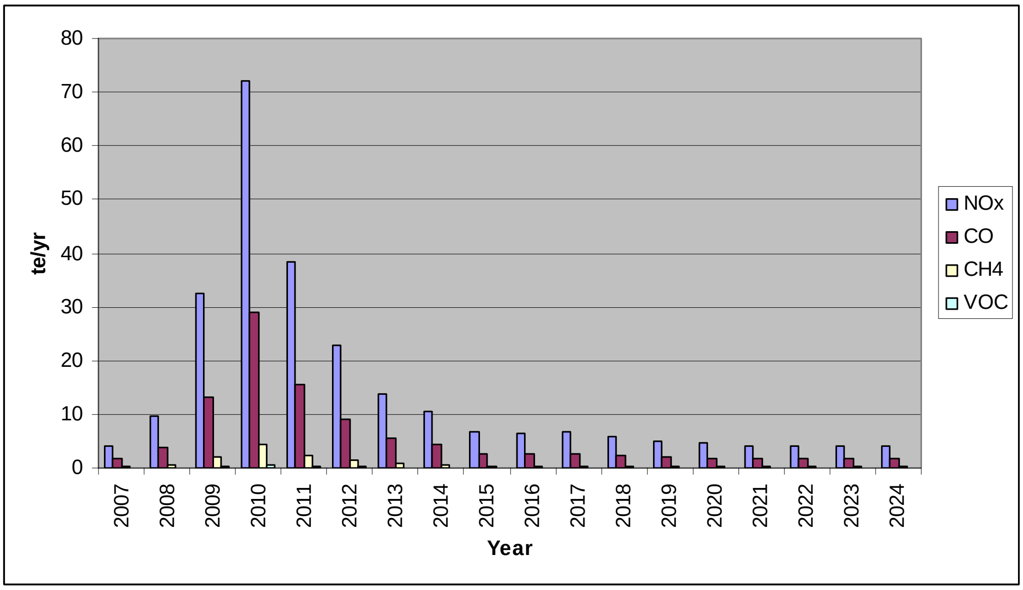
Table 5.9 presents onshore operations emissions of CO_2, NO_x, CO, CH_4, and VOCs over the life of field of the ACG FFD ACG project for the VFD pumps.

Table 5.9 Onshore operations emissions (VFD pump option)

Year	CO_2	NO_x	CO	CH_4	VOC
	te/y	te/y	te/y	te/y	te/y
2007	1,694	4	2	0	0
2008	4,012	10	4	1	0
2009	13,603	32	13	2	0
2010	30,244	72	29	5	1
2011	16,053	38	15	2	0
2012	9,563	23	9	1	0
2013	5,832	14	6	1	0
2014	4,453	11	4	1	0
2015	2,842	7	3	0	0
2016	2,751	7	3	0	0
2017	2,814	7	3	0	0
2018	2,513	6	2	0	0
2019	2,121	5	2	0	0
2020	1,946	5	2	0	0
2021	1,694	4	2	0	0
2022	1,694	4	2	0	0
2023	1,694	4	2	0	0
2024	1,694	4	2	0	0

Figure 5.15 shows the amount of NO_x, CO, methane (CH_4), and VOCs for the onshore plant over the life of the field, using the design profiles of Produced Water expected at Sangachal Terminal.

Figure 5.15 Estimated annual emissions of NO_x, CO, CH_4, and VOCs to the atmosphere during the operation of ACG FFD PWD project facilities



There will also be the intermittent emissions from the PWD storage tank blanket gas. Fuel gas will be routed to the EOP flare and therefore combustion emissions of CO_2, NO_x, CO, VOCs, and unburnt hydrocarbons will be emitted.

Onshore flaring will only occur during the filling of the PWD storage tank and hence will be intermittent. The design and operation of the ACG FFD PWD system will ensure that all the Produced Water received at the onshore Sangachal Terminal will be piped to CWP. In the event that CWP is not available there are two PWD storage tanks at Sangachal Terminal. When these tanks are filling the fuel gas blanket will be displaced and routed to the EOP flare for combustion. Normal operations will involve a continuous flow of Produced Water to CWP, hence the tanks will not be filling under normal operations and flaring will not normally be required.

5.5.1.3 Offshore installation and commissioning

The installation and commissioning of the pipeline and facilities at CWP require seagoing vessels.

Assumptions
Emissions attributable to these vessels have been calculated based on certain assumptions. Assumptions include the type of vessel, how many vessels, how much fuel they will use for the duration of the installation and commissioning period, and the Emission Factor for the pollutant of concern. This method needs to assume a worst case situation of the vessels being used continuously for the duration of the installation and commissioning period, whereas the vessel use may well be intermittent depending on weather, therefore actual emissions will be less than presented here.

The PLBG uses 15 tonnes of fuel per day and all other vessels are assumed to use 6 tonnes of fuel per day. The installation has been split into different sections due to the different types of vessels used for the different functions; nearshore trenching will require different vessels than the offshore pipeline installation. Therefore this section has been split into offshore pipeline installation, nearshore trenching and CWP tie-in.

Table 5.10 presents the types of vessels that will be used for the installation of the offshore pipeline, how many people on board (POB), and the duration that the vessel will be used.

Table 5.10 Offshore pipeline installation vessel details

Vessel	Number of vessels	Persons On Board (POB)	Duration (days)
Pipe-lay-barge	1	270	120
Anchor handling vessel	2	15	120
Pipe-haul barges	6	10	120
Supply vessels	1	10	120
Survey vessel	1	40	120

Table 5.11 presents the number and type of vessels that will be used for the nearshore trenching.

Table 5.11 Nearshore trenching vessel details

Vessel	Number	POB	Duration (days)
Anchor handling vessel	1	4	120
Support vessel	2	17	120
Small crew boat	1	3	120

Table 5.12 presents the type of vessel used for the CWP spool piece tie-in.

Table 5.12 Spool tie in at CWP vessel details

Vessel	Number	POB	Duration (days)
DSV	1	104	20

Table 5.13 presents the type of vessel and duration for the commissioning of the offshore pipeline.

Table 5.13 Commissioning of pipeline vessel details

Requirement	Details
Vessels	2 x survey vessel/DSV
Duration (days)	30 days
Fuel (Tonnes per day)	6

Emissions
This section has calculated the predicted emissions attributable to the installation, near shore trenching, CWP tie-in, and commissioning of the ACG FFD PWD pipeline using the previous assumptions. Table 5.14 is the cumulative emissions for each of the activities associated with the installation and commissioning of the offshore pipeline.

Table 5.14 Emissions associated with offshore and pipeline installation, and commissioning

Item	Emissions (tonnes)					
	CO_2	CO	NO_x	SO_2	CH_4	VOC
Pipeline installation	28,800	72	531	72	2	22
Nearshore trenching	9,216	23	170	23	1	7
Spool tie in at CWP	384	1	7	1	0	0
Pipeline commissioning	1,152	3	21	0	0	1
Total	**39,552**	**99**	**729**	**96**	**3**	**30**

5.5.2 Wastes

Waste management for ACG FFD PWD activities will be in line with the current waste management strategy at the Sangachal Terminal. Waste will be segregated and disposed at an appropriate disposal facility. Where a final disposal route is yet not identified, waste will be stored for final treatment and/or disposal. The Terminal has constructed and commissioned a Central Waste Accumulation Area (CWAA) for the reception, segregation, and storage of all wastes prior to their transfer offsite for disposal or further storage. This is currently in operation and will form the final onsite storage/collection point for all PWD wastes, as detailed in AIOC's Waste Management Procedure.

This section presents details of the types and volumes of wastes that will be generated during, construction, installation, commissioning, and operation of the onshore and offshore facilities. Liquid wastes are discussed in Section 5.5.2.1 and solid wastes are discussed in Section 5.5.2.2.

5.5.2.1

Liquid wastes

Hydrotest water onshore
Hydrotesting will be carried out on the onshore equipment. This testing will use water that has a VCI added to it; this water will be disposed to the holding pond for chemical degradation. The water will be tested periodically until sufficiently degraded prior to discharge to the outer drainage channel at the Terminal. The amount of hydrotest water in this section will be approximately 200 m^3.

Onshore pipeline to beach
Hydrotesting will be carried out on this short section using either potable water or firewater. This testing will use water that has a VCI added to it; this water will be disposed to the holding pond for chemical degradation. The water will be tested periodically until sufficiently degraded prior to discharge to the outer drainage channel at the Terminal. The amount of hydrotest water in this section will be approximately 200 m^3.

Hydrotest water offshore
The nearshore and offshore pipeline will be hydrotested after installation using chemically inhibited seawater. The hydrotest water will be pigged from onshore to offshore to empty the pipeline, using Produced Water to push the pig along. The hydrotest water commissioning procedure is yet to be developed, but the inhibited seawater will be discharged to sea near the CWP. The amount of chemically inhibited seawater in the pipeline will be 18,707 m^3.

Effluent wastes
Sanitary waste will be generated on board vessels throughout the duration of the pipeline installation and commissioning operations offshore. The key assumptions for deriving the estimated amounts of sanitary waste generated that each crewmember will generate:

- 0.22 m^3 / day of grey water;
- 0.10 m3 / day of black water.

Water from showers, sinks, and laundry is regarded as grey water and sanitary sewage is black water. The anticipated amount of time that the vessels will be in use is a maximum of 120 days, and some of the vessels will be significantly less than this. The estimates of sanitary waste presented as Table 5.15 are based on a worst-case scenario.

Table 5.15 Sanitary waste estimates

Parameters		Estimate
Grey water (m^3)	Days	120 maximum
	Total	12023 m^3
Black water (m^3)	Days	120 maximum
	Total	5465 m^3

Any discharge of sewage waste overboard will be done in compliance with MARPOL 73/78 Annex IV (Chapter 2, Section 2.4.6).

All vessels proposed for use in the installation programme will be equipped with certified sewage systems capable of treating effluent to International MARPOL 73/78 standards. Water from showers, sinks, and laundry (grey water) will be discharged directly overboard without treatment. Sanitary sewage (black water) will be treated to meet all existing and anticipated national and international requirements. Sanitary sewage sludge from all operational vessels will be transported to shore on board the pipe haul barges to a designated reception facility.

Galley food waste will be treated in a macerator prior to discharge to meet specifications of the MARPOL 73/78 Annex V this requires that the waste be broken down into particles of less than 25 mm diameter.

Other wastes generated onboard the operational vessels (pipelay barge, supply and support vessels) will be segregated according to the following categories and stored appropriately for onshore treatment and or disposal:

- General solid waste (e.g., plastics, glass)
- Paper waste
- Wood waste
- Scrap metal waste
- Hazardous solid waste
- Hazardous liquid waste

Solid wastes

Onshore construction

Waste streams generated during the onshore construction phase of the ACG FFD PWD project consist of similar types of waste already discussed. It is very difficult to quantify the majority of these wastes, but best estimates are provided in Table 5.16. All waste materials will be segregated and stored for treatment and/or disposal and will be controlled by means of careful documentation, handling, and transportation, as detailed in BP's Waste Management Procedure.

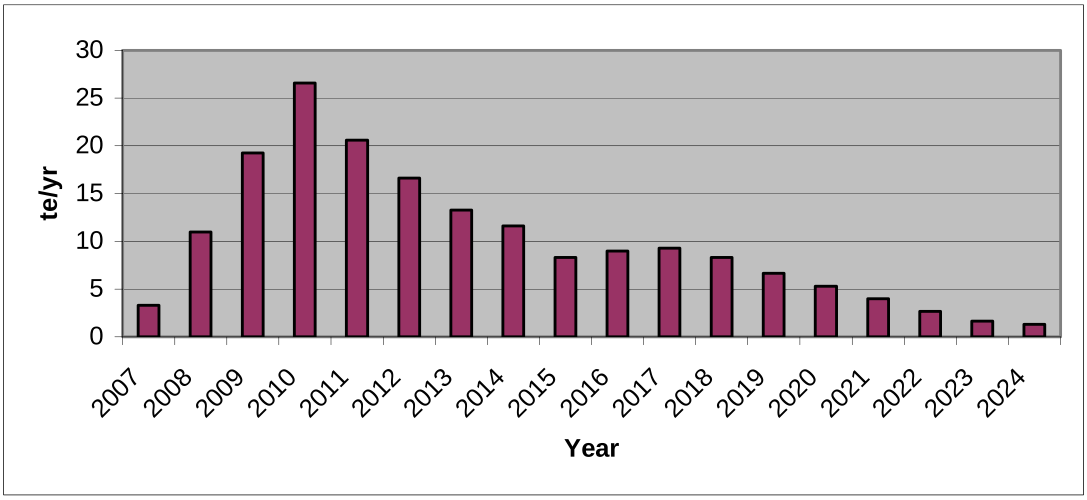
Table 5.16 Estimated wastes during onshore construction

Category/waste type	Annual waste generated			
	<1 tonne	<10 tonne	<100 tonne	>100 tonne
Paper and cardboard			♦	
Wood, packing crates			♦	
Cable/electrical wire		♦		
Scrap metals				♦
Surplus construction material (concrete, aggregate)				♦
Insulation				♦
Plastic wrapping			♦	
Other metals (nails, solder)			♦	
Empty drums				♦
Sand/shotblast materials				♦
Absorbents (spill clean-up)			♦	
Welding flux			♦	
Dessicants			♦	
Lubricating oil			♦	
Oil	♦			
Paints	-	-	-	-
Solvents	-	-	-	-
Primers	-	-	-	-

Onshore operations

Sand and solids separated onshore will be collected. Figure 5.16 presents the predicted solids over the life of the project. This assumes that 0.91 kg of solids will be accumulated per 1000 barrels of oil assuming all particles are larger than 30 microns. This calculates to be 72.6 kg/day during pipeline design rate production of 80,000 bpd.

Figure 5.16 Onshore solid waste



Pipeline construction

It is very difficult to quantify exactly how much waste will be generated during the pipeline installation programme; however wastes types and volumes given in Table 5.17 have been estimated for a 6-month pipelaying programme.

Table 5.17 Estimated waste types and volumes for a 6-month pipeline installation programme offshore

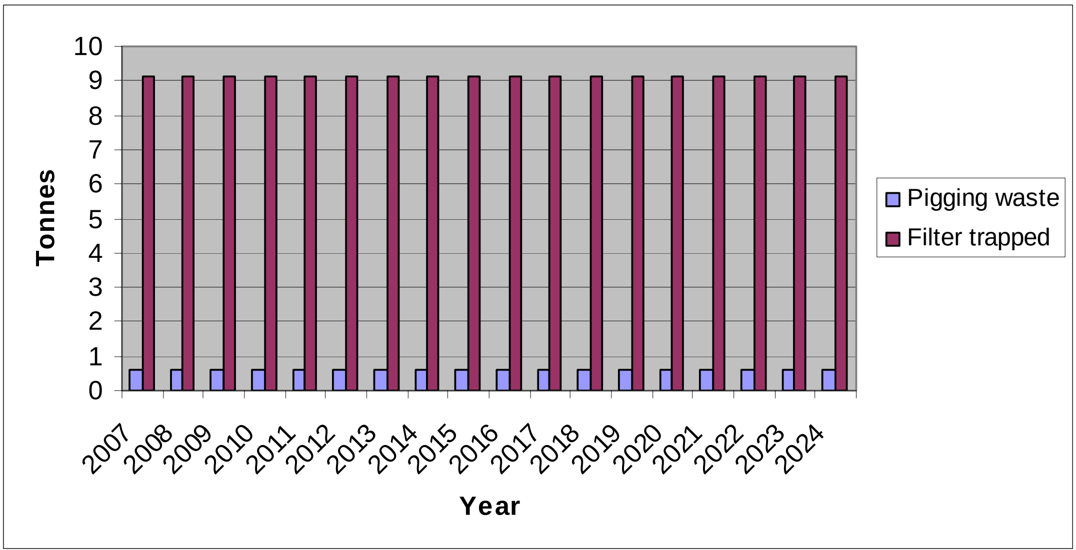
Category/waste type	Waste generated (per annum)			
	<1 tonne	<10 tonne	<100 tonne	>100 tonne
Paper and cardboard	♦			
Wood		♦		
Food waste		♦		
Electrical wire	♦			
Scrap metals		♦		
Scrap electrical materials	♦			
Empty drums		♦		
Filters		♦		
Rags		♦		
Sand/shotblast materials		♦		
Absorbents (spill clean-up)	♦			
Clinical waste	♦			
Oil				♦
Paints	♦			
Thinners	♦			

Offshore operations waste

The solid waste from the pigging operations will be placed in sealed containers and shipped to shore for appropriate disposal. It is anticipated that the pipeline will be pigged every 2 weeks. Corrosion products from this operation are expected to be < (less than) 23 kg each pig run that will fall out in the pig receiver offshore. This results in 0.6 te/yr of solid waste to dispose off from the pigging operations. The project plans to install cartridge filters to remove the solids from the PWD stream prior to introduction into the WI manifold. When a filter is full the PWD flow will be transferred to the second filter and the solids on the blocked filter will be removed and put into drums, which will then be sealed prior to shipping to shore for appropriate disposal. The solid waste from the PWD flow is anticipated to be 9 te/year

Figure 5.17 presents the predicted annual pigging waste and the volume of waste that will be trapped in the offshore filters for disposal

Figure 5.17 Offshore solid waste



5.6 Facility decommissioning

In view of the operational lifetime of the ACG FFD it is not possible to provide a detailed methodology for the potential decommissioning of the PWD facilities. In accordance with the PSA, AIOC will produce a field abandonment plan one year before 70 percent of the identified reserves have been produced. The decommissioning plan will give details of the strategy for required measures for the offshore and onshore facilities, including pipeline decommissioning, offshore facility removal, where appropriate, and onshore Terminal decommissioning.

The PSA does not state specific requirements on the methodology of decommissioning and in view of the operational lifetime of the ACG FFD project, it is not possible at this time to provide finalised details for the method or extent to which the facilities will be decommissioned.

At this time it is not possible to predict what the future legislation and standards will be regarding decommissioning, but the future decommissioning plan will take into consideration the legislation existent at the time. An ESIA will be produced for the decommissioning plans.

6 Environmental Description

Contents

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6.1 Introduction

This chapter describes the key environmental factors for the Azeri, Chirag, and Gunashli (ACG) Full Field Development (FFD) Produced Water Disposal (PWD) project in the vicinity of the proposed ACG FFD PWD pipeline onshore right-of-way (ROW) and offshore route.

The ACG FFD PWD project is the latest in the phased FFD of the ACG Contract Area and a considerable amount of environmental information has been gathered for the project over the period from 2000 to present (as reported in previous Environmental and Socio-economic Impact Assessments, or ESIAs). The purpose of this section is to concentrate on the environmental characteristics specific to the ACG FFD PWD project, providing updated information generated since the ACG FFD Phase 1, 2, and 3 ESIAs (where this exists) while avoiding unnecessary repetition of earlier ESIA information. Where no new information exists reference is made to the relevant chapter in the earlier ESIA reports where readers may wish to obtain further information.

The ACG FFD Phase 1, 2, and 3 ESIA reports are available online at
http://www.bp.com/subsection.do?categoryId=9006656&contentId=7013370
and may be downloaded in full from this link.

6.1.1 Definition of project location

As discussed in Chapter 5 Project Description, the proposed PWD pipeline will run from the boundary of Sangachal Terminal through the ACG FFD Phase 1 (Azeri-Sangachal) and 2 (Chirag-Sangachal) Pipeline ROW to the ACG FFD Phase 1 and 2 landfall site on Sangachal Bay (although fabrication and construction will be required at SOCAR's ShelProjectStroi or SPS Fabrication Yard). From the landfall site, the PWD pipeline will run a distance of 181 km to the offshore platforms at ACG FFD Phase 1 (Central Azeri).

For the purposes of this Chapter, the project locations are therefore defined as follows:

- Terrestrial environment: including the onshore areas of Sangachal Terminal, the pipeline ROW to the Salyan (Baku-to-Astara) Highway, and the SPS fabrication yard.
- Coastal environment: consisting of two environmental regimes: the onshore coastal and marine nearshore environment. The onshore coastal environment is the pipeline ROW from the Salyan (Baku-to-Astara) Highway to the proposed pipeline landfall (near the landfall site where the pipeline will cross the shoreline, or mean lower low water – MLLW – contour). There is as yet no official definition of the marine nearshore environment of Sangachal Bay, but in reference to the proposed project entrenchment distance from the pipeline landfall site, this report will consider the nearshore environment to be within 5 km of the shoreline.
- Offshore environment: This extends from 5 km offshore (the coastal zone boundary) to the proposed reinjection location within the ACG Contract Area in the middle Caspian Sea.

These areas are illustrated in Figure 6.1

6.1.2 Data sources

Since the time of writing the ACG FFD Phase 1, 2, and 3 ESIAs, a series of terrestrial and marine studies have been carried out in the vicinity of Sangachal Terminal and Sangachal Bay under the Integrated Environmental Monitoring Plan (IEMP) (Table 6.1). These surveys have been drawn upon to add updated information for this Chapter.

Figure 6.1 Location of project

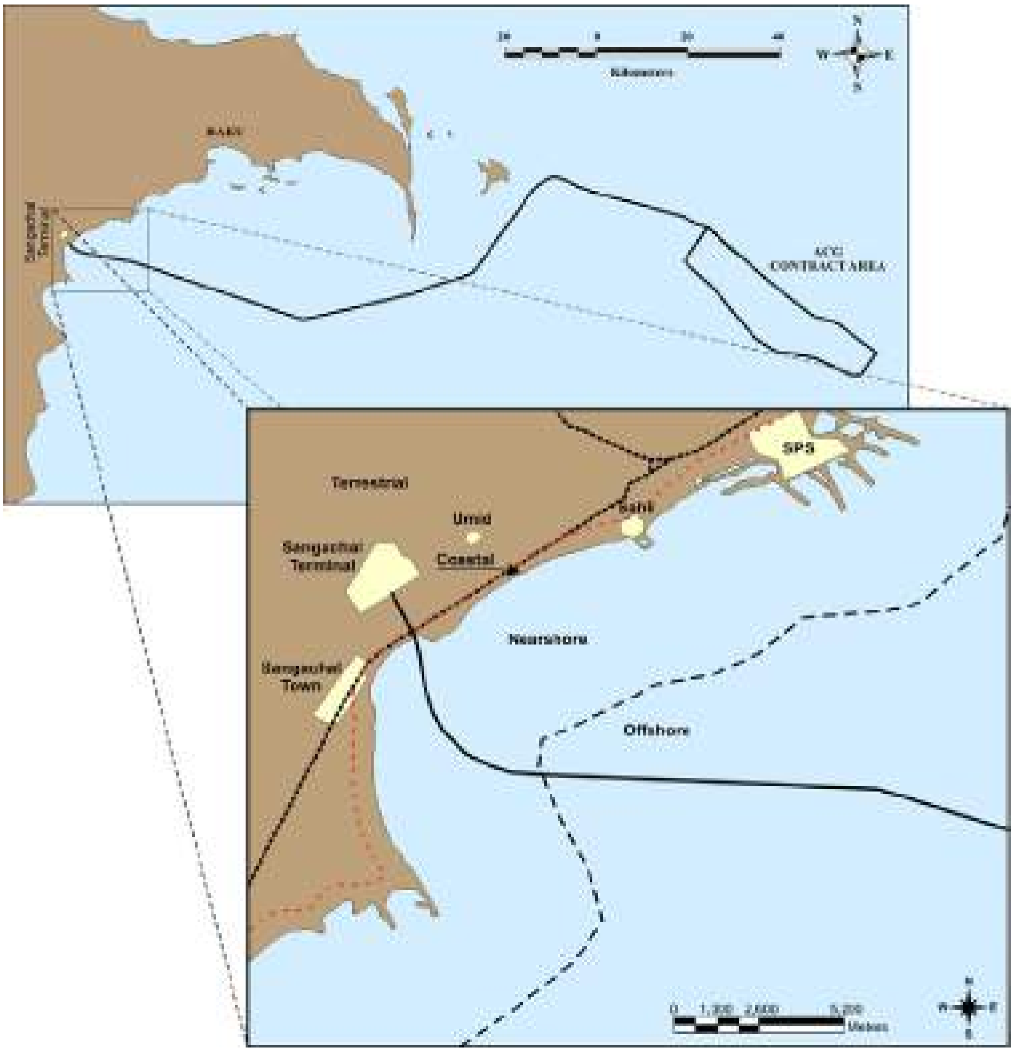


Table 6.1 IEMP terrestrial and marine studies (2003 to 2005)

Date	Title
2003	Sangachal Beach Profiling – Coastal Morphology
2003	Sangachal Watershed Analysis
2003-2006	Overwintering Bird Surveys (annual)
2003	Water Management and Landscape Study
2003	Seabed Environmental Mapping of Sangachal Bay
2004	Sangachal Offshore Survey (March)
2004	Sangachal Metocean Study
2004	Biomonitoring at Sangachal (May-September)
2004	Overview of the AIOC Environmental Monitoring in the Caspian Sea
2004	Sangachal Seabed (Benthic) Survey October 2003
2004	Fish Monitoring, Sangachal Bay
2004-2005	Breeding Bird Survey (annual)
2004-2005	Autumn Bird Survey (annual)
2004-2005	Sangachal Air Monitoring
2004-2005	(Sangachal) Integrated Terrestrial Monitoring
2005	Pipeline Landfall Site Ecology – Vegetation Recovery
2005	Integrated Environmental Monitoring Programme Annual Report (Draft)
2005	(Sangachal) Integrated Terrestrial Monitoring (Autumn)

6.2 Terrestrial environment

6.2.1 Climate

Meteorological data for the onshore project area are available from two locations near the landward project terminus: at the Sangachal Terminal and Alyat (30 km south). The climatic characteristics of the area have been described in detail in Chapter 6 of the ACG FFD Phase 1 and Phase 2 ESIAs. In summary, the climate is characterised as warm, semi-arid steppe. Summers are warm and dry with temperatures ranging from 35 to 40°C. Corresponding conditions in winter show temperatures near 0°C and snow on average 10 days out of the year. The highest rainfall occurs between September and April.

6.2.2 Facility air quality and noise levels

Chapter 6 of the ACG FFD Phase 3 ESIA provides data on facility air quality and noise levels in the vicinity of the terminal and at the SPS fabrication yard. The ACG FFD PWD project represents a continuation of the working regime of these facilities, and atmospheric condition information presented in the Phase 3 ESIA may also be applied to this project.

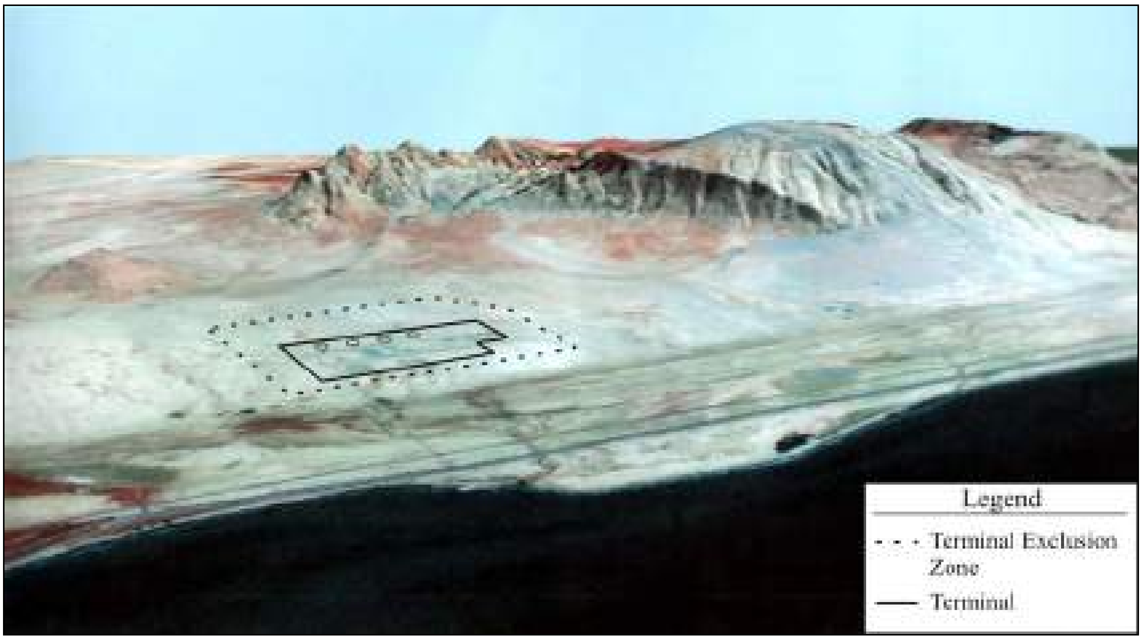
6.2.3 Topography and landscape

6.2.3.1 Sangachal Terminal

Sangachal Terminal occupies an area of around 32 km^2 located in a low-lying basin along the margin of the Caspian Sea. Within the basin the land surface is typically 12-14 m below the world ocean datum (taken as the Baltic Sea in Former Soviet Union, or FSU, countries; the Caspian sea level datum is referenced as 24.5 m below the world ocean datum following a net increase of 2 meters since 1977, UNECE, 2003) and is approximately 10-12 m above the local sea level. North of the basin a range of steeply sloping hills called *Qaraqus Dagi*, or Blackbird Mountain, rise to elevations 300-400 m above the world ocean datum (Figure 6.2).

Topography in the vicinity of Sangachal Terminal is uniform overall, displaying a northwest-southeast gradient with terrain sloping gradually from 10 m elevation above local sea level down to the beachfront. Within the vicinity of the Sangachal Terminal the terrain displays gentle undulations of less than a metre.

Figure 6.2 Topography surrounding Sangachal Terminal



6.2.3.2 SPS Fabrication Yard

The SPS yard lies approximately 20 km southwest of Baku and 12 km east-northeast of Sangachal Terminal on the western coastline of the Caspian Sea (Figure 6.1). A coastal plain with undulations of up to 2 m surrounds the yard, backed by steeply sloping hills affiliated with the *Qaraqus Dagi* (Blackbird Mountain), forming a ridgeline locally that runs approximately parallel to the coast. The coastline in the vicinity of the yard is characterised by shallow lagoons. The yard area itself is significantly degraded with little apparent ecological value.

6.2.4 Soils and contamination

This section concentrates on the terrestrial area between the Sangachal Terminal boundary and the coastal landfall site representing the main terrestrial area associated with the installation of the ACG FFD PWD pipeline. Other than this section of the pipeline running from the Sangachal Terminal to the Sangachal Bay landfall site, the terrestrial environments associated with the proposed pipeline development lie within existing terminal and industrial site boundaries.

Details of the soils and soil contamination data along the pipeline route are provided in Section 6.3 of the ACG FFD Phase 3 ESIA. Analysis was also conducted on soil samples taken in the terminal vicinity during the ACG FFD Phase 1 ESIA. Sample analyses results for metals indicated that these were within the range considered to be “protective of human health and the environment” (URS, 2002a). Soil samples were also tested for Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAH). Based on the testing conducted it was concluded that soil contamination was not significant.

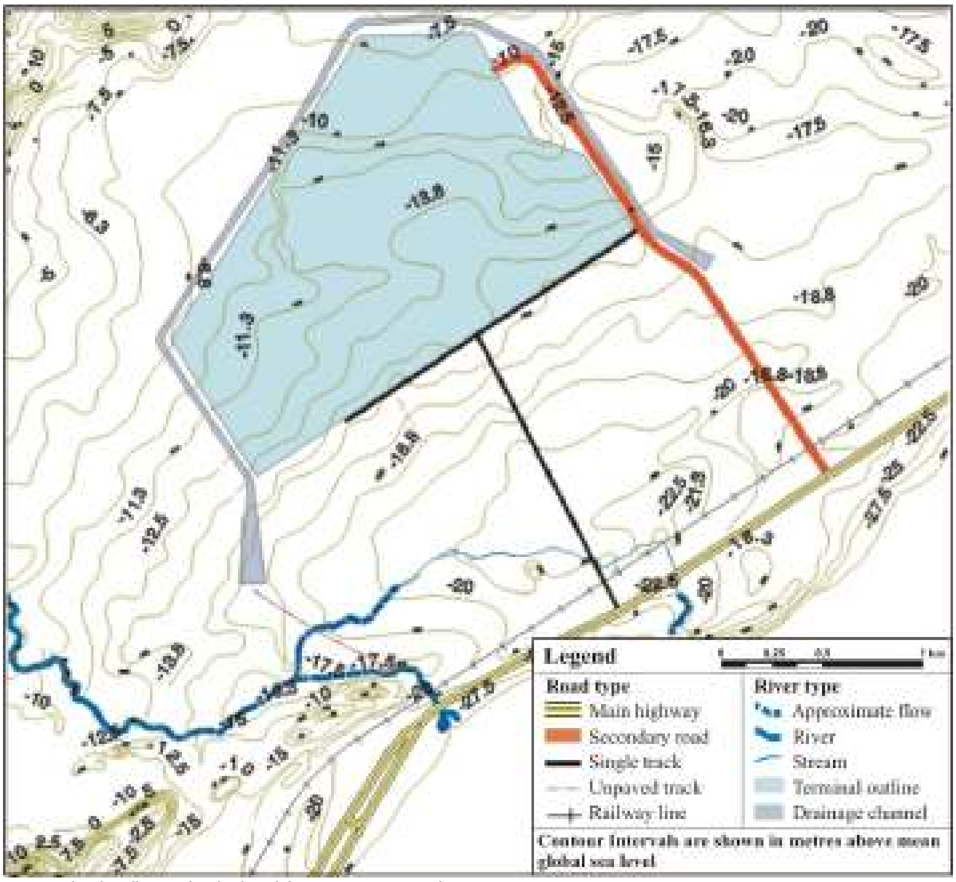
6.2.5 Hydrogeology

The largest wadi (dried-up riverbed) in the vicinity of Sangachal Terminal is that associated with the Djeyrankechmes River. The wadi exhibits poor bank stability and is liable to flash flood during periods of heavy rainfall. During periods of peak flow it has a high sediment load. The Djeyrankechmes basin delivers an average water yield of 1.0 $l.s^{-1}$ km^{-2}, decreasing to zero near the coast.

A flood protection drainage channel has been built around the perimeter of the Sangachal Terminal site. The channel is designed to divert floodwaters around the terminal site into existing natural drainage lines between the terminal and the Caspian Sea (Figure 6.3).

Groundwater in the vicinity of the Caspian coastline has been generally described as complex, affected by both stable natural factors (such as those related to the Khvalyn layer, usually found at a depth of 16-17 m) and dynamic induced factors (UNIDO, 1998). Among the induced factors are both natural and disturbed water regimes. Naturally induced waters include those relating to the modern rise in the Caspian Sea (which has been observed since the 1970s). A modern littoral deposit of groundwater exists at a depth of 7 m. Disturbed water regimes are produced by changes in year-round drainage. Anthropogenic changes in drainage near Sangachal Terminal are related to seasonal drainage, and as such do not induce a disturbed regime.

Figure 6.3 Topography and drainage in the Sangachal Terminal Area



Note: Data in the figure is derived from URS, 2004b

6.2.6 Terrestrial habitats

The proposed pipeline fabrication yards are in existing industrial areas that are ecologically degraded, and are not areas of significant terrestrial habitat. The following subsection therefore concentrates on the area in the vicinity of Sangachal Terminal and the onshore section of the pipeline ROW.

The area in the vicinity of Sangachal Terminal has been surveyed a number of times prior to the expansion of the terminal and installation of the onshore pipelines as part of ESIAs conducted for the ACG FFD and Shah Deniz Gas Export (SDGE) projects. The data provided in the ACG FFD Phase 1 and 2 ESIAs are also summarised in this section.

The habitats in the vicinity of Sangachal Terminal have been classified into six biotopes based on the results of previous surveys (the Western Hills and Western Plains zones noted in Figure 6.4 are essentially the same habitat, and for the purposes of this report are combined into one biotope). Figure 6.4 illustrates the distribution and characteristics of the six habitats that will be affected by this project.

Figure 6.4 Summary of terrestrial habitats in the vicinity of Sangachal Terminal

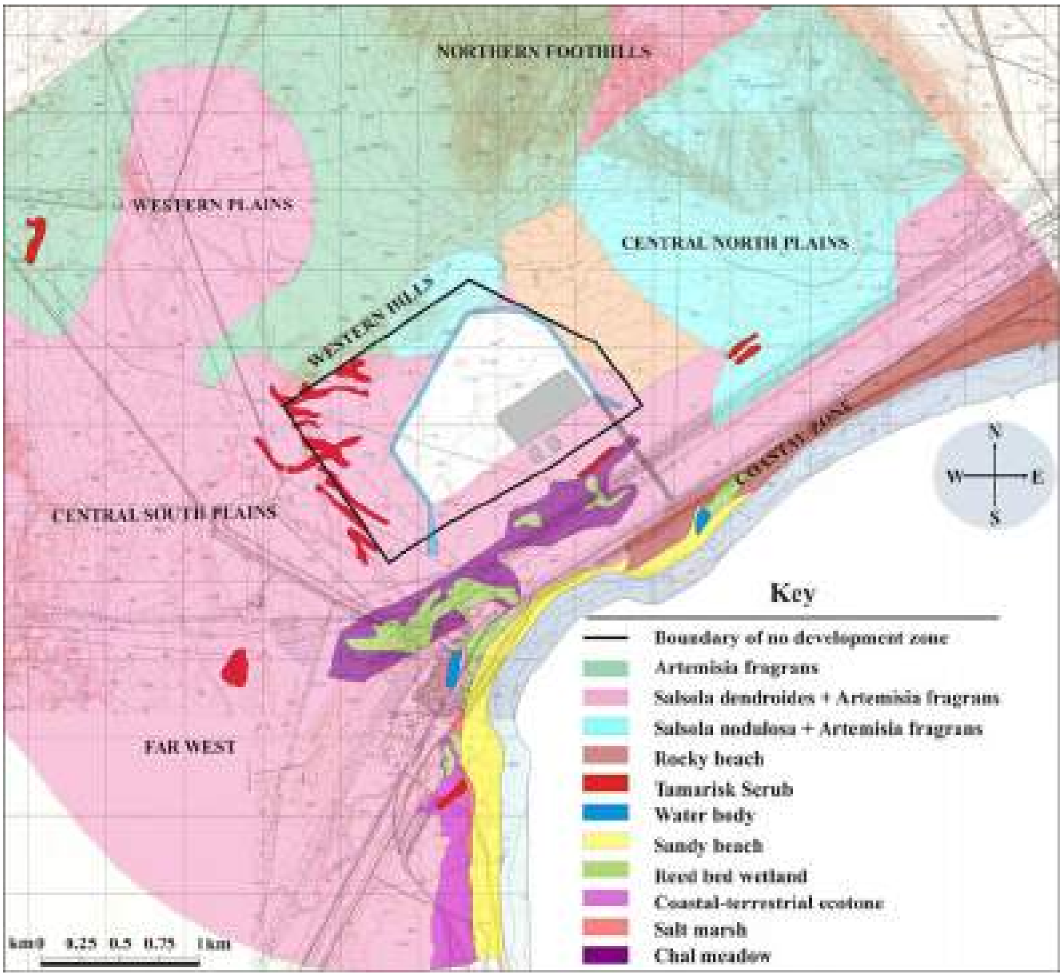


Table 6.2 provides a description of the habitats in the vicinity of Sangachal Terminal and lists protected Red Data species from the Azerbaijan Red Book (ARB) and The World Conservation Union (IUCN) Red List that are considered characteristic of each habitat. The area of Sangachal Terminal spans the central south plains, with the proposed ACG FFD PWD pipeline ROW crossing this habitat to the coastal zone.

A walkover survey performed in 2005 by URS of the proposed ACG FFD PWD pipeline ROW between Sangachal Terminal boundary and the Salyan Highway confirmed the two main terrestrial habitats reported in previous surveys; semi desert scrub and marshland occurring in a series of artificial and natural drainage channels running between the main terminal access road and the old access road. The marshland habitats show seasonal variation based on the availability of water during the year (Figure 6.5).

Table 6.2 Description of habitats surrounding Sangachal Terminal

Biotope/Zone	Description
Northern Foothills (vicinity of *Qaraqus Dagi* or Blackbird Mountain)	Rocky foothills with frequent mudflows and a sparse cover of saltwort tumbleweed *Salsola nodulosa.* Patches of spring flowering ephemerals occur (Wall speedwell or *Veronica arvensis,* Salsify or *Tragopogon graminifolius, Torularia contortuplicata,* and monkswort or *Nonea lutea*) and grasses (a local version of Bermuda grass or *Cynodon dactylon*, Foxtail brome or *Anisantha rubens,* and goatgrass or *Aegilops biuncialis*).
Western (and far northern) Plains and Western Hills	Dominant species include saltwort tumbleweed *Salsola dendroides* and wormwood *Artemisia fragrans,* the latter being particularly dominant in drier areas. Tamarisk (*Tamarix spp*.), grasses and flowering ephemerals were evident in lower areas. The ARB species ***Astragalus bakuensis*** was recorded. ***Ferula persica****,* an ARB and IUCN (Indeterminate) species, was seen in the area.
Central North Plains	A flat expanse of desiccated fine clay soil with minimal vegetative cover. Individual plants of saltwort tumbleweed *Salsola nodulosa* and small-leaf seablite (*Suaeda microphylla*) and stunted clumps of meadow grass *Poa bulbosa* and burr medick (*Medicago minima*).
Far West	Tamarisk scrub including *Tamarix Meyeri* and a continuous groundcover of grasses including *Colpodium humile*, *P. bulbosa* and *Eremopyrum triticeum*, the emphemeroid marigold (*Calendula persica*) is also present. Higher ground dominated by saltwort *S. dendroides* and wormwood *A. fragrans* with tamarisk thickets and camelthorn (*Alhagi psuedalhagi*) in lower lying areas.
Central South Plains	Semi-desert communities (*Salsola dendroides, S. nodulosa* spp. and *Artemisia fragrans*), reed dominated marshland (*Phragmites australis* and *Typha latifola*) and a large number of tamarisk stands (*Tamarix spp*.). Seeds of ***Iris acutiloba*** (ARB and IUCN Endangered) were recorded.
Coastal Zone	Semi-desert areas (Figure 6.5a) with two main components: wormwood (*Artemisia fragrans*) and saltwort tumbleweeds (*Salsola dendroides and Salsola nodulosa*). Several ARB (Azeri Red Book) species were recorded: ***Ferula persica*****,** ***Cladochaeta candidissima (*****IUCN, Indeterminate*****)*****,** ***Glycyrrhiza glabra*** and ***Nitraria schoberi*****.** Dead individuals of ***Calligonum bakuensis*** an IUCN (Indeterminate) and ARB species were also recorded. Rocky coastline areas have sparse vegetation cover (primarily marigold or *Convolvulus persicus*, and *Argusia siberica*), littoral reedbeds (Figure 6.5b, *Juncusetum acutus* and *Phragmites australis*), shallow lagoons, and a salt marsh dominated by *Salicornia europea.*

Figure 6.5 Habitat types between Sangachal Terminal and the coastal zone

a) Semi-desert vegetation (as described in Table 6.2)

Vegetation at N 4018890 E 4949253.

b) Wetland vegetation (as described in Table 6.2)

Vegetation at N 4019444 E 4948941.

Note: Data in the figure is derived from URS, 2005b

6.2.7 Terrestrial faunal species

Semi-desert scrub areas provide a suitable habitat for a variety of species including red-tailed sanderling (*Meriones lybicus*), wall lizards (including *Eremias and Ophisops* species), snakes (including dice snake *Natrix tesellata* and Dahl's whip snake *Coluber najadum*), and the Red-listed spur-thighed tortoise (*Testudo graeca*). Rodent burrows and brown hare (*Lepus europeaus*) have also been frequently observed during walkover surveys of the area.

During seasonal periods where water is abundant, the wetlands provide a valuable habitat for amphibians, primarily common marsh frog (*ranna ridibunda*), and reptiles such as the European Pond Turtle (*Emys orbicularis*) and the Caspian Pond Turtle (*Mauremys caspica*). These also provide a nursery ground for freshwater fish species (Figure 6.6).

Figure 6.6 Typical aquatic wildlife observed in the wetland areas between Sangachal Terminal and the coastal zone

Common Marsh Frog (*Ranna ridibunda*).

Note: Data in the figure is derived from URS, 2005b

A number of ornithological surveys conducted near the Sangachal Terminal under the IEMP provide a comparison of data with that found in 2001 prior to the expansion of the Sangachal Terminal (reported in ACG FFD Phase 1 ESIA, Appendix 11 *Terrestrial Flora and Fauna Study*). These surveys have been conducted during breeding (summer) periods in 2004 and 2005 over an area of approximately 50 km^2 surrounding the terminal to encompass the habitat types illustrated in Figure 6.4.

Bird surveys (conducted at different times of the year in 2001, 2002, 2004, and 2005) have recorded a total of 54 different species in the study area during the breeding seasons (URS, 2005a). In the central plains the important bird species identified (in terms of vulnerability) comprised breeding greater sand plover, booted warbler, and black-bellied sandgrouse (the latter is a Red Data species).

The survey also found that several common bird species have been displaced (or now occupy smaller territories) as a result of construction activities not connected to Sangachal Terminal. None of these displaced species were threatened and therefore no mitigation measures were recommended.

Near the Sangachal Terminal recovery of vegetation has taken place naturally up to the present, especially in the southern part of the area where marsh exists (with reeds, reedmace, and rushes of the *Juncus* sp.) and in the tamarisk scrubland, the latter providing suitable bird breeding habitat.

These areas were identified as being of the greatest ornithological interest in this habitat with an increase in the populations of several passerines (songbirds) recorded, notably:

- Booted warbler (14 singing males in 2001, 20 in 2004, and 26 in 2005);
- Rufous bush robins (9 pairs in 2001; at least 35 pairs in 2004; and more than 19 pairs in 2005); and
- Isabelline wheatears (3 pairs in 2001; 8 pairs in 2004, and 7 pairs in 2005).

In the central north plain changes in breeding populations include:

- The appearance of large numbers of lesser short-toed lark, unrecorded in 2001;
- Progressive expansion of the range of booted warblers, with four singing males now present (none here in 2001, three in 2004) and;
- Isabelline wheatears (none recorded in 2001, 15 pairs recorded in 2004, declining to only one pair in 2005).

The breeding bird survey 2005 concluded that the footprint of the expanded terminal area appears not to have significantly impacted breeding bird populations.

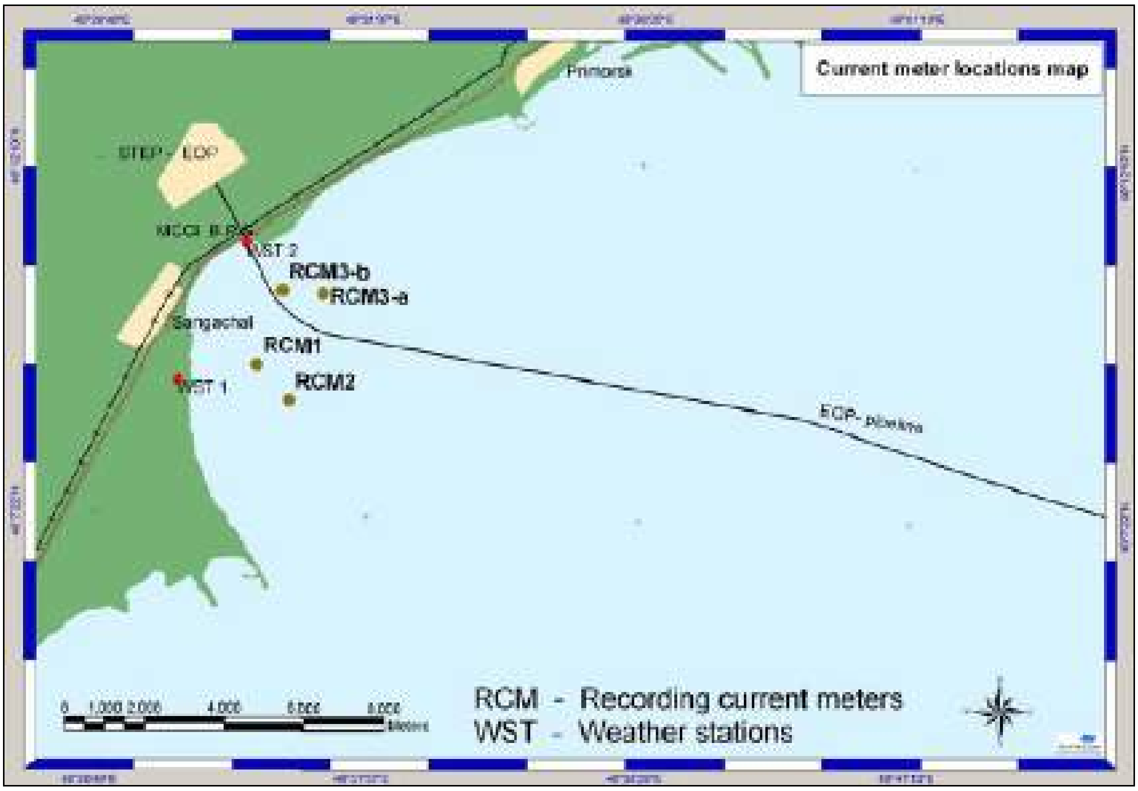
6.3 Coastal environment

A number of surveys conducted in Sangachal Bay since the time of writing the ACG FFD Phase 1, 2, and 3 ESIAs have provided more recent data than reported in those documents. These have formed the basis of a revised description of the onshore coastal environment.

6.3.1 Coastal climate

Climatic data for the coastal zone of Sangachal Bay and nearshore waters have been further defined during the Sangachal Metocean Study (AmC, 2004b). Two weather stations were operative between June 19, 2003, and June 4, 2004, one at the pipeline landfall (WST 2) and a second further to the south (WST 1, Figure 6.7). Figure 6.8 illustrates the seasonal distribution of climate measurements from the survey (merging the data from the two weather stations).

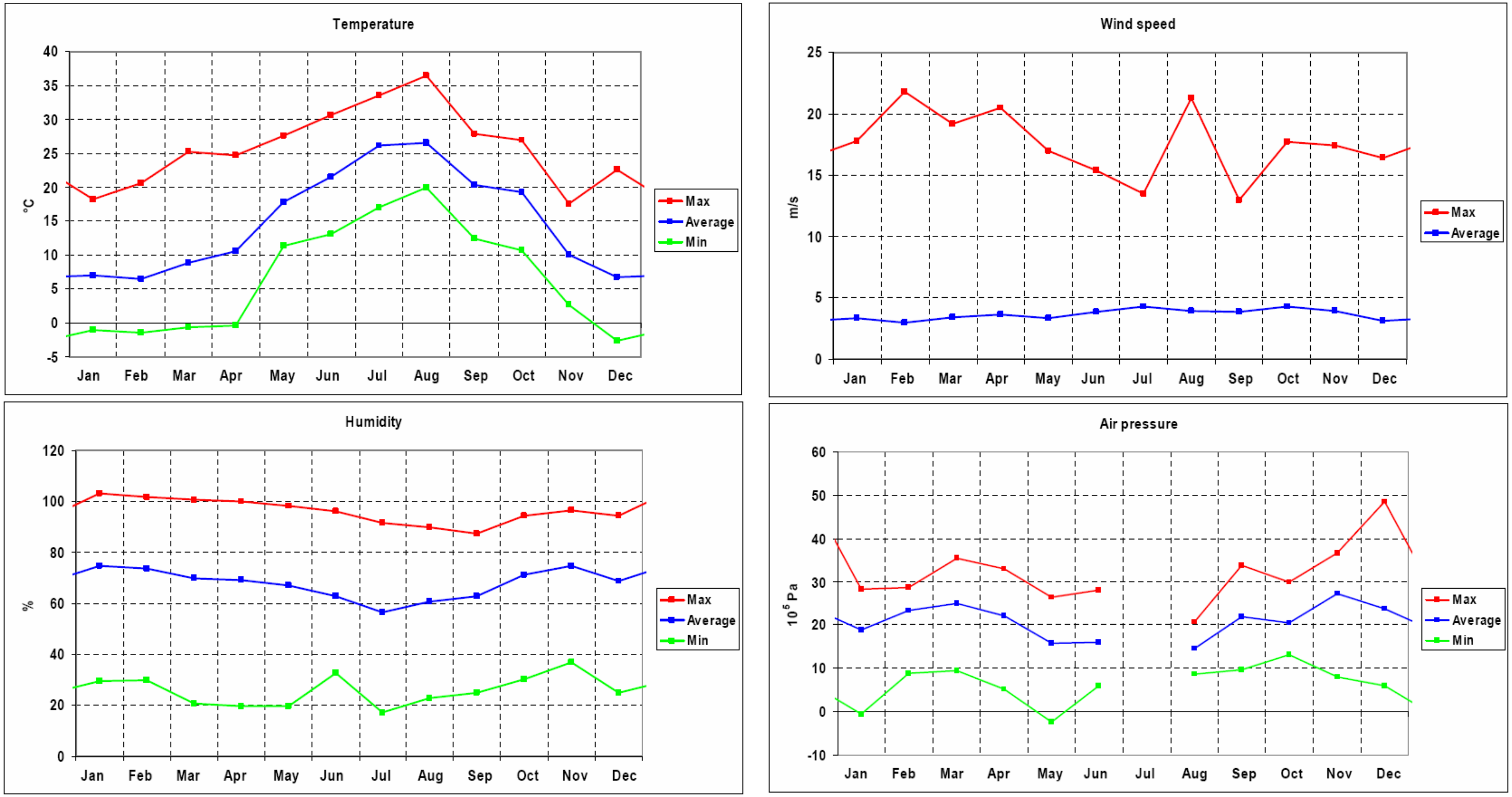
Figure 6.7 Location of survey stations for the Sangachal Metocean Study



Note: Data in the figure is derived from URS, 2004

The mean annual air temperature during the survey period was 14.4°C, and daily mean air temperatures ranged from a high of 26.6°C in August to 6.4°C in January. Annual precipitation totals for the observed period were a characteristic 21.7 cm. Wind conditions displayed a slight (1-2 m/s) offshore breeze in the morning, replaced by stronger onshore winds in the afternoon (average winds are less than 5 m/s).

Figure 6.8 Seasonal meteorological data from the coastal weather stations (2003-2004)



Note: The data from the two weather stations have been merged. The air pressure data gap reflects the lack of readings for air pressure achieved at WST 2, which operated August 5, 2003 through June 4, 2004; air pressure data was unavailable from WST1 during July 2003. Data in the figure is derived from AmC, 2004b.

6.3.2 Coastal habitats

Coastal areas in the immediate vicinity of the proposed ACG FFD PWD pipeline landfall have been subjected to a variety of anthropogenic changes since 2001 through the installation of the ACG FFD Phase 1 and 2 oil and gas pipelines, the SDGE gas pipeline, associated methanol-ethanol-glycol (MEG) lines, and fibre optic lines. To date six pipelines have been installed or are in process of installation.

Figure 6.9 shows the pipeline landfall site plan with details of the ACG FFD and SDGE pipelines. Figure 6.10 provides photographs of the landfall locations identified in Figure 6.9. These were taken in June 2001 (prior to landfall construction activity) and February 2006 to illustrate the changes to the landfall area from the pipeline construction programme. During the construction of both these projects, the landfall area of the proposed ACG FFD PWD pipeline was, where necessary, cleared of vegetation, compacted, and graded (as noted in the photographs within Figure 6.10). A number of temporary buildings were erected and vehicle access, parking, and equipment laydown areas were provided.

During the installation of each ACG FFD and SDGE pipeline, a temporary finger pier or berm was constructed consecutively at each landfall approach into the bay to enable vehicle and equipment access during pipelay, with the berm moving progressively down the beach. The presence of the earlier berms caused reduction in the nearshore water flow (locally interrupting the longshore drift) which resulted in temporary sediment accumulation at the site of the berms; most of these berms have now been removed, allowing a resumption of the natural longshore sediment transport processes.

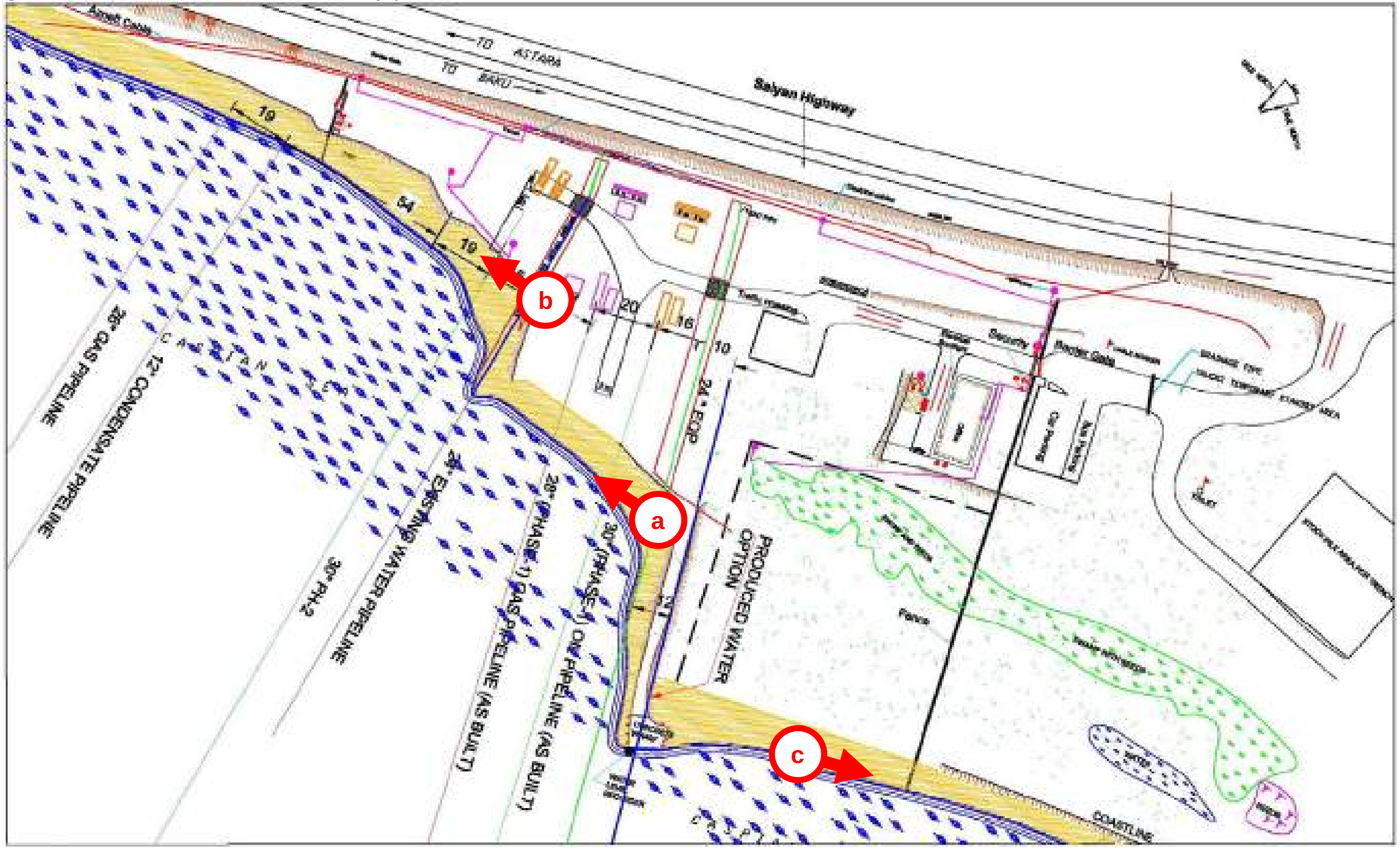
Existing facilities will be used for this project. Additional land will be required northeast of the pipeline route for onshore vehicle access, but this will be within the landfall security fence boundary. Offshore, a new berm will be emplaced during the construction of the ACG FFD PWD pipeline northeast of the nearshore pipeline route. As with the remainder of the landfall area, this berm will be subject to the reinstatement programme adopted for the ACG FFD Phase 1, 2, and SDGE Stage 1 ESIAs after completion of construction activities, in fulfilment of the commitments made in those documents.

The surrounding vicinity of Sangachal Bay coastal environment is undisturbed and displays several habitats including:

- coastline with sparse vegetation (primarily Persian bindweed or Convolvulus persicus, and Siberian tournefortia or Argusia sibirica),
- littoral reedbeds (the sharp rush or Juncus acutus, the common reed or Phragmites australis, tamarisk scrub or Tamarix, and reedmace or Typha sp.),
- shallow lagoons, a salt marsh dominated by the glasswort Salicornia europea, and
- semi-desert areas with two main components: a wormwood species (Artemisia fragrans) and saltwort tumbleweed species (Salsola dendroides and Salsola nodulosa).

Several ARB (Azerbaijani Red Book) species have been recorded in this area, and these include; ferula (*persica*), *Cladochaeta candidissima* (IUCN, Indeterminate), *Glycyrrhiza glabra*, and nitre bush (*Nitraria schoberi*). Dead individuals of *Calligonum bakuensis*, an IUCN (Indeterminate) and ARB species, were also recorded.

Figure 6.9 The ACG FFD and SDGE pipeline landfall location



Note: The letters a-c refer to photographs shown in Figure 6.10; arrows represent the direction of view in the given photograph.

Figure 6.10 Changes in the landfall environment of Sangachal Bay

A1 Looking southwest from the EOP pier

June 2001

A2

February 2006

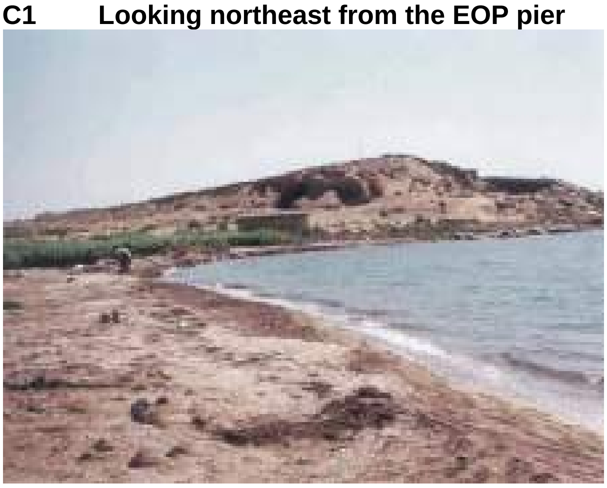
B1 Looking southwest along the site

June 2001

B2

February 2006

C1 Looking northeast from the EOP pier



June 2001

C2

February 2006

6.3.3 Coastal faunal species

Coastal faunal species have been surveyed as part of the ACG FFD Phase 1 and 2 ESIAs, as presented in Chapter 6 of those reports. The area in the vicinity of the pipeline landfall supports a wide range of species, with faunal evidence of wolf (*Canis lupus*), fox (*Vulpes vulpes*), marsh frog (*Rana ridibunda*), European grass snake (*Natrix natrix*), Caucasian agama lizard (*Agama caucasia*), and Dahl's whip snake (*Coluber najadum*).

A number of ornithological surveys have been conducted along the Caspian Sea coastline since 2000, covering areas from the Absheron Peninsula to the area of the Kura River mouth. These surveys have aimed at identifying important bird areas along the coast to facilitate BP's Oil Spill Response Plan (OSRP) for the ACG FFD projects and have concentrated on the abundance of waterfowl during the autumn (moulting) and overwintering periods. Figure 6.11 illustrates the autumn and overwintering migration bird surveys, summarising the results of all data collected.

Of the survey areas, the main sites of interest are Sangachal Bay and the Shelf Factory Lagoons (SPS yard). As can be seen from Table 6.3, the Shelf Factory Lagoons is the more important area of the two in both autumn migration and overwintering periods in terms of the total number of birds the site hosts during the year. Whilst numbers of birds at this area are high, no Red Data species (Stattersfield and Capper, 2000) have been recorded at this site during the surveys. Throughout the survey periods the most abundant species within the Sangachal Bay survey area were tufted duck (*Aythya fuligula*), coot (*Fulica atra*), and common pochard (*Aythya ferina*); within the Shelf Factory Lagoons, the most abundant species during the same period were coot, red-crested pochard (*Netta rufina*), and common pochard.

Table 6.3 Results of the coastal birds surveys: Total waterfowl population numbers by site, 2002-2006

Survey/Year	Sangachal Bay (Terminal)	Shelf Factory Lagoons (SPS)
Overwintering Bird Survey		
2002	4,139	44,504
2003	2,208	9,367
2004	1,739	9,827
2005	2,865	22,365
2006	3,633	37,934
Autumn (Moulting) Bird Survey		
2004	314	11,817
2005	275	7,321

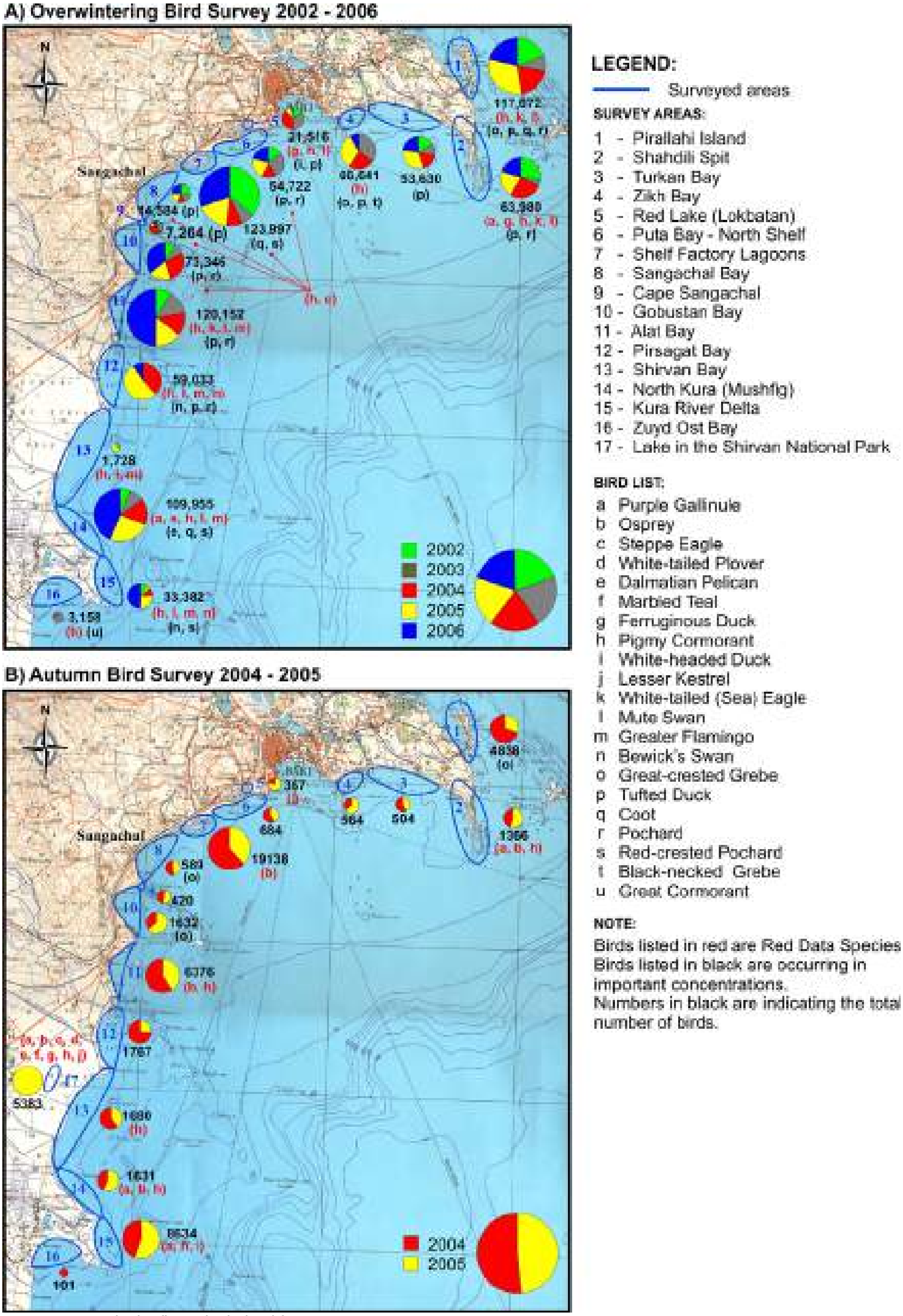
Note: Data in the figure is derived from URS, 2005b, URS, 2006

In terms of important numbers of a single species, a 1 percent level is used to identify Wetlands of International Importance as designated under the Ramsar Convention on Wetlands (Ramsar Convention 1971). This states that any site that regularly holds 1 percent or more of a regional population of waterbirds qualifies as a wetland of international importance.

The Autumn (Moulting) bird surveys found Sangachal Bay hosting over the 1 percent level (for the West Asia and the Caspian regions) of great crested grebe for both years 2004 and 2005. In winter, Sangachal Bay hosted over the 1 percent level of tufted duck (Figure 6.11).

These surveys show that construction activities in these areas have not had a significant impact on the suitability of these sites to host large seasonal numbers of bird populations.

Figure 6.11 Overwintering bird survey locations 2000-2005 and summary of results



Note: Data in the figure is derived from URS, 2006

6.4 Sangachal Bay environment

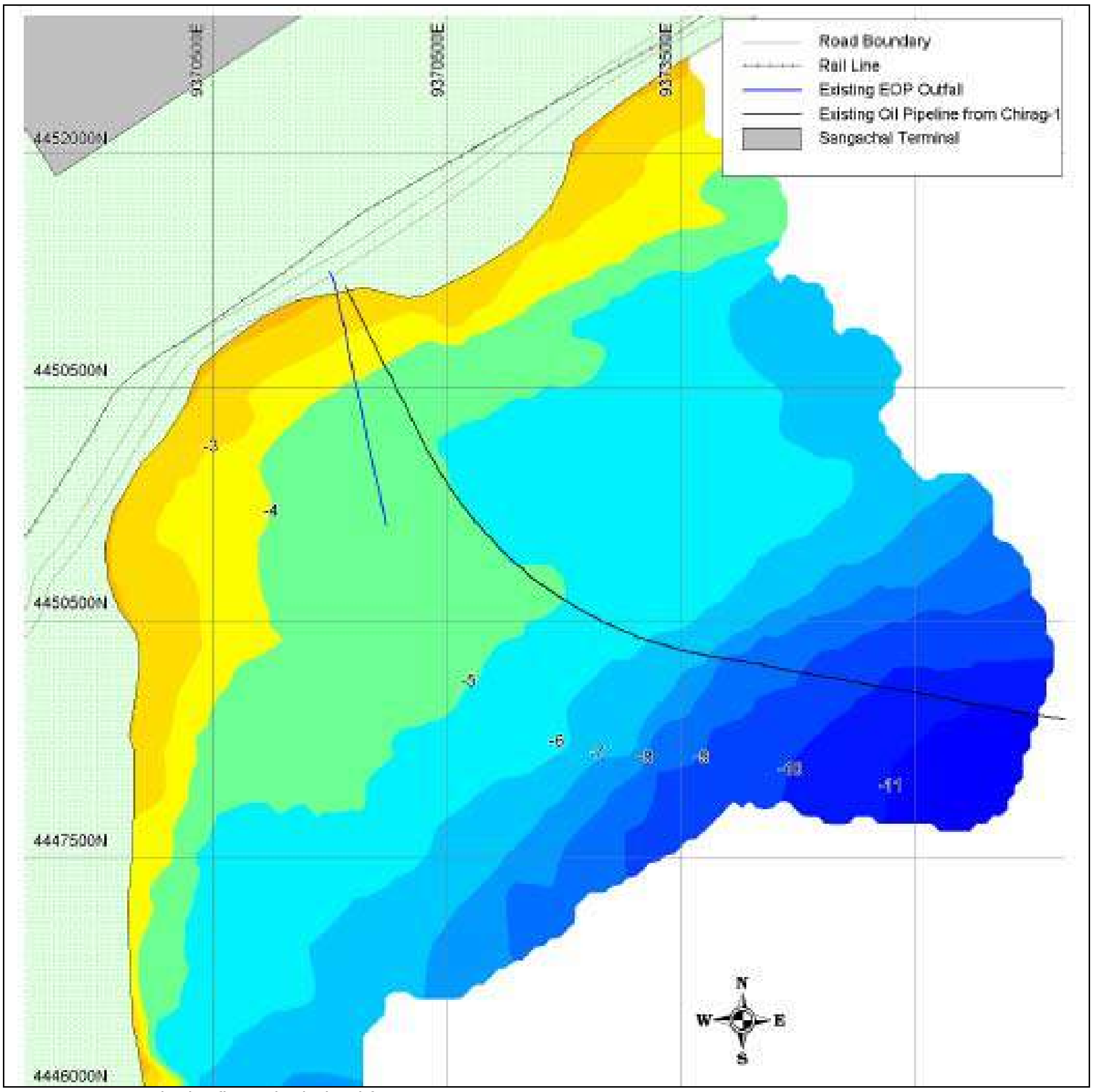
A number of surveys conducted in Sangachal Bay since the time of writing the ACG FFD Phase 1, 2, and 3 ESIAs have provided more recent real time data than reported in those documents. These have formed the basis of the revised descriptions of the Sangachal Bay (nearshore) environment described in the following subsections.

6.4.1 Physical oceanography

6.4.1.1 Bathymetry

Sangachal Bay is a shallow bay that slopes gently from the shoreline for approximately 600 m into the bay, where a 5-6 m deep shelf develops. A sill defines the seaward side of this shelf along the ACG FFD PWD pipeline route 3-5 km from the shore. From this sill, the bathymetry continues to descend into open sea, reaching a depth of 11 m at an average of 5 km offshore (Figure 6.12).

Figure 6.12 Bathymetry of Sangachal Bay with respect to the ACG FFD PWD pipeline



Note: Data in the figure is derived from AmC, 2004a

6.4.1.2 Temperature

Sea surface temperatures in Sangachal Bay vary seasonally, increasing from April to reach a maximum of 19°C during August, declining thereafter to a minimum of just over 5°C in January (Figure 6.13).

6.4.1.3 Tides

The Caspian Sea is non-tidal and water movements in the area are current-driven.

6.4.1.4 Currents

Current patterns are predominantly wind-driven, especially in shallows and upper water layers. Close to shore, currents are also influenced by factors such as the configuration of the coastline, bathymetry, bottom relief, and density differences caused by freshwater run-off.

In Sangachal Bay, a weak current pattern prevails near the shore and have been known to run in opposing directions within the space of a few kilometres (AmC, 2004a). Further from the shore, the currents are stronger, and run either to the NE or SW (parallel to the shore) depending on prevailing winds, with mean velocities of 7-10 cm/s and maximum velocities of 35-40 cm/s (seasonal variation illustrated in Figure 6.13).

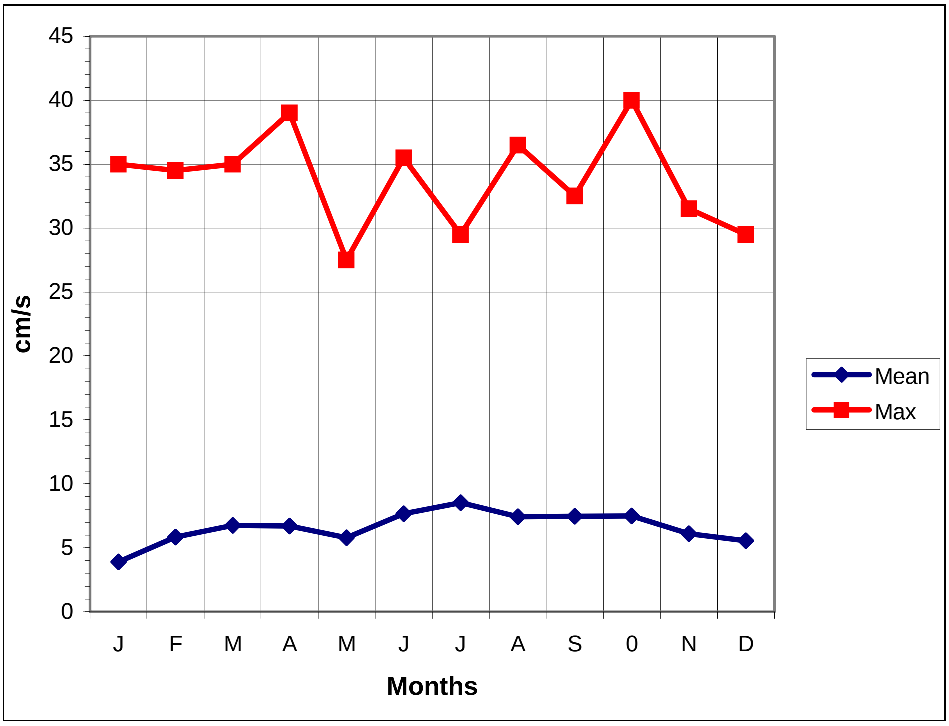
6.4.1.5 Storm surges and waves

Temporary sea level changes in the Caspian have occurred as a result of strong winds blowing along the axis of the landlocked sea (when winds generate surge along the greatest fetch). This generally takes place when the winds blow from the north and northeast, and to a lesser extent when the winds blow from the south and southeast (Kosarev and Yablonskaya, 1994).

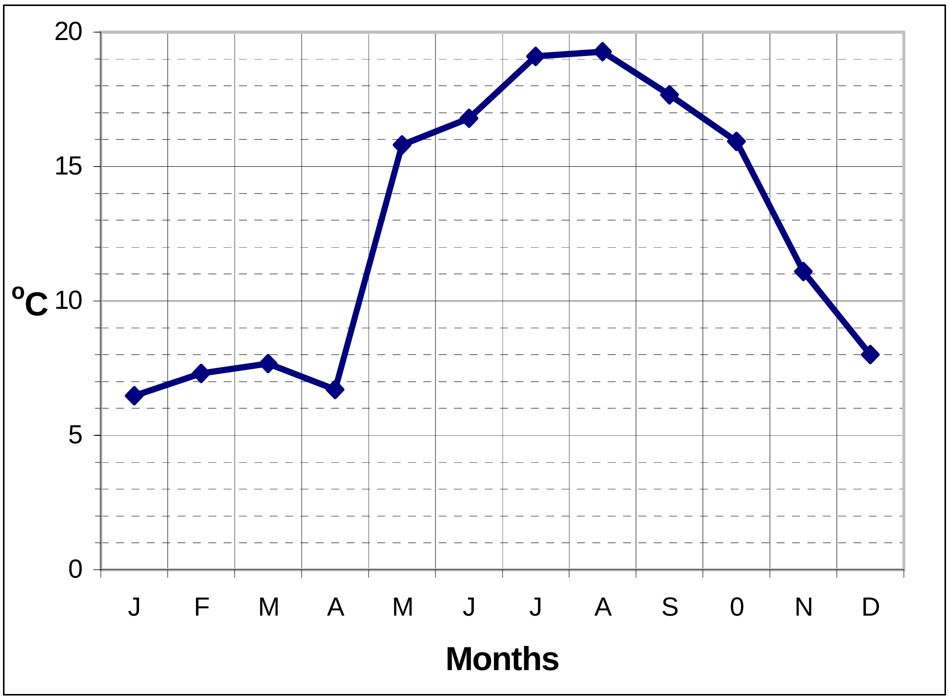
South of the Absheron Peninsula, wind either generates a rise or fall in wave heights, depending on direction. Winds from the north (locally called “Khazri” when they are particularly strong) will cause a drop in sea level, while winds from the south and southeast (locally called “Gilavar” when strong) will cause the sea level to rise on the south shore of the peninsula. In Baku Bay, this change has been observed to be as much as 70-80 cm. The typical time period for a storm surge is estimated at between 6-24 hours (Kosarev and Yablonskaya, 1994).

Figure 6.13 Seasonal variations of oceanographic data from the recording current meter (RCM) stations (illustrated in 6.9) June 2003-June 2004

a) Current speeds



b) Temperature



Note: Data in the figure is derived from AmC, 2004b

6.4.2 Water characteristics

6.4.2.1 Water chemistry

The Caspian Sea contains waters of ancient oceanic origin, diluted and changed by river outflows. This process has reduced the relative concentration of chloride salts in the water and increased the proportion of carbonates, sulphates, and calcium compounds. The average salinity of the southern basin of the Caspian Sea is approximately 12.9‰, and generally described as “brackish.”

6.4.2.2 Water quality

During March 2004 (AmC, 2004a) water samples were obtained from midwater depth at the 12 offshore sampling locations depicted in Figure 6.17. During October 2003 (AmC, 2003b) water samples were also collected from midwater depths closer to shore within (Figure 6.14). Several parameters were recorded including: total suspended solids (TSS), total hydrocarbons (THC), biochemical oxygen demand (BOD), chemical oxygen demand (COD), the concentrations of surfactants, phenols, nutrients, and heavy metal concentrations.

TSS has an important role in the fate of contaminants such as hydrocarbons, metals, and nutrients, as the contaminants are known to absorb to particulate matter and be rendered otherwise undetectable within the water column (Witt 2002). TSS concentrations were less than 6.35 mg/l in the offshore survey, lower than the levels detected in the nearshore survey conducted in October 2003. The reason for the difference was not definitely determined, although given that the surveys were conducted in different seasons it is possible that the diminished TSS concentrations were associated with variation in plankton density.

THC analysis provides a measure of water contamination from both natural and industrial hydrocarbon sources. THC concentrations ranged between 13.3 and 19.3 µg/l substantially lower than the average of 44.9 µg/l recorded during the October 2003 survey (AmC, 2004a) and well below the national Maximum Permissible Concentration (MPC)[1] for surface waters (50 µg/l).

BOD is a measure of oxygen consumed by microorganisms during organic decomposition and provides an indirect measure of the concentration of biodegradable organic compounds in a water sample. BOD measurements were near the quantification limits for all stations. This finding is typical for 5-Day BOD (BOD_5) in seawater (AmC, 2004a).

COD is a measure of the oxygen consumed by organic pollutants in the water (not necessarily living); values in Sangachal Bay were observed in 2003 between 39.1 and 62.8 mg/l. These were 2-3 times higher than the levels recorded further from the shore during 2004. Higher levels of chemically oxidizable material are associated with proximity to shore, and this trend is therefore to be expected (AmC, 2004a).

There was no evidence in either survey that heavy metal concentrations in the water column were present at a concentration that might adversely affect biota.

[1] MPC: Maximum Permitted Concentration is defined as a national standard that defines permissible concentrations for dissolved constituents within the water column.

6.4.3 Coastal sediments

6.4.3.1 Sediment characteristics

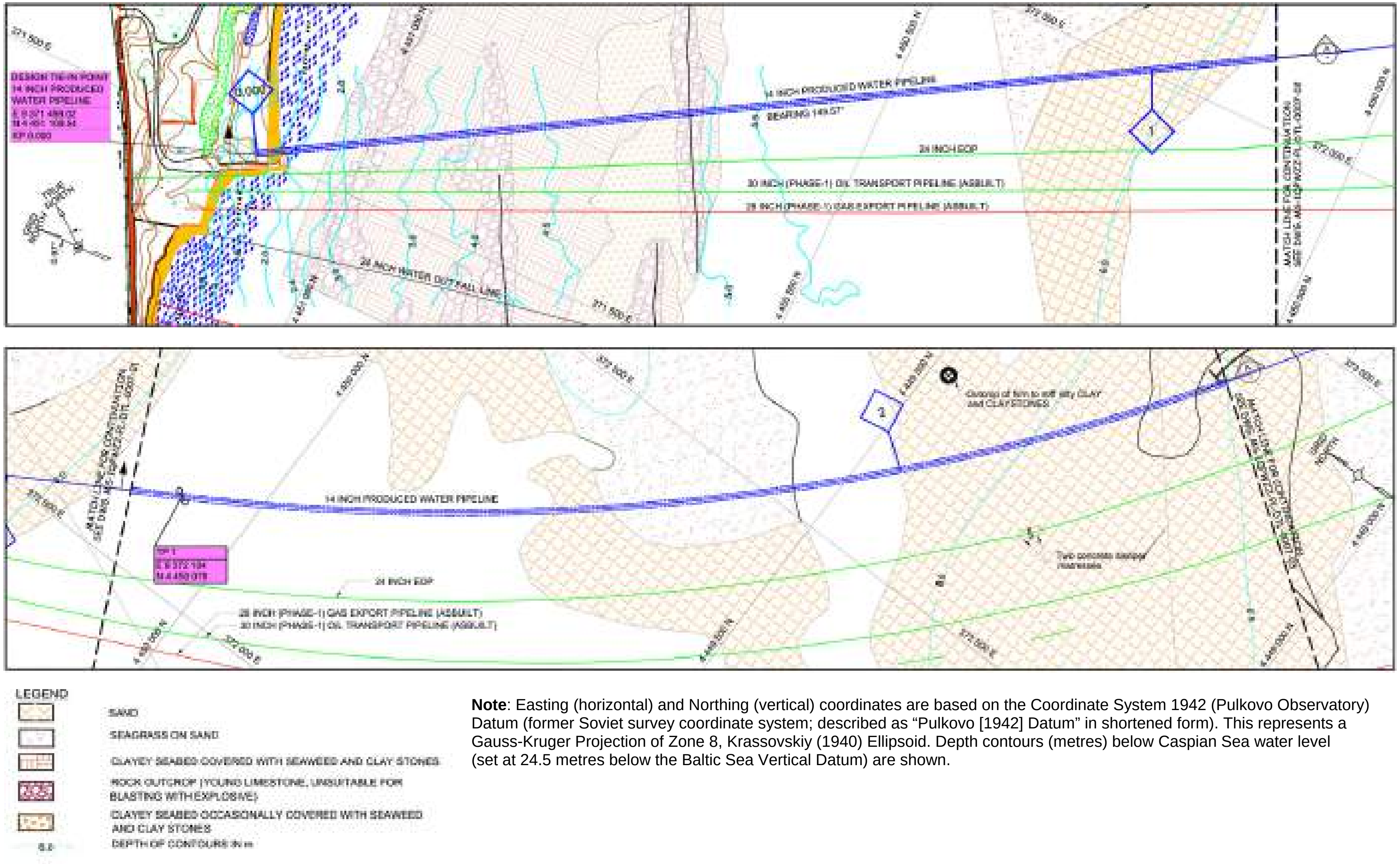
As part of the Define Engineering for the ACG FFD PWD pipeline near shore of Sangachal Bay (Figure 6.14 and 6.15), seabed conditions were surveyed in order to determine the distribution of soils through which trenching operations would occur. This survey was conducted along the length of the nearshore pipeline to a depth of 11 m, where the pipeline would be allowed to surface as it continues out to the Compression and Water Injection Platform (CWP) at Central Azeri platform complex within the ACG Contract Area. A narrative description of the results of this survey follows.

The ACG FFD PWD pipeline, as described in the Project Description, will pass the contour of the Caspian Sea surface (MLLW) at a land promontory (the EOP pier) near the landfall of the other pipelines coming from the ACG and Shah Deniz Contract Areas (Northing 4451109.54 Easting 9371498.02 on the Pulkovo 1942 Datum). The pipeline trench will be dug from there in a south-southeast direction (bearing 149.57°) through clayey seabed, which slopes downward to 3 m depth over 100 m distance (3 percent grade). From there, the slope of the trench becomes much shallower as it passes through limestone outcroppings interspersed with dense clay and claystone surfaces, reaching 5.5 m depth (or 2.5 m additional depth) approximately 450 m (a further 350 m out) from the shore (0.7 percent grade).

From this point, the pipeline route passes through sandier terrain as the seabed slopes at a considerably shallower rate (representing 0.1 percent grade), passing through a seagrass bed near 800 m from shore. At 1,025 m from the shore, the pipeline begins to change direction (Point of Tangent TP1, located at Northing 4450078 Easting 9372104), passing through a 2,300 m curve (to Point of Curve TP2, located at Northing 4448836 Easting 9373884). Within this curve, a 250 m wide bed of seagrass will be encountered by trenching crews at roughly 1.5 km from the shoreline, and through the 200 m wide sill at the edge of Sangachal Bay at 2 km from the shoreline. On the far side of this sill, a large seagrass bed set in sandy soil will be encountered from 2.4 km to 3.2 km from the shore.

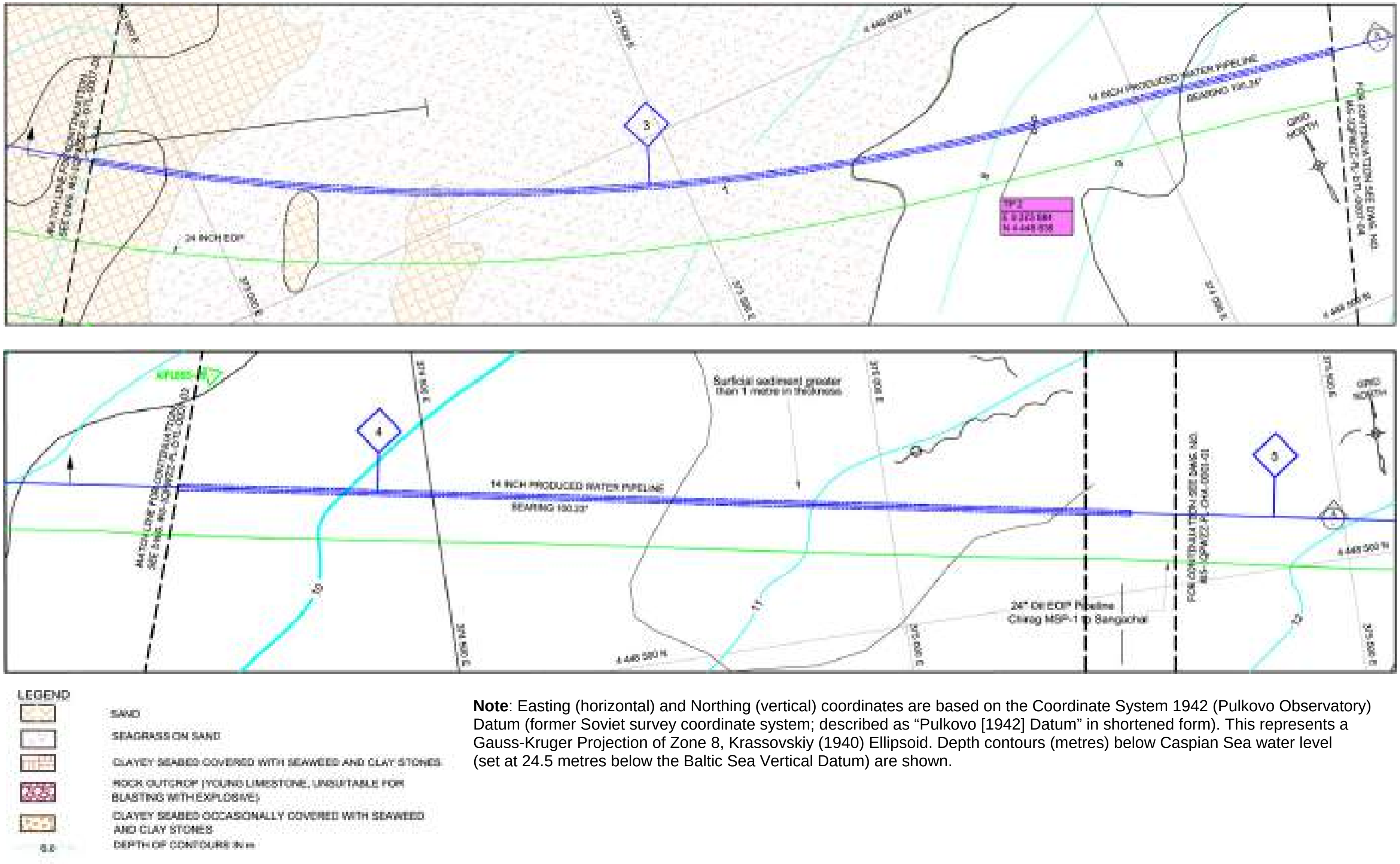
From the Point of Curve (TP2, roughly 3.3 km from the shore), the pipeline trench will continue its descent (slightly more than 8 m depth here, the grade increasing to 0.5 percent) in an east-southeast direction (bearing 100.24°) for a little more than 1 km to the 11 m depth contour. From here, the pipeline will continue for 350 m, surfacing 5.0 km from the shore (the last 100 m being a transition from trenched to above ground pipeline). In this last straight segment, the surface sediments increase to a depth of over 1 m.

Figure 6.14 Coastal sediment regime in plan view (to Sangachal Bay sill)



Note: Easting (horizontal) and Northing (vertical) coordinates are based on the Coordinate System 1942 (Pulkovo Observatory) Datum (former Soviet survey coordinate system; described as "Pulkovo [1942] Datum" in shortened form). This represents a Gauss-Kruger Projection of Zone 8, Krassovskiy (1940) Ellipsoid. Depth contours (metres) below Caspian Sea water level (set at 24.5 metres below the Baltic Sea Vertical Datum) are shown.

Figure 6.15 Coastal sediment regime in plan view (beyond Sangachal Bay sill)



Note: Easting (horizontal) and Northing (vertical) coordinates are based on the Coordinate System 1942 (Pulkovo Observatory) Datum (former Soviet survey coordinate system; described as "Pulkovo [1942] Datum" in shortened form). This represents a Gauss-Kruger Projection of Zone 8, Krassovskiy (1940) Ellipsoid. Depth contours (metres) below Caspian Sea water level (set at 24.5 metres below the Baltic Sea Vertical Datum) are shown.

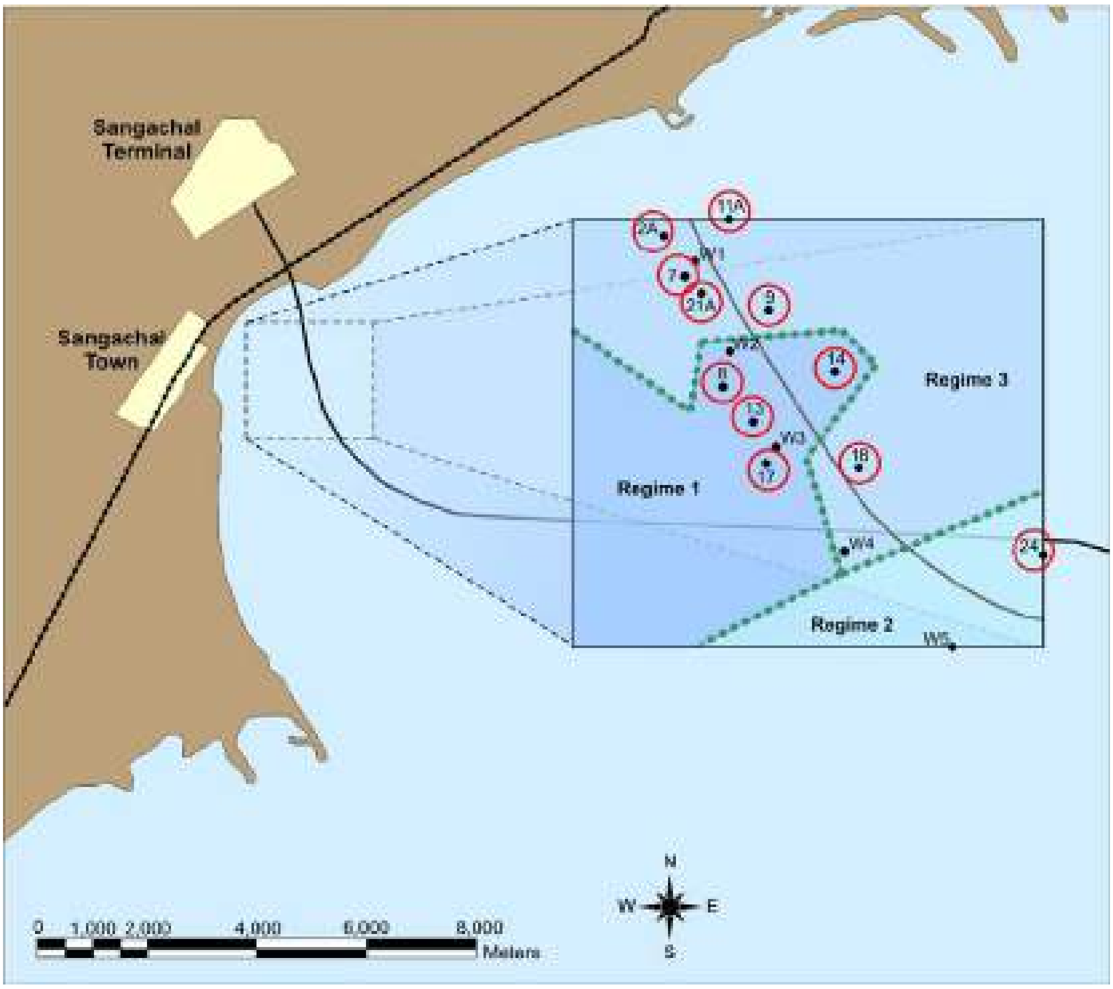
6.4.3.2 Benthic characteristics

A description of the benthic environment in the Sangachal Bay area was provided in the ACG FFD Phase 1 ESIA Chapter 6. This section draws relevant information from the ESIA and environmental seabed surveys, including three acoustic mapping surveys (2001, 2002, and September 2003) and benthic surveys (October 2003 for nearshore coastal, and March 2004 for offshore coastal) that were carried out in the Bay.

The objective of the benthic surveys was to provide data on the status of the benthic environment in Sangachal Bay, and to gain a better understanding of the environmental gradients and natural variability of the bay's ecosystem.

A benthic survey was conducted in October 2003, covering 24 locations predominately in shallow nearshore waters (Figure 6.16), with 11 locations in the immediate vicinity of the proposed project. (Five additional water column surveys are depicted in the figure, which is referred to further in the report, i.e., W1-W5.)

Figure 6.16 Nearshore survey in Sangachal Bay (2003) showing the stations in proximity to the proposed ACG FFD PWD pipeline route (in red)



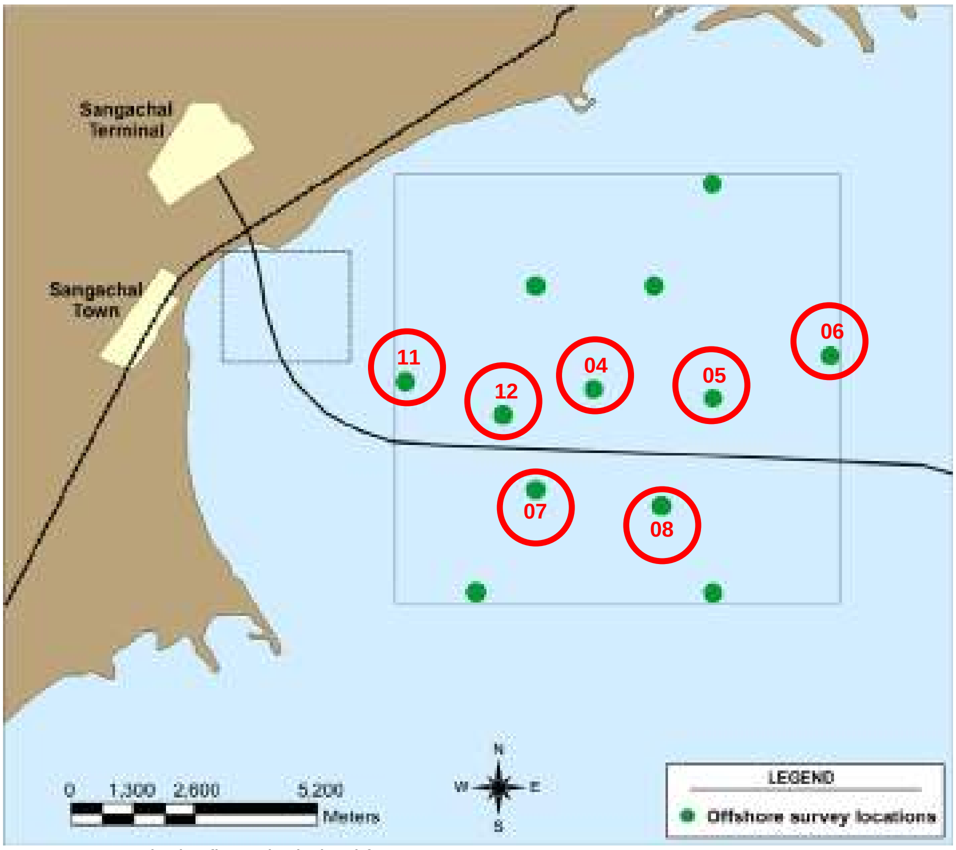
Notes: Data in the figure is derived from AmC, 2003b

The 2003 survey identified three sediment types or regimes, as identified in Figure 6.16. These are described as follows:

- **Regime 1:** Fine silty sediments, mostly well sorted with high organic content, found in the central-western part of the survey area.
- **Regime 2:** Coarse-grained sands, moderately well sorted with low organic content, found in the deeper water to the south and southeast of the survey area.
- **Regime 3:** Fine to medium sand with variable fine material (silt/clay) matrix, well-sorted to extremely poor-sorted with moderate organic content, found in the shallow nearshore northern and deeper eastern part of the survey area.

The March 2004 survey, in addition to water samples, provided sediment sampling data for the same 12 locations further offshore (Figure 6.17, and mentioned in Section 6.4.2.2).

Figure 6.17 Offshore survey locations for Sangachal Bay (2004)



Notes: Data in the figure is derived from AmC, 2004a

Sediment samples collected were regarded as poorly sorted (a sediment sample located away from the pipeline route was regarded as well-sorted), indicating in the general area a wide range of particle sizes. At a distance of 3-5 km from shore, soil particle sizes were at their greatest diameter. This corresponded with the location of a sill located at the edge of Sangachal Bay, described in Section 6.4.1.1 (Sangachal Bay bathymetry). The lower fine material content also corresponded with a decrease in organic material within the benthic environment. Table 6.4 provides sediment data collected at each of the survey locations located in the immediate vicinity of the pipeline route (i.e., sites identified in Figures 6.16 and 6.17).

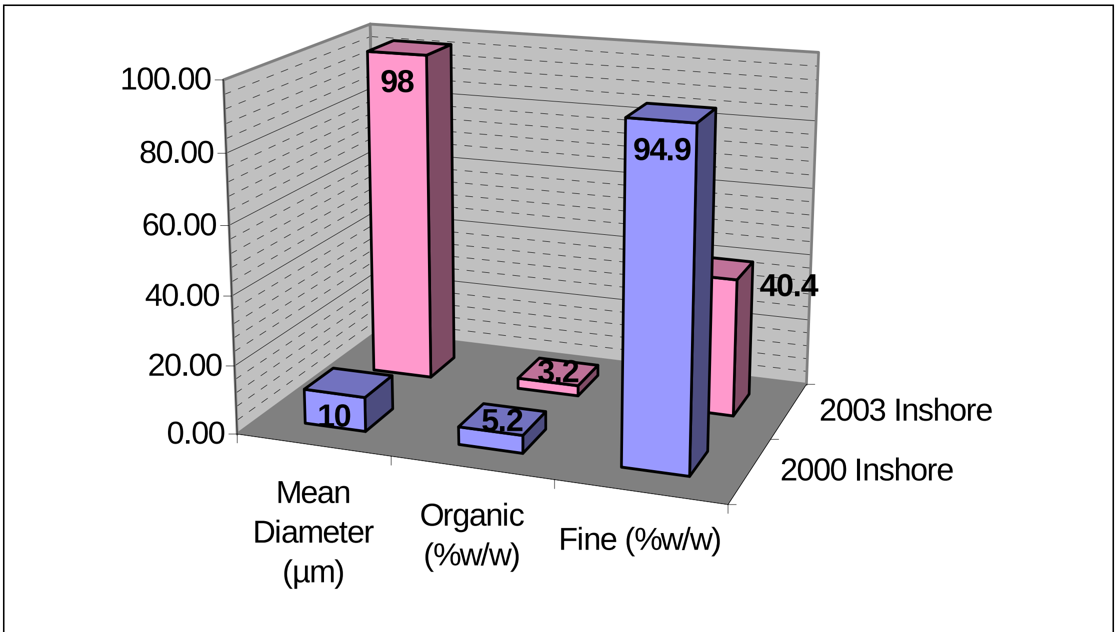
Table 6.4 Sediment data collected along ACG FFD PWD pipeline route

Year	Station	Sediment type (per Wentworth)	Mean diameter (µg)	Organic content (%w/w)	Silt/clay (%w/w)	Sorting index
2003	**2a**	Very fine sand	98	2.8	21.1	Very poor
2003	**7**	Fine sand	222	4.1	32.1	Extremely poor
2003	**8**	Very fine silt	5	5.3	99.3	Good
2003	**9**	Very fine sand	99	2.6	40.1	Extremely poor
2003	**11a**	Fine sand	127	1.3	20.5	Poor
2003	**13**	Very fine silt	6	7.2	99.0	Good
2003	**14**	Medium silt	17	4.4	79.3	Extremely poor
2003	**17**	Fine silt	15	4.8	99.8	Extremely good
2003	**18**	Fine sand	159	2.9	30.7	Extremely poor
2003	**21a**	Very fine sand	72	3.2	47.1	Extremely poor
2003	**24**	Coarse sand	719	1.2	1.8	Moderate
2004	**11**	Very fine sand	68	3.7	55.2	Extremely poor
2004	**12**	Medium silt	30	4.4	69.2	Extremely poor
2004	**04**	Coarse silt	33	4.5	80.9	Extremely poor
2004	**05**	Fine silt	16	4.1	79.1	Extremely poor
2004	**06**	Coarse silt	55	5.0	60.0	Extremely poor
2004	**07**	Coarse silt	32	4.2	68.6	Extremely poor
2004	**08**	Medium silt	24	5.1	73.5	Extremely poor

Notes: Data in the table is derived from AmC, 2003b and 2004a. Data within the green portion of the table are for nearshore locations, while data in the blue portion of the table are for offshore locations.

Caspian sediments generally comprise components from distant sources not necessarily within Azerbaijan, such as silt, clay, and gravel of fluvial and ice-age (Pleistocene) glacial origins, together with shell fragments and shell sand.

Figure 6.18 Median sediment characteristics nearshore



Note: Data in the figure is derived from AmC, 2003b

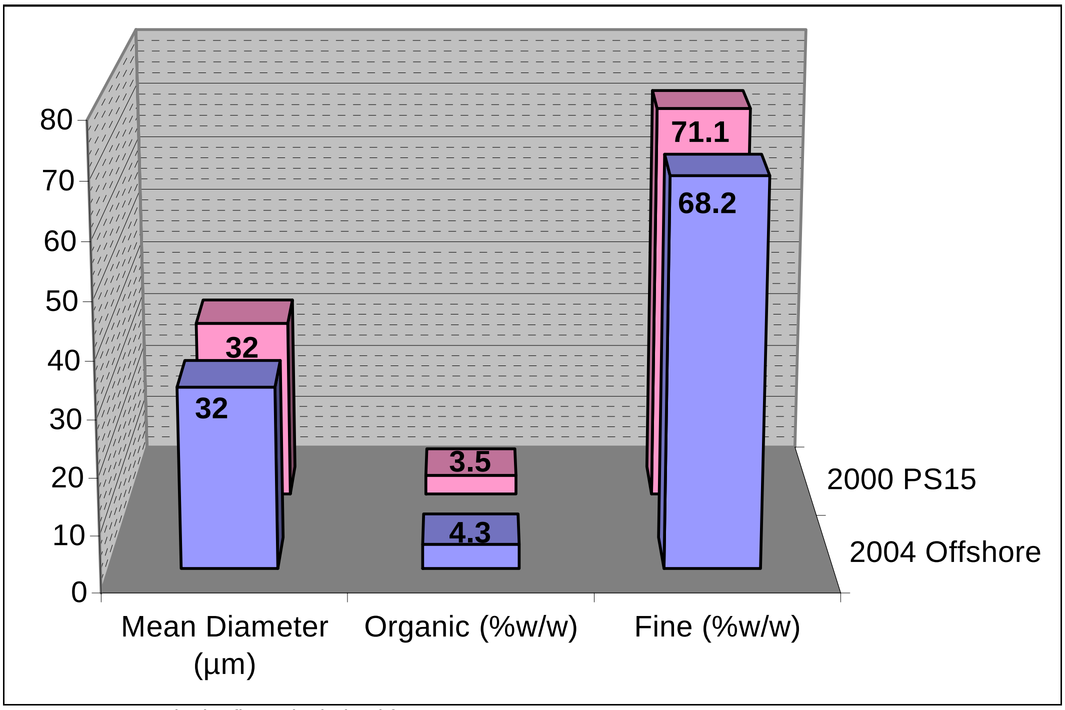
Sediment studies have been conducted in two separate areas, nearshore and offshore (Figure 6.16 and Figure 6.17). The following sediment characteristics were recorded in both surveys; mean particle diameter (mean diameter), organic content (percent) and fine particle (silt/clay) content (percent). Given the heterogeneity of the seabed environment there was considerable variation in the parameters measured between sampling locations. The median value for a parameter is therefore used to represent the 'typical' properties of the sediment.

Results of the sediment analysis for the 24 samples taken during the nearshore survey are depicted in Figure 6.18. The results of the 2003 survey are compared with those from a survey conducted in the same area in 2000. Since 2000 the data collected indicates that there has been an overall increase in particle size diameter indicating a change from fine silty sediments towards coarser sandy sediments.

Results of the sediment analysis of the 12 samples taken during the offshore survey are depicted in Figure 6.19. The results of the 2004 survey are compared with an earlier single sample from a nearby location obtained during 2000.

Comparison of Figure 6.18 and Figure 6.19 illustrates the increase in sediment particle size with distance from shore. This trend is also observed within the samples taken during 2004 where, in addition to an increase in sediment particle size with distance from shore, there is an increase in the proportion of silt/clay and organic matter in the sediment (AmC, 2004b).

Figure 6.19 Median sediment characteristics offshore



Note: Data in the figure is derived from AmC, 2004a

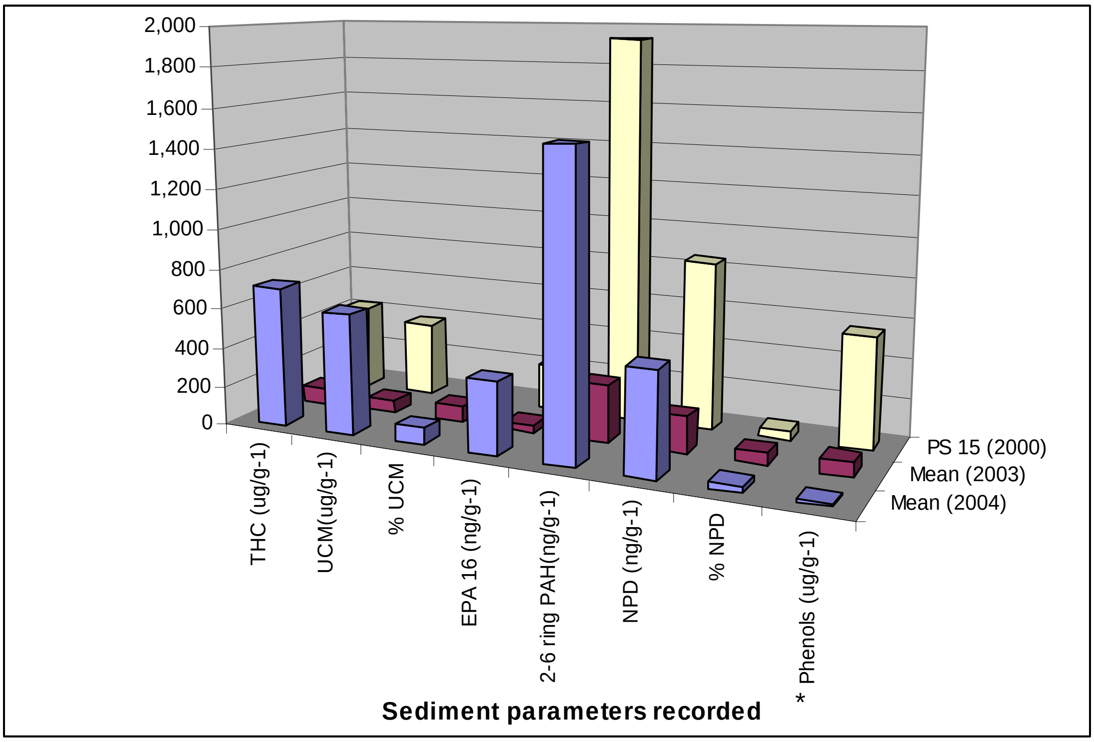
6.4.3.3 Sediment chemistry

Hydrocarbons

The average total hydrocarbon (THC) concentration in sediments in the nearshore area of Sangachal Bay in 2003 was approximately twice as high as in 2000 (AETC, 2005). However, this overall comparison does not allow discrimination of the variation in THC concentrations between sampling locations, some of which have maintained a constant level of THC. The changes in THC appear to be associated with changes in sediment composition. As sediment size increases THC also increases. There are two possible causes for the increase in sediment size and THC: coarser sediments being deposited from sources further offshore (away from contamination sources), or underlying, historically contaminated sediment being exposed by erosion of finer overlying sediments that were deposited during a temporarily calmer regime of local water currents within the survey area.

Figure 6.20 compares concentrations of selected parameters in sediment in the nearshore area, i.e., Sangachal Bay (represented by 'Mean (2003)' in the Figure) with areas outside Sangachal Bay (represented by 'PS 15 (2000)' and 'Mean (2004)' in the Figure). The latter areas have a much higher hydrocarbon concentration than the nearshore area and it is therefore possible that the observed increase in both sediment particle size and THC concentration closer to the coastline is attributed to the deposition of sediments transported by storms from offshore areas into Sangachal Bay.

Figure 6.20 Concentrations of selected parameters in sediment



Note: * Phenol concentration has been multiplied by a factor of 100 to permit a relative comparison to be made between the three surveys.
PS15 (2000) and Mean (2003) data were from nearshore sampling locations, while Mean (2004) data were from offshore sampling locations. Data in the figure is derived from AmC, 2003b and 2004b.

Heavy metals

The median concentrations of heavy metals found within the nearshore waters of Sangachal Bay decreased between 2000 and 2003 (Table 6.5). Although the overall median value has declined, there is considerable variation between sampling locations, with some showing reduced concentrations and others showing increased concentrations of heavy metals.

Reductions in heavy metal concentrations appear to be associated with those sampling locations where there has been an increase in sediment particle size and a decrease in the silt-clay content (AETC, 2005). This indicates that most of the heavy metal measured is associated with the silt-clay component of the sediment.

Compared to the nearshore area, the offshore area sampled during the 2004 survey exhibited higher levels of heavy metals in sediments (with the exception of arsenic and cadmium). Mercury levels were considerably higher in the offshore location – approximately six times as high as the nearshore locations (Table 6.5).

At both nearshore and offshore sampling locations the spatial pattern of heavy metal concentrations was relatively uniform, indicating an absence of point source inputs.

Table 6.5 Comparison of median sediment heavy metal concentrations between nearshore and offshore coastal areas

Survey	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Mercury	Lead	Zinc
Nearshore (2000)	NM	NM	<2.5	60.57	41.5	32,967	0.03	22.6	87.3
Nearshore (2003)	12.5	258	0.29	29.2	28.5	22,837	0.037	20.8	60
Offshore (2004)	9.6	286	0.21	73.1	29.1	20,581	0.21	40.9	91.2

Note: Data in the table is derived from AmC, 2003b and 2004b
NM = Not Measured

6.4.4 Biological environment

6.4.4.1 Sea grass

Seagrass (*Zostera nolti*) beds in Sangachal Bay have been identified during successive ESIAs as a potentially sensitive habitat. Environmental mapping of the seabed conducted in 2003 demonstrated that dense seagrass beds occupy shallow waters close to shore. Seagrass is also located on the outer reef that is in deeper water (up to 6 m). In the previous years' surveys (conducted in 2001 and 2002) the seagrass community on the outer reef differed from the nearshore community in being mixed with algae. In 2003 there was a lack of red algae.

Although the total area in the bay occupied by seagrass and algal habitats remained relatively constant during the 27-month period after the 2001 survey was conducted, there has been a significant increase in the area of seagrass and a corresponding reduction in the area of red algae (AmC, 2003a).

6.4.4.2 Plankton

Plankton abundance varies significantly on a seasonal basis - for a detailed description of seasonality see the ACG FFD Phase 1 ESIA, Chapter 6 (URS, 2002a).

Phytoplankton

Phytoplankton sampling was conducted at five locations (W1-W5 depicted in Figure 6.16) in Sangachal Bay during October 2003. A total of 16 species were identified of which 8 were diatoms (*Bacillariophyta*), 5 were dinoflagellates (*Dinophyta*) and 3 were blue-green algae (*Cyanophyta*). The most abundant phytoplankton species were the diatoms *Chaetoceros wighamii* and *Thalassionema nitzschioides*. The former represented 61-69 percent of the community at each sample location and the latter 6-21 percent (AmC, 2003b). Phytoplankton abundance by class is given in Table 6.6.

Table 6.6 Phytoplankton abundance (cells/l) by class at sample stations located within Sangachal Bay

Class	Station				
	W1	**W2**	**W3**	**W4**	**W5**
Cyanophyta	6520	11,960	6800	4120	19,720
Bacillariophyta	32,240	47,040	46,520	39,840	79,600
Dinophyta	1040	1720	920	120	120
Total	**39,800**	**60,720**	**54,240**	**44,080**	**99,440**

Note: Data in the table is derived from AmC, 2003b

Zooplankton

Zooplankton sampling was conducted in Sangachal Bay during October 2003 (W1-W5 as depicted in Figure 6.16). A total of six species were identified from three taxonomic groups; Copepods (*Copepoda*), comb jellyfish (*Ctenophora*), and water fleas (*Cladocera*). From Table 6.7 it is evident that *Copepoda* were the dominant zooplankton group at the time of the survey. Of the species recorded, three were endemic and three were invasive species from the Black and Azov seas.

Table 6.7 Zooplankton abundance (percent) at sample stations located nearshore within Sangachal Bay

Taxonomic group	Station				
	W1	**W2**	**W3**	**W4**	**W5**
Copepoda (excluding *nauplii*)	90	95	98	89	94
Ctenophora (excluding eggs)	10	5	0	3	0
Cladocera	**0**	**0**	**2**	**8**	**6**

Note: Data in the table is derived from AmC, 2003b

Acartia tonsa, a Mediterranean invader, dominated *Copepoda*. This dominance was noted in earlier surveys as being a characteristic of nearshore waters (Woodward Clyde, 1996). Eggs of the comb jellyfish, *Mnemiopsis leidyi* (a ctenophore), were present in all samples. This organism has also been recorded in previous surveys since 2000.

6.4.4.3 Benthic macrofauna

This section describes benthic macrofauna (seabed dwelling organisms retained on a 0.5 mm mesh sieve) collected from both the nearshore and offshore sampling locations.

The nearshore sampling of benthic macrofauna conducted during 2003 (Figure 6.16) identified 18 taxa. An earlier survey conducted in the same area in 2000 identified 31 species. The difference between the two surveys was partly from the lower taxonomic richness at a single station, which recorded 21 species in 2000, of which 6 were not found elsewhere, but by 2003 this station only recorded 6 species, none of which were unique.

Overall, the nearshore benthic fauna of Sangachal Bay show limited diversity with a dominance of a small number of species: the invasive polychaete worms *Nereis diversicolor* and *Hypaniola,* the native oligochaete *Isochaetides*, and the invasive mussel *Mytilaster lineatus.* Non-native species account for most of the biomass.

The offshore macrofauna sampling conducted in 2004 (Figure 6.17) recorded 12 taxa – a relatively low number in comparison to other studies in the Caspian Sea (AmC, 2004b). As with nearshore sampling locations, the offshore area is limited in diversity, but has substantial biomass (35 g/m^2) at many sampling locations (compared to 9.5 g/m^2 in the nearshore area). Like the nearshore community, the offshore community is dominated by introduced species – one mollusc (the mussel *Mytilaster lineatus*) and one polychaete worm (*Nereis diversicolor*).

Although the habitat was homogenous, species distribution is patchy and the majority of species were recorded infrequently.

In 2004, a biomonitoring study was conducted that featured the *Mytilaster lineatus* mollusc as an indicator species for assessment of water quality. This study was performed to assess the potential impact of trenching operations on the quality of habitat for macrofauna within different parts of Sangachal Bay. The study indicated that the molluscs would not accumulate either metals, THC, or PAH levels from water clouding during normal trenching activities (AmC, 2004c)

Worms (oligochaete and polychaete, the latter predominantly *ampharetid polychaetes*), and amphipod crustaceans dominate the offshore benthic environment. These organisms share several important characteristics:

- They are small - no more than 1-2 cm long;
- They have short generation times - between 4 and 12 weeks, which means that they can produce several generations per year; and
- They are either deposit or suspension feeders, which means that they are largely dependent on fine settled or suspended sedimentary material for food, and that they are also exposed to any chemical contaminants associated with sediment particles.

Deposit and suspension feeders are well adapted to maintaining their position in environments with high sediment deposition rates. Relatively short generation times mean that populations of these animals also have the potential to replace losses within months rather than years. Amphipods, for instance, are sensitive to hydrocarbons in sediment, and populations will reduce during periods of significant contamination. Persistent impact occurs only where there is sustained chemical contamination.

In addition to the amphipod crustaceans, oligochaete worms, and polychaete worms, several other biological groups are important. Bivalves are a significant component of the benthic fauna close to shore, and are either deposit feeders (*Abra ovata*) or filter feeders (*Dreissena* spp.*, Didacna, Cardium, Mytilaster lineatus*). Bivalves reproduce and grow relatively slowly. Consequently, any damage to bivalve populations can take longer to repair. With the exception of *Abra*, bivalves are relatively vulnerable to water contamination because they filter large volumes of water.

Caspian gastropods are a diverse group, all members of which are small surface deposit feeders. Under good conditions, gastropods are generally capable of achieving high population densities quite rapidly. Gastropods are primarily vulnerable to surface sediment contamination, and are relatively vulnerable to physical smothering.

The midge (*Chironomus* spp.), a waterborne insect species, is similar in size and habits to the small annelids, but have been known to be capable of suspension feeding as well as deposit feeding. Larvae can develop to adulthood in approximately four weeks, so this species has the capacity to recover rapidly from temporary disturbances.

6.4.4.4 Fish

Fish monitoring has taken place in the past within Sangachal Bay (Figure 6.21), starting in 2000 when quarterly samples were obtained close to the shoreline. Follow up studies commenced in 2002 and have been conducted throughout 2003 and 2004 (AmC, 2004c) and 2005 (AmC, 2006). The monitoring conducted focused on two species resident in the bay - sandsmelt (*Atherina mochon caspia*) and goby (*Neogobius fluviatilis pallasi*). The parameters recorded include size, weight, and a series of health indicators. More information on fish stocks is available within Chapter 7.

Samples caught throughout the 2004 survey period showed no external signs of stress or pathology. Measurements of pollution stress indicators have been either anomalous or difficult to interpret. This was particularly the case for micronucleus frequencies observed in the sampling in the latest survey. High values were noted not only in the samples collected in Sangachal Bay, but also at reference sites near the SPS Fabrication Yard and at Zagulba (a site on the north shore of the Absheron Peninsula, AmC, 2004d). Frequencies were higher during summer, possibly indicating UV activation of hydrocarbons (potentially derived from natural and/or anthropogenic sources) in the water column (AETC, 2005).

Figure 6.21 Fish monitoring locations for Sangachal Bay surveys, 2000-2005

6.5 Offshore environment

This section details the offshore environment through which the proposed ACG FFD PWD pipeline route will pass as described in Chapter 5. The description includes the route of the PWD pipeline to the CWP at Central Azeri (ACG FFD Phase 1).

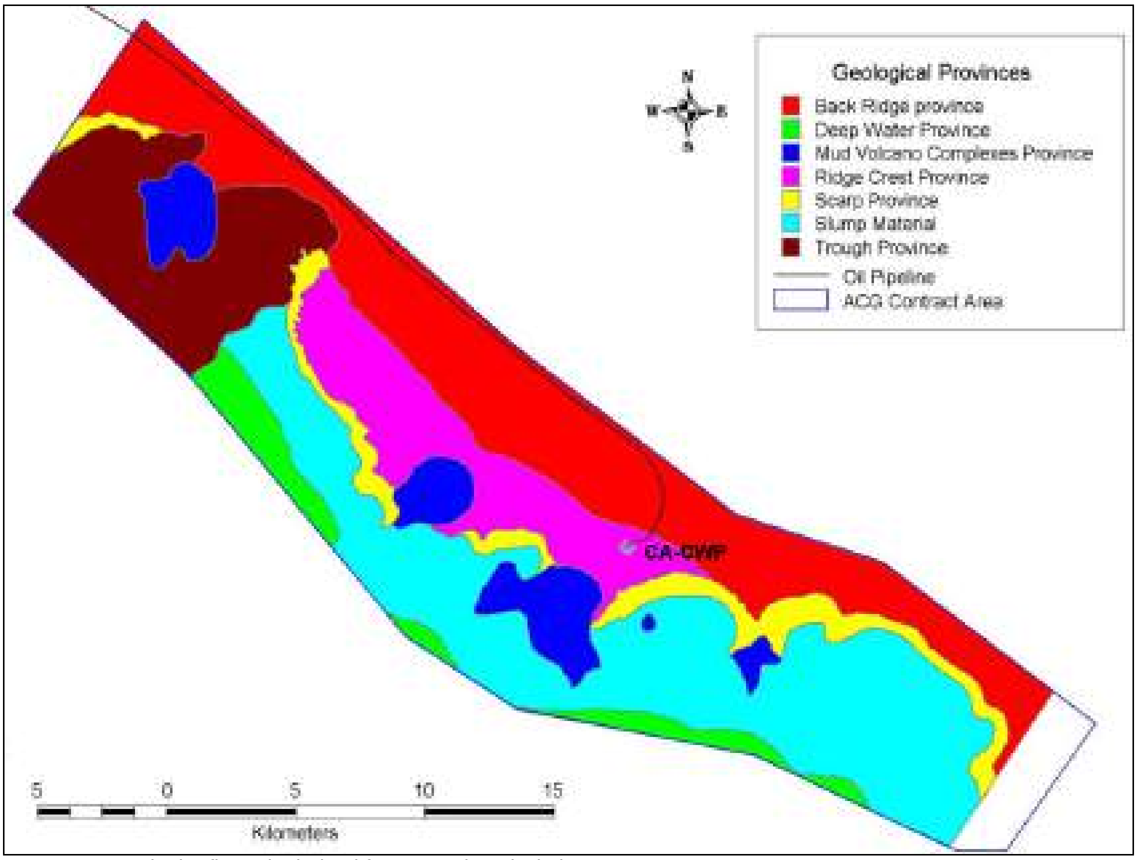
6.5.1 Physical oceanography

6.5.1.1 Bathymetry

The ACG Contract Area is located on the Absheron ridge, which is a submarine extension of the Absheron peninsula. Water depths in the ACG Contract Area ranges from 170-200 m and a mud volcano is situated in the vicinity.

Seabed topography throughout the area is irregular (Figure 6.22), and as a result, water flow through the area varies as the ridge significantly obstructs north-south currents along this area of the Caspian Sea.

Figure 6.22 Geological province map of the ACG Contract Area (Central Azeri CWP)

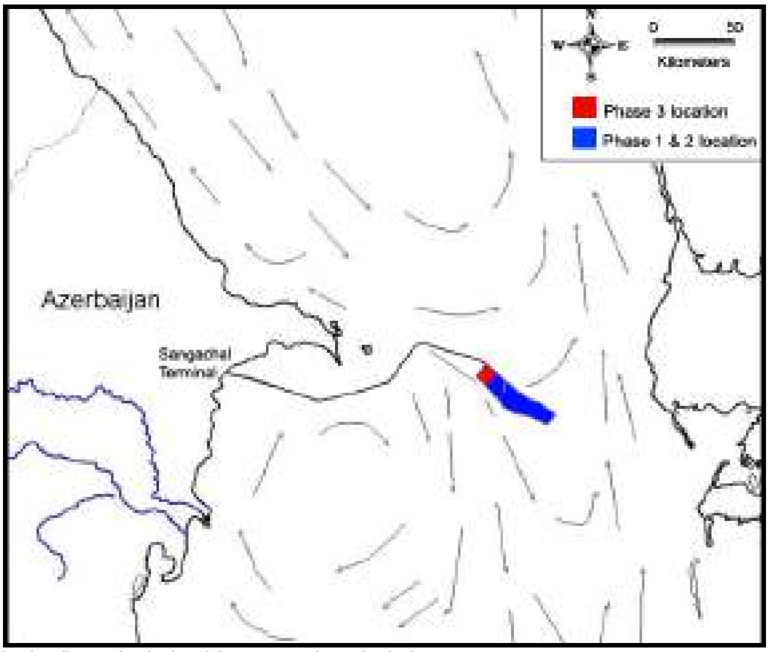


Note: Data in the figure is derived from Woodward Clyde, 1996.

6.5.1.2 Currents and waves

Residual (long-term) current patterns in the Caspian Sea predominantly flow easterly toward the ACG Contract Area in the vicinity of the ACG FFD PWD pipeline route (Woodward Clyde, 1995). This easterly flow, prevailing south of the Absheron Peninsula, eventually merges with southward-moving currents from the northern Caspian (resulting from river flow feeding into the western side of the landlocked sea) that overcome the Absheron subsea ridge and pass through the Contract Area (Figure 6.23).

Figure 6.23 Residual current patterns in vicinity of project



Note: Data in the figure is derived from Woodward Clyde, 1995.

The proposed ACG FFD PWD pipeline runs parallel to the Chirag-Sangachal (ACG FFD Phase 2) pipeline. Measurements of water currents made along the Chirag-Sangachal pipeline from October to December 1996 indicated that currents were generally weak, less than 0.2 m/s 90 percent of the time (URS, 2002a). Maximum surface currents were 0.4 m/s and mean surface currents 0.1 m/s. Maximum measured current velocity in the middle depths of the water column (50 m) was 0.65 m/s. Near the seabed, current speed and direction data collected along the Chirag-Sangachal pipeline corridor from October 1999 to May 2000, recorded a maximum current velocity of 1.26 m/s. Current direction and speed are depicted in Figure 6.24.

Figure 6.24 Current vectors showing mean speed (m/s) and direction along pipeline

Waves in the offshore area, including the ACG Contract Area, are wind driven and subsequently the windiest months also exhibit the greatest wave action. The largest waves can be expected when the wind direction is northerly or southerly, as waves have longer distance (fetch) to build up at these wind directions.

Wave height data recorded at Oil Rocks (*Nyeftyanye Kamni* in Russian or *Neft Dashlari* in Azerbaijani), located southeast of the Absheron Peninsula and northwest of the ACG Contract Area, indicates that the months of July, August, and September have the strongest winds and storms, with a higher frequency of wave heights in excess of 2 m recorded. The period of October to February however shows the greatest number of wave heights between 1 and 2 m, reflecting the steady occurrence of strong winds during this period.

South of the Absheron Peninsula northerly winds will create a fall in sea level while southerly winds result in a rise. The area of greatest wave development exists in the western portion of the Middle Caspian basin near the central section of the Absheron Ridge.

6.5.1.3 Sea temperature

Sea surface temperatures in the offshore ACG Contract Area vary seasonally from a mean minimum of approximately 5°C between December and February to a maximum temperature of approximately 25°C in July and August (URS, 2004). Temperatures in deeper waters in the South Caspian remain at 6°C year round. Ice does not occur in the Contract Area; however, during extreme winters, dense cold water is believed to flow under warmer surface waters from the North to the South Caspian basins.

A stratified water column develops in the Contract Area from late spring through summer. A thermocline occurs at water depths between 20 and 60 m (Kosarev and Yablonskaya, 1994). Across this thermocline the water temperature has been known to drop sharply from above 20°C to 10-12°C. The depth of the thermocline increases during the summer and autumn months as surface water temperatures and wind-driven turbulence increase. During winter the thermocline breaks down, reforming again the following spring.

6.5.2 Offshore water characteristics

6.5.2.1 Water chemistry

As explained in Section 6.4.2.1, the Caspian Sea contains waters of ancient oceanic origin, which have been diluted and changed by river outflows. This process has reduced the relative concentration of chloride salts in the water and increased the proportion of carbonates, sulphates, and calcium compounds.

Disturbance of the water surface and phytoplankton activity during winter and spring increase the oxygen content of surface waters. During the summer, stratification of the water column reduces oxygen levels below the thermocline.

The average salinity of the southern Caspian Sea, including the ACG Contract Area, is approximately 12.9‰. For offshore areas of the middle and southern Caspian basins, seasonal and spatial differences in salinity are less than 1‰, ranging between 12.5 and 13.4‰.

6.5.2.2 Water quality

Two ACG Contract Area regional surveys (AmC, 2004d) sampled water quality in the ACG Contract Area (Figure 6.25). The survey found that the level of hydrocarbons in ACG Contract Area waters was higher than observed in 1995 but similar to levels observed in more recent surveys. Heavy metal concentrations did not differ below or above the thermocline, and did not occur in any observable local concentrations at any of the locations monitored in either survey.

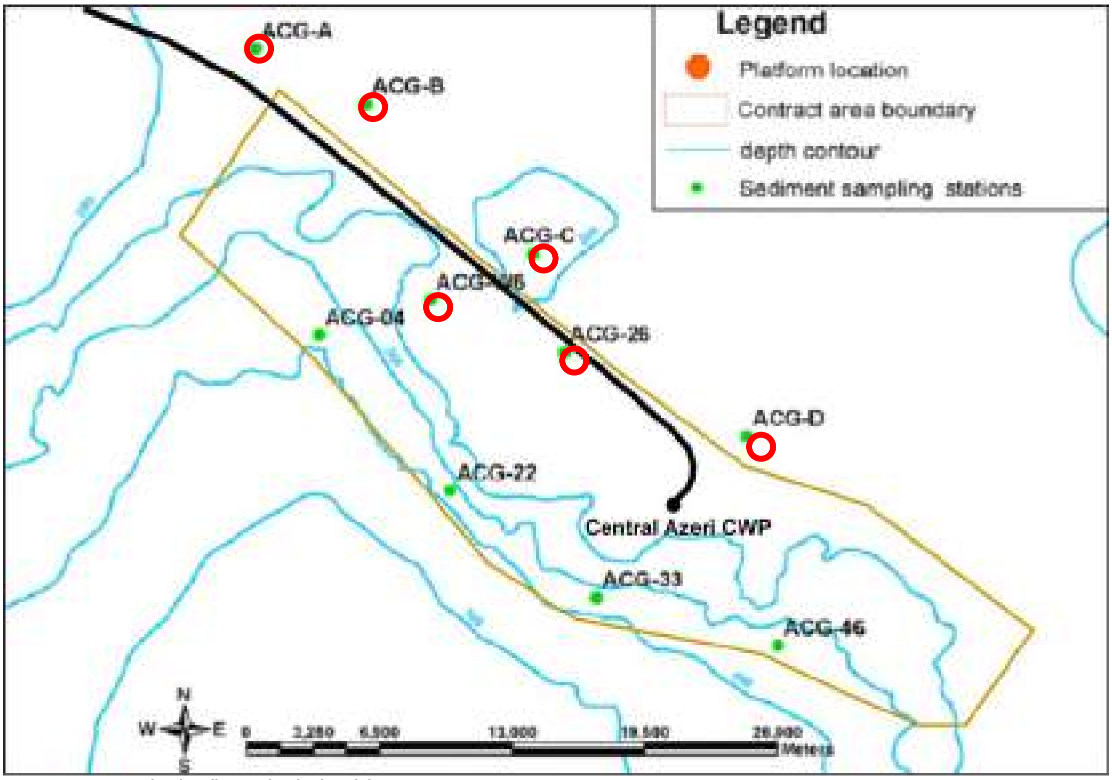
6.5.3 Offshore sediments

6.5.3.1 Sediment characteristics

Caspian sediments in the offshore area include silt, clay, and gravel of ice-age glacial and fluvial origins. Much of the coarse materials identified in the Ridge Crest province (Figure 6.22) and other shallow locations are gravel and sand formed from shell fragments (as indicated by the high carbonate content).

Sediment samples were collected throughout the Contract Area as part of the 2004 ACG Contract Area regional survey. The survey sampled sediment specifically at 10 stations, 6 of which lie along the proposed ACG FFD PWD pipeline route (Figure 6.25).

Figure 6.25 ACG Contract Area regional survey sampling (stations lying along the proposed ACG FFD PWD pipeline route are shown in red)



Note: Data in the figure is derived from AmC, 2005c.

The survey results indicate a predominance of poorly to extremely poorly sorted fine sand to course silt with low organic content along most of the proposed ACG FFD PWD pipeline (within the Back Ridge Province), with increased silt deposits nearer to the Central Azeri platform (Table 6.8).

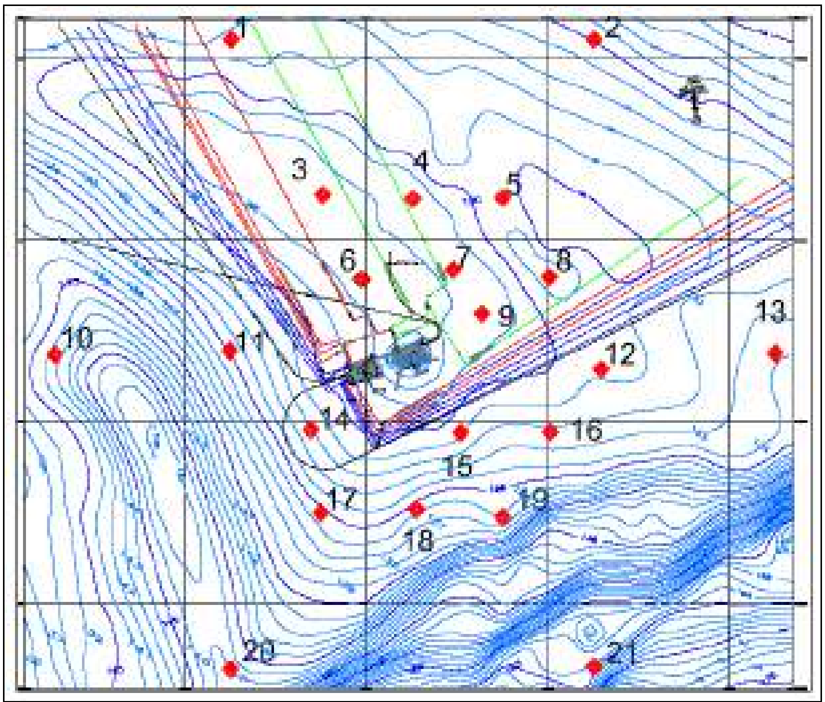
Table 6.8 Sediment data collected along proposed ACG FFD PWD pipeline route

Station	Mean diameter (µg)	Organic content (%w/w)	Silt/ clay (%w/w)	Sediment type (per Wentworth)	Sorting index
ACG-A	14	4.2	87.7	Fine-medium silt	Very poor
ACG-B	136	4.1	69.3	Medium silt/sand	Poor
ACG-C	177	3.5	32.2	Fine sand	Extremely poor
ACG-D	9	6.8	87.7	Fine silt	Moderate
ACG-W6	502	4.1	55.1	Medium silt/coarse sand	Poor
ACG-26	12	4.9	84.6	Fine silt	Poor

Note: Stations are as identified within Figure 6.25. Data in the table is derived from AmC, 2005c.

Sediment samples collected at 21 stations (Figure 6.26) in the 2003 Central Azeri survey are characterised by coarser material, most of which are shell fragments greater than 2 mm diameter, underlain by finer material (silt and clay). This is typical of sediment in the Ridge Crest province. The amount of coarser material tended to diminish at the deeper survey locations (mostly south and west). Organic content of the soil within the area ranged from 1.4 to 3.8 percent (Table 6.9).

Figure 6.26 Sampling pattern for Central Azeri post-drill survey (2003)



Note: Data in the figure is derived from AmC, 2004e. The figure includes existing and planned seabed infrastructure. Horizontal gridlines are every 500 m.

Table 6.9 Sediment data collected near the Central Azeri platforms (Figure 6.26)

Station	Mean diameter (µg)	Organic content (%w/w)	Silt/clay (%w/w)	Sediment type (per Wentworth)	Sorting index
1*	402	1.4	21.1	Medium sand	Extremely poor
2	467	3.8	33.7	Medium sand	Extremely poor
3*	521	2.2	19.3	Coarse sand	Extremely poor
4	432	2.8	43.1	Medium sand	Extremely poor
5	153	2.2	35.8	Fine sand	Extremely poor
6*	715	2.2	14.6	Coarse sand	Extremely poor
7	341	2.8	14.0	Medium sand	Extremely poor
8	331	1.9	20.8	Medium sand	Extremely poor
9	432	2.2	18.7	Medium sand	Extremely poor
10	153	2.0	19.2	Fine sand	Very poor
11	51	3.0	58.9	Medium silt	Extremely poor
12	450	2.8	16.2	Medium sand	Extremely poor
13	214	3.6	29.9	Fine sand	Extremely poor
14	174	2.6	45.9	Fine sand	Extremely poor
15	356	2.0	23.0	Medium sand	Extremely poor
16	611	1.9	18.3	Coarse sand	Extremely poor
17	436	2.1	22.9	Medium sand	Extremely poor
18	561	2.2	19.2	Coarse sand	Extremely poor
19	56	3.1	56.3	Coarse silt	Extremely poor
20	326	1.9	14.3	Medium sand	Extremely poor
21	55	3.3	46.9	Coarse silt	Extremely poor

Note: Data is derived from AmC, 2004e.
* Highlighted data indicates sediment-sampling location near pipeline route.

6.5.4 Offshore biological environment

6.5.4.1 Plankton

Plankton abundance varies significantly on a seasonal basis - a detailed description of this seasonality exists in the ACG FFD Phase 1 ESIA, Chapter 6. As discussed in Section 6.5.1.3, a seasonal thermocline develops each summer in Caspian waters as surface waters become warmed. This thermocline defines the lower limit of the environment in which plankton in the Caspian Sea thrives. Since the time of writing the ACG FFD Phase 1 and 2 ESIAs, additional phytoplankton surveys have been conducted in the ACG Contract Area (AmC, 2004d and 2005c).

Phytoplankton

A total of 31 species of phytoplankton were identified in the 2004 survey, 13 of which were observed throughout the ACG Contract Area. A total of 25 species were identified in the 2005 survey, 10 of which were observed throughout the Contract Area.

The most abundant species of phytoplankton observed in the 2004 survey were diatomic Eukaryotic algae (*Thalassionema nitzschioides* – 631 cells/l, *Pseudosolenia calcar-avis* – 465 cells/l, *Chaetoceros wighamii* – 256 cells/l), blue-green Prokaryotic algae (*Microcystis pulverea* – 201 colonies/l) and dinoflagellate Eukaryotic algae (*Prorocentrum scutellum* – 92 cells/l). The most abundant species of phytoplankton observed in the 2005 survey were diatomic Eukaryotic algae (*Pseudosolenia calcar-avis* – 639 cells/l, *Chaetoceros wighamii* – 336 cells/l), blue-green Prokaryotic algae (*Lynbya limnetica*) and dinoflagellate Eukaryotic algae (*Prorocentrum scutellum* – locally concentrated in the Shah Deniz gas field).

Zooplankton

The regional survey identified 27 zooplankton taxa, including 7 species of *Rotatoria*, 7 species of *Cladocera*, 1 *Copepoda* species (*Acartia tonsa*, adult and nauplii), 1 *Cirrepedia* species (*Balanus improvisus* or Bay Barnacle larvae), 1 *Ostracoda* species (*Cypredeis littoralis*), 4 species of *Mysida*, 2 species of amphipod crustacean, 1 species of cumacean crustacean (*Schizorhynchus bilamellatus*), 1 species of mollusc larva, 1 species of fish larva, and 1 species of fish (a pipefish, *Syngnathus nigrolineatus caspius*). The highest density of zooplankton in the Contract Area was approximately 3 mg of Carbon per cubic metre (mg C m^{-3}), roughly 10 percent of the phytoplankton mass.

The species most consistently present (and generally most abundant) were the:

- copepod *Acartia tonsa*
- cladoceran crustaceans *Pleopis polyphemoides* and *Polyphemus exiguous*
- ctenophore *Mnemiopsis leidyi*

Numerical dominance by *Acartia* in the copepod fauna has been noted previously as a characteristic of nearshore waters (Woodward Clyde, 1996).

The invasive comb jellyfish *Mnemiopsis leidyi* maintained a typical density of 2-4 individuals per cubic metre averaged over a 100 m depth, with the majority of individuals located in the upper 30 m depth (above the thermocline). It appeared at the time of the survey that their main prey was the *Acartia tonsa*, which retained an average of 51 individuals per cubic metre in sampled areas. However, jellyfish are a feeder that discriminates prey based on size (irrespective of species). Other species of similar size, the *Limnocalanus grimaldii*, *Calanipeda aquae dilcus*, and *Eurytemora grimmi* species, which had been previously observed in earlier ACG Contract Area surveys during the 1990s, were absent in 2004.

6.5.4.2 Benthic macrofauna

Analysis of benthic samples taken during the ACG Contract Area Regional Survey (Figure 6.25) regional survey identified 72 macrofaunal taxa, seven of which were juveniles of larger species. This richness was described as typical in the history of the ACG Contract Area, with the number of species roughly equivalent to previous surveys taken in the region (in the 1995-96 baseline survey, the overall number of species found was 67).

Several species of crustaceans (amphipods and cumaceans) and prosobranch molluscs were observed in the 2005 survey area. Polychaete and oligochaete worms were abundant in all survey locations, though only a few varieties were identified. Decapods (such as crabs or shrimp) were absent from the region, and bivalve molluscs (the mussel *Dreissena rostriformis*, *Dreissena grimmi*, and the clam *Abra ovata*) were represented by a moderately low number of individuals. Seed shrimp (*Ostracoda*), oligochaete worms (*Isochaetides michaelseni* and *Tubificidae* spp.), amphipod crustaceans (*Gammarus* spp.), cumacean crustaceans (*Schizorhynchus eudorelloides*), and polychaete worms (*Hypania invalida*) were among the most common species. All numerically dominant species observed in this survey are native to the Caspian Sea.

Four invasive species were identified in the ACG Contract Area: the Bay Barnacle *Balanus improvisus* (observed near survey location ACG-A), the clam *Abra ovata* (observed at a single location near the Central Azeri platforms), the mussel *Mytilaster lineatus* (observed at various locations near the Central Azeri platforms) and the bristleworm *Nereis diversicolor* (seen near some of the platforms within the ACG Contract Area).

6.5.4.3 Fish

The most recent seasonal survey in the Contract Area was performed in the vicinity of the Deep Water Gunashli platform in 1999-2001, within 20 km of the Central Azeri CWP platform. The results of this survey (see Table 6.10) were presented in the ACG FFD Phase 3 ESIA, but a brief summary will be presented here.

These surveys, the latest taken five years before this report, identified a total of 17 fish categories to species level or family. Of these, three species – sandsmelt (*Atherina mochon caspia*), vobla (*Rutilis rutilis kurensis*), and goby (*Neogobius fluviatilis pallasi*) – were sampled in significant numbers.

Migratory species were studied through literature reviews. Sturgeons, Caspian salmon (*Salmo trutta caspius*), Caspian lamprey (*Caspiomyzon wagneri*), and seashad have been known to occur within the Contract Area and pipeline route area as juveniles, and as they migrate to spawning streams. The spawning destinations include the Kura, Terek, and Samur rivers (which feed into the southwest and southern Caspian Sea) for salmon, and the Volga River (which feeds into the northern Caspian Sea) for sturgeon.

Resident and other species, other than the goby, include: the pipefish (*Syngnathus nigrolineatus*), which more frequently congregate nearshore (Kosarev and Yablonskaya, 1994); kilka (herring family), which are the most abundant in Caspian Sea fisheries (these feed on plankton and serve as prey for larger fish species); and mullet, which was introduced from the Black Sea in the 1930s, migrate to the northern Caspian in the spring, and spawn in deeper waters during the summer.

The closest fishery to the proposed project is Makarov Bank, which is approximately 115 km to the west of the Contract Area. However, it should be noted that fishing vessels from other Caspian littoral states have been observed fishing within the Contract Area.

Table 6.10 Catch data from Gunashli field sampling programme, 1999-2001

Fish Species	Years									
	1999				2000				2001	
	Apr	Aug	Oct	Dec	Apr	Aug	Oct	Dec	Apr	Aug
Anchovy kilka	192 /2-3	263 /2-3	23 /2-3	-	117 /2	44 /2	15 /2	-	11 /1-2	-
Bigeyed kilka	184 /2-3	190 /2-3	37 /2-3	22 /2	51 /2	48 /2	22 /1-2	14 /1-2	6 /1-2	-
Sandsmelt	16 /1-2	10 /1-2	-	21 /1-2	11 /1-2	9 /1-2	-	9 /1-2	8 /1-2	7 /1-2
Blackback shad	15 /3-4	26 /3-4	8 /3-4	-	6 /3-4	2 /3-4	-	-	-	-
Goby- *A. profundorum*	-	-	-	-	-	1 /3	-	-	-	-
Sturgeon	-	-	1 /12	2 /14-16	-	-	-	1 /14	-	-

Note: Data is derived from URS, 2004.
Numerator indicates number of individuals, denominator indicates estimated age.

6.5.4.4 The Caspian Seal

The Caspian seal (*Phoca caspica*) is listed by the IUCN as Vulnerable and is the only aquatic mammal in the study area. It is endemic to the Caspian and is the world's smallest species of seal with a lifespan of up to 50 years. The number of Caspian seals is not presently known. However, in 1987 there were estimated to be 360,000-400,000 individuals (Krylov, 1990).

Year-round Caspian seal haul-out sites on the Absheron Peninsula include the Shah-Dilli Spit, Zhiloy Island, and other nearby islands. The majority of the seal population (85-90 percent) migrates during the late autumn/winter to the northern Caspian where they breed until early spring. It is estimated that approximately 10-15 percent (40,000-60,000 individuals), mainly consisting of juveniles and other non-breeding individuals, remain in the middle and southern Caspian all year round. During the late spring (April-May), migratory individuals from the north begin to reach the feeding areas of the middle and southern Caspian. The migratory seals initially confine their feeding activities to the coastal waters while replenishing their fat reserves, depleted by up to 50 percent during the winter.

Once reserves have been replenished and buoyancy restored, the seals move into the deeper water areas of the middle and southern Caspian, returning periodically to their haul-out sites. In October-November the seals commence the return migration northwards.
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7 Socio-Economic Baseline

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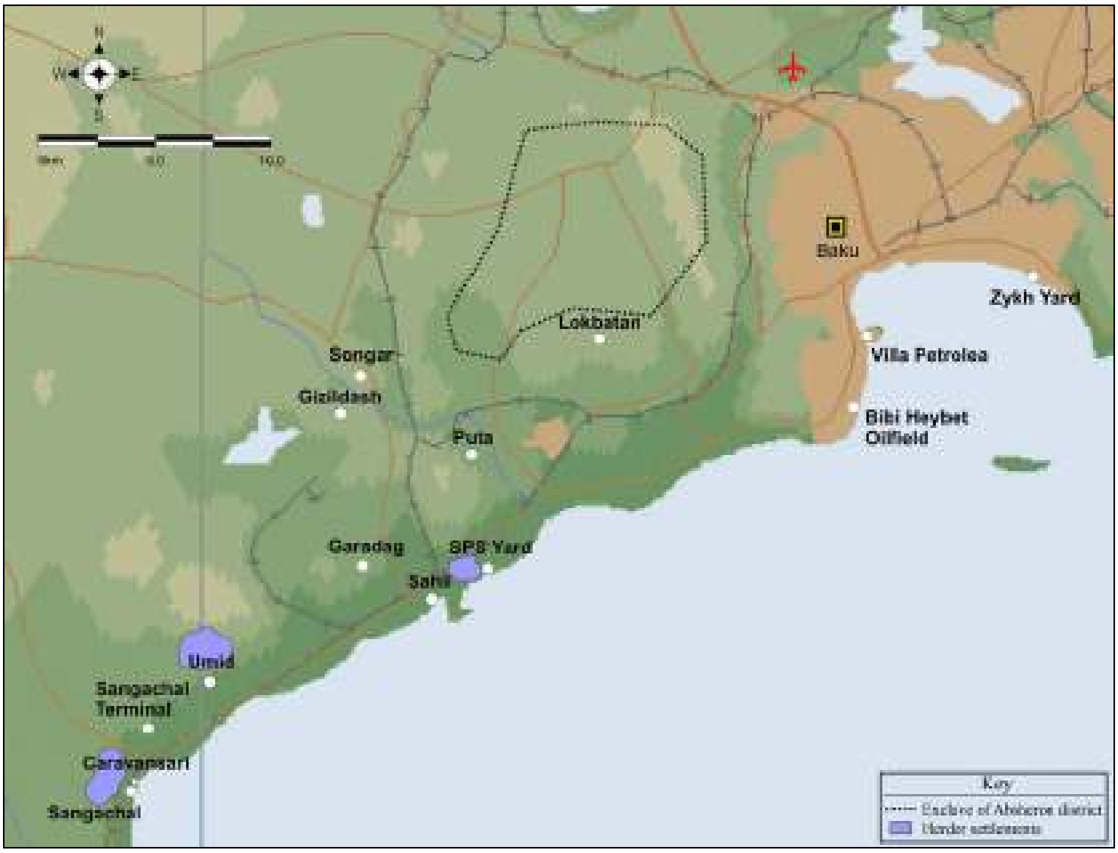
7.1 Introduction

The following section provides an overview of the socio-economic environment within which the Azeri, Chirag, and Gunashli (ACG) Full Field Development (FFD) Produced Water Disposal (PWD) project will be constructed and also operated. A detailed description of the socio-economic environment, together with updated demographic information for Sangachal and the surrounding regions of Sahil and Umid provided by the Garadag Executive Power (government of the Garadag District within the Sahar/Municipality of Baku) were described in Chapter 7 of the ACG FFD Phase 3 ESIA and so are not repeated here (URS, 2004).

The following subsections provide updated information from that presented in ACG FFD Phase 3 ESIA, with detail provided on the socio-economic conditions specific to the proposed PWD project area. The locations of places referred to in the text are shown in Figure 7.1.

Figure 7.1 Location map



Note: Data adapted from URS, 2004.

7.2 National data

7.2.1 Gross Domestic Product (GDP)

A country's gross domestic product (GDP) is one among several methods to measure the size of its economy. Equal to the total market value of all final goods and services produced in a country in a given year, the GDP represents the one-year total of consumer, investor, and government spending, plus the same year's difference between value of exports and the value of imports.

ACG FFD Phase 3 ESIA Chapter 7 provides details on Azerbaijan's GDP and proportion of production from each industry sector over the period 2001-2002. The key industries in Azerbaijan include oil and gas, steel, cement, chemicals, and textiles. In 2002, the oil sector accounted for 20 percent of GDP and over 50 percent of total industrial output, whilst agriculture accounted for approx 20 percent of production (UNDP, 2003).

The Asian Development Outlook (ADO), a component of the Asian Development Bank assessing economic trends and prospects in developing Asia, reports that the GDP of Azerbaijan increased by 10 percent in 2004. Progress in foreign capital investments in the oil and gas sector, namely the BTC oil pipeline, and the development of the ACG oil fields and the SD gas field, provided the stimulus for this overall increase. Industry grew overall by 12.2 percent, accounting for 62 percent of the GDP increase, with construction expanding by nearly 42 percent as a result of oil sector investments, a building boom in Baku, and foreign-funded infrastructure projects. Agriculture, whilst being an important employer (accounting for nearly 40 percent of total employment in the country, refer to Section 7.2.3) rose by only 4.6 percent, contributing only 5.9 percent to total GDP growth. Services expanded by 7.7 percent, reflecting mainly an upsurge in communications and trade (ADB, 2005).

The buoyant oil sector, triggered by high world oil prices, resulted in changes in Azerbaijan's balance of payments, with exports increasing by 31.5 percent. These exports represented an income of approximately $3.5 billion, or 40.5 percent of the GDP, and international reserves (including the oil fund) climbed by $284 million. Similarly, investment activities in the country led to a rapid 25.2 percent expansion of the level of imports at 40 percent of GDP in 2004, resulting in an approximate balance in the trade account (ADB, 2005).

7.2.2 Population and demographics

Data from the State Statistical Committee of Azerbaijan Republic (ASSC) provides revised country population data from that detailed in previous reports. These data for 2000-2005 are shown in Table 7.1, together with the age distribution shown in Table 7.2.

Table 7.1 Population data for Azerbaijan 2000-2005

Years	Total population, (1,000s)	Distribution		Percent of total population	
		Urban	Rural	Urban	Rural
2000	8016.2	4086.4	3929.8	51	49
2001	8081.0	4107.5	3973.5	50.8	49.2
2002	8141.4	4130.1	4011.3	50.7	49.3
2003	8202.5	4154.3	4048.2	50.7	49.3
2004	8265.7	4254.3	4011.4	51.5	48.5
2005	8347.3	4298.3	4049.0	51.5	48.5

Note: Data adapted from ASSC, 2005.

Table 7.2 Distribution of population by age groups 2003-2005

*Age group	Person (1,000s)			Percent (%)		
	2003	2004	2005	2003	2004	2005
All ages	**8202.5**	**8265.7**	**8347.3**	**100**	**100**	**100**
0-4	558.5	560.9	566.4	6.8	6.8	6.8
5-9	767.0	702.2	709.1	9.3	8.5	8.5
10-14	929.1	915.7	924.7	11.3	11.1	11.1
15-19	874.2	897.7	906.6	10.6	10.9	10.9
20-24	728.4	752.2	759.6	8.9	9.1	9.1
25-29	624.3	642.4	648.7	7.6	7.8	7.8
30-34	645.4	623.4	629.6	7.9	7.5	7.5
35-39	677.5	675.5	682.2	8.3	8.2	8.2
40-44	678.6	690.2	697.0	8.3	8.3	8.3
45-49	469,1	522.7	527.9	5.7	6.3	6.3
50-54	318,7	332.3	335.6	3.9	4.0	4.0
55-59	158.6	189.8	191.7	1.9	2.3	2.3
60-64	235.9	196.4	198.3	2.9	2.4	2.4
65-69	234.0	248.9	251.4	2.9	3.0	3.0
70 and over	303.2	315.4	318.5	3.7	3.8	3.8

Note: Data adapted from ASSC, 2005. Age recorded at beginning of each year.

Population growth appears constant with the population increasing to nearly 8.4 million in 2005. As can be seen from Table 7.1, the distribution of the population is reported to be 51.5 percent in urban areas and 48.5 in rural areas.

7.2.3 Employment and income

ASSC reports employment figures by the number of the economically active population (Table 7.3) and by industry sector (Table 7.4). Unemployment statistics for Azerbaijan show only approximately 56,000 unemployed in 2004 from an available workforce of 5.3 million in 2004. This represents approximately 1.5 percent of the working population in 2004 (Table 7.3). However, this figure includes only individuals who registered for unemployment assistance. The ASSC carried out a labour force survey in 2003 (following international standards) that showed instead that unemployment was at 10.7 percent, with the urban rate double that of rural areas (14.0 percent versus 7.0 percent, respectively). Women suffered higher unemployment rates than men (12.2 percent versus 9.6 percent, respectively, ADB, 2005).

Table 7.3 Number of economic active population 2000 to 2004

Parameter	2000	2001	2002	2003	2004
*Population at working age (1,000s)	3,748.2	3,763.4	3,777.5	3,801.4	3,820.1
Registered unemployed persons	43,739 (1.2%)	48,446 (1.3%)	50,963 (1.4%)	54,365 (1.4%)	55,945 (1.5%)
Of which: male	19,283 (44%)	21,808 (45%)	23,088 (45%)	25,313 (47%)	26,669 (48%)
: female	24,456 (56%)	26,638 (55%)	27,875 (55%)	29052 (53%)	29276 (52%)

Note: Data adapted from ASSC, 2005. Year 2005 data unavailable.
*Male at age 15-61, Female at age 15-56

Table 7.4 Employment by kinds of economic activities 2000-2004 (1000 persons)

Industry Sector	2000	2001	2002	2003	2004*	% Total
Employment total	**3,704.5**	**3,715.0**	**3,726.5**	**3,747.0**	**3,764.2**	**100**
Agriculture, hunting, and forestry	1,517.2	1,482.0	1,495.0	1,497.0	1,498.5	39.8
Fishing	2.0	2.3	2.5	2.8	2.9	0.1
Mining and quarrying	39.6	42.1	42.2	42.3	42.4	1.1
Manufacturing	169.3	163.9	169.5	169.9	170.1	4.5
Electricity, gas, and water supply	40.5	41.0	39.9	39.8	39.9	1.1
Construction	153.6	155.0	178.0	180.0	185.1	4.9
Wholesale and retail trade; repair of motor vehicles, motorcycles, and personal and household goods	626.1	659.5	611.9	618.3	611.4	16.3
Hotels and restaurants	9.8	11.0	11.3	11.8	15.7	0.4
Transport, storage, and communications	167.0	167.5	169.8	178.5	186.9	5.0
Financial intermediation	13.5	13	13.2	13	13.1	0.3
Real estate, renting, and business activities	98.0	97.0	97.2	97.5	95.6	2.5
Public administration and defence; compulsory social security	257.7	267.3	265.3	265	263.4	7.0
Education	317.9	318.0	329.9	330	330.1	8.8
Health and social work	168.9	170.0	173.6	173.8	173.5	4.6
Other community, social, and personal service activities	123.2	125.0	126.7	126.8	135.0	3.6
Extra-territorial organizations and bodies	0.2	0.4	0.5	0.5	0.6	0

Note: Data adapted from ASSC, 2005. Year 2005 data unavailable.
*Number of employed in 2004 was 3,764,200 of which 1,971,400 persons were men, 1,792,800 women.

Income levels per person in 2004 are portioned according to industry sectors in Table 7.5. These figures show the average income is highest for workers in the mining sector (approximately $500/month) and lowest for workers in the agriculture, hunting, and forestry sectors ($32/month).

Table 7.5 Average monthly nominal wages 2004

Name of kinds of activities	Average monthly nominal wages (in 1000 manats)[1]		
	Total	of which	
		state	non-state
Employment total	483.4	318.6	894.8
Agriculture, hunting, and forestry	146.5	143.1	153.5
Fishing	170.5	179.6	99.1
Mining and quarrying	2,254.6	845.3	7,823.1
Manufacturing	494.2	451.4	558.9
Electricity, gas, and water supply	434.9	392.9	818.3
Construction	1,084.3	507.0	1,717.8
Wholesale, retail trade, and repairs	578.6	291.4	590.3
Hotels and restaurants	554.4	221.3	669.1
Transport, storage, and communications	565.8	542.1	745.1
Financial intermediation	1,082.9	584.9	1,421.8
Real estate, renting, business activities	1,038.1	340.5	3,237.1
Public administration and defence; compulsory social security	433.5	557.6	150.3
Education	255.1	253.2	423.2
Health and social work	148.1	135.0	715.5
Other community, social, and personal service activities	216.4	203.1	336.2

Note: Data adapted from ASSC, 2005. Data for January to December 2004. Year 2005 data unavailable.
[1]Exchange rate at the time of writing was 4,550 Azerbaijan old manats (AZM) = US$1. The new (*yeni*) manat (AYM) introduced at the start of 2006, equal to 5,000 AZM, does not apply to this table.

7.2.4 Poverty

In 2001, the State Statistical Committee of the Azerbaijan Republic introduced a Households Budget Survey. Using an absolute poverty line of 120,000 AZM per capita per month ($24 at the exchange rate at that time) it was estimated that 49 percent of the population was living in poverty. The survey also showed that:

- Poverty is greatest in urban areas;
- One quarter of the total Azerbaijan poor population lives in Baku;
- Larger households (families) have a greater risk of being impoverished than small households;
- Children have a slightly higher poverty risk than the elderly;
- Households where the head has refugee or internally displaced person (IDP) status are more likely to be poor; and
- Employment is one of the most important ways of protecting households from poverty.

The Azerbaijani government adopted a Poverty Reduction and Development Plan in October 2002. The programme focuses on poverty reduction, increased growth in the non-oil sector, the reduction of corruption, continued monitoring of monetary policy, governance measures, and improved expenditure control.

The Government's Strategy identified the need to target social benefits for the most vulnerable groups, for example children, women, the elderly, the disabled, refugees, and IDPs. It is designed to mitigate the short-term impacts of new public utility policies (e.g., increasing the collection of utility payments and reducing energy subsidies). Sector working groups have tackled issues related to economic development, poverty monitoring, fiscal policy, monetary and exchange rate policy, social benefits, investment policy, the education and health sectors, IDPs and refugees, the energy sector, juridical reform, agriculture, environmental safety and tourism, sport, and culture.

According to figures from the 2002 household budget survey, approximately half of the population was found to be living in poverty with a poverty line of AZM 175,000 ($36). Assuming no cost of living increase and using this poverty line, 2003 data show that over 45 percent of the population was still living in poverty (ASSC, 2006).

Table 7.6 Distribution of monthly average per capita incomes in 2003

*Monthly average income per capita (1000 AZM)	Number of persons (1000s)	Percent (%)
50-80	46.1	0.6
80-100	149.8	1.8
100-110	192.4	2.3
110-120	261.6	3.2
120-130	349.9	4.2
130-140	431.9	5.2
140-150	569.9	6.9
150-160	560.6	6.8
160-180 (poverty line)	1192.1	14.5
180-200	1071.6	13.0
200-240	1597.4	19.4
240-280	904.9	11.0
280-320	416.2	5.1
320-360	207.1	2.5
360-400	104.3	1.3
400-440	59.9	0.7
440-480	46.2	0.6
480-520	23.3	0.3
520-550	13.3	0.2
550-600	16.2	0.2
600+	19.5	0.2
Total	**8234.1**	**100**

Note: Data adapted from ASSC 2005. Year 2004 and 2005 data unavailable.
*Income comprises wages and state social payments (unemployment, pensions).
Exchange rate at the time of writing was 4550 AZM = US$1

7.3 Regional data

The regional-level government entity in proximity to the ACG FFD PWD project (and Sangachal Terminal) is the Garadag District of the Sahar/Municipality of Baku. Detailed information on the population size, ethnic composition, employment, education, and health is provided in the ACG FFD Phase 3 ESIA, Chapter 7 for the following areas:

- Sangachal town;
- Umid IDP/cement workers camp; and
- Sahil town.

The most recent published data available from ASSC is derived from statistical analyses of 2004 data. The data presented on the areas of Sangachal, Umid, and Sahil in the ACG FFD Phase 3 ESIA (URS, 2004) was compiled using this data, through consultation and interviews with the Garadag District Executive Power (URS, 2004a). As this is the most recent available information, it is not repeated within this ESIA.

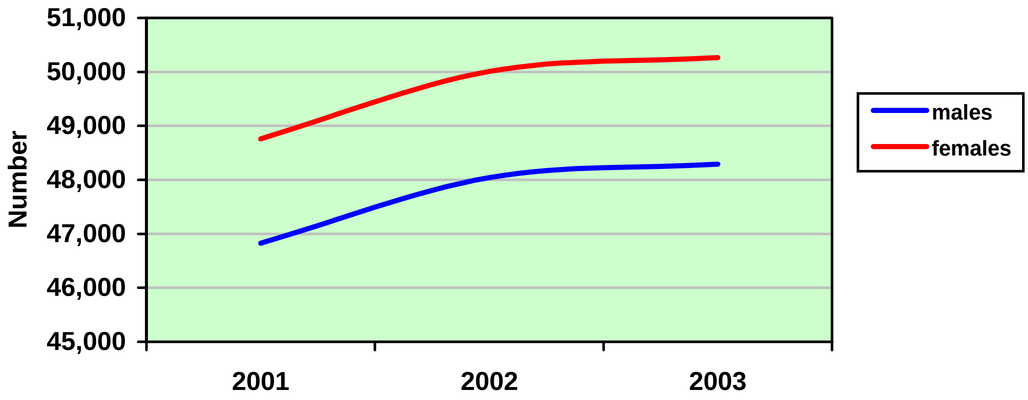
7.3.1 Economic activity

Since 2001 there has been significant levels of activity in the region as a result of the construction associated with ACG FFD Phases 1, 2, and 3 projects and Shah Deniz Stage 1. In particular, construction has been taking place at Sangachal Terminal and the SPS fabrication yard. Additional oil sector investment has been provided the local communities near these facilities through Community Investment Programmes that are being implemented in association with the construction activities. This investment has resulted in a number of community improvement projects being implemented in the area, e.g., community centres, schools, education, etc.

7.3.2 Population

Discussions in 2004 with Garadag Executive Power indicated that 98,555 people were officially registered in the District in 2003. This is in comparison to the 95,586 that were registered in 2001 and indicates a 3.1 percent increase in population levels in the district between 2001 and 2003. Whilst the increase in work in the region may have been believed to be a contributing factor with people moving to the area, the majority of jobs offered by the BP projects were for males (due to the physical nature of the work). Looking at the regional demographic data over the period 2001-2003, the percentage split between males and females shows a consistent 49 percent (male) and 51 percent (female) proportion (Figure 7.2). In addition, the age profile has stayed relatively stable over recent years, with the main regional growth sectors in the 0-4, 10-14, and 35-39 brackets (URS, 2004). Ethnicity of the population was also observed to be constant; the majority of the population in the District were practicing Muslims, with only a small minority, approximately 7.4 percent, practicing Christians (URS, 2004). This supports the conclusion that demographic trends are not caused by domestic migration from surrounding areas by people with different ethnicities seeking work opportunities, but rather are attributed to young people staying in the area and starting families, taking advantage of the increased financial investment in the area.

Figure 7.2 Population of Garadag District 2001 – 2003



Note: Data adapted from URS, 2004.

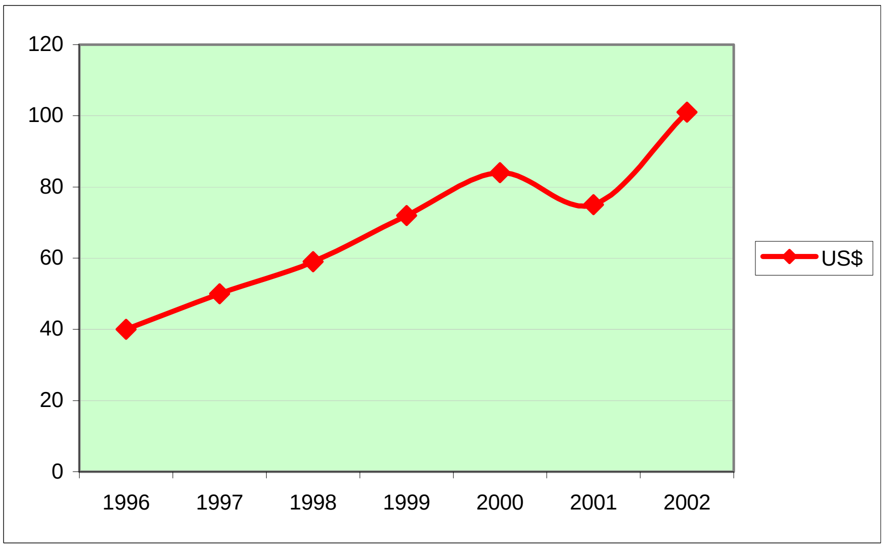
7.3.3 Employment and income

According to the Garadag Executive Power, unemployment in the region has dropped considerably since 2001. Unemployment was approximately 53.8 percent in 2001, 10.1 percent in 2002 and 6.4 percent in 2003[11]. This represents a dramatic change since 2001, and the Executive Power believes that employment associated with the construction works at Sangachal Terminal and the local fabrication yards is an influencing factor in the improved overall employment picture within the region, particularly within Sahil.

The main economic activities in the region revolve around industry, oil and gas, and trade sectors. The expansion of Sangachal Terminal and activities at the SPS yard are viewed as key reasons for the economic development occurring in the area since 2001. Alongside this, a portion of the local community are involved in independent economic activity such as fishing, agriculture, and cattle breeding.

Income levels in Garadag District between 1996 and 2002 are detailed in Figure 7.3. As illustrated, the average monthly salary in the district increased by 154 percent between 1996 and 2002.

Figure 7.3 Average monthly salary, Garadag District 1996 – 2002



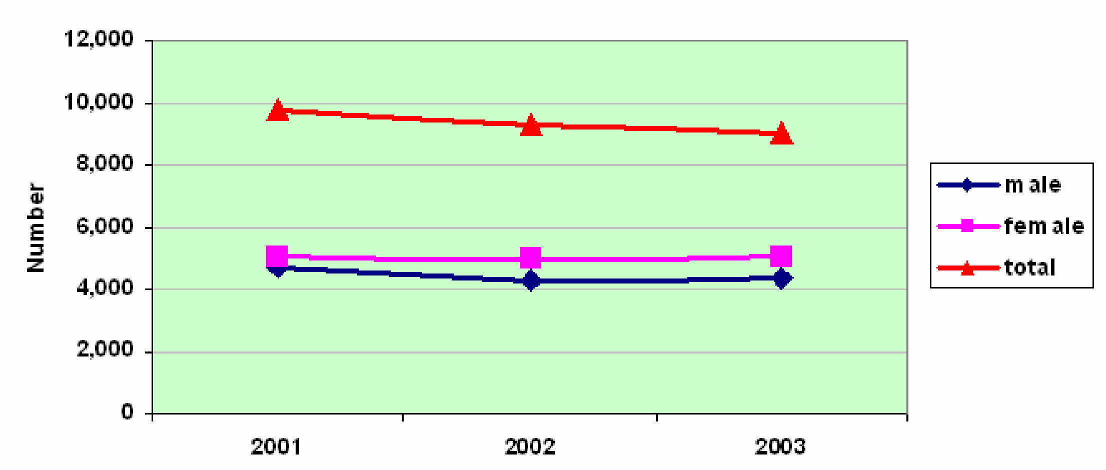
Note: Data adapted from URS, 2004. Year 2003-5 data unavailable.

Discussions with representatives of Garadag Executive Power believe that the quality of life for people in the district has improved in the last few years. They believe this change is in part linked to the increased employment opportunities through the construction activities on BP/Azerbaijan International Operating Company (AIOC) projects in the region bringing increased income levels in households, thus helping improve the quality of life for many adults since 2001. At the same time the Executive Power believe that the quality of life for children in the region has also increased, assisted through better educational and sporting facilities that have been developed through BP/AIOC led community development projects, e.g., new sports grounds, school and library upgrades, computer courses, etc.

7.3.4 Internally Displaced People (IDPs)

The total numbers of IDPs within Garadag District between 2001 and 2003 are detailed in Figure 7.4. The IDPs in the District are located mostly in Lokbatan, Sahil, Gizildash, Sangachal Settlement, and Umid Settlement. Just over 20 percent of the IDPs in the District are from Armenia and the remaining 80 percent are IDPs from Fizuli, Agdam, Zengilan, Gubadli, Kelbejer, Jebrayil, and Lachin districts; Shusa, Khojavend, and Khojali cities; and villages of the Nagorno-Karabakh region (URS, 2004).

Figure 7.4 Gender distribution of IDPs – Garadag Region 2001 to 2003



Note: Data adapted from URS, 2004. Year 2003-5 data unavailable.

The majority of the IDPs in Garadag arrived between 1993 and 1994, although a small number still continue to arrive to date. Most live in government-provided shelters, although an unknown number do rent property privately. Despite approximately 50 percent of the male IDP population in the region being employed as manual labourers, unemployment is still viewed as one of the key problems for IDPs, alongside a lack of housing (Garadag Executive Power 2003).

7.4 Infrastructure relevant to the ACG FFD PWD project

As discussed in Chapter 5, the ACG FFD PWD project incorporates onshore works through the installation of the PWD pipeline from Sangachal Terminal to the landfall at Sangachal Bay, and offshore from the landfall to the Central Azeri (CA) and Deep Water Gunashli fields in the ACG Contract Area. This section describes the infrastructure in these areas.

7.4.1 Onshore infrastructure

The onshore pipeline route between Sangachal Terminal and the Salyan Highway is in an existing Right Of Way (ROW) and a designated exclusion zone. Within this area, the infrastructure that the PWD pipeline will cross comprises a railway line, third-party utility lines, and pipelines. Where operational, these utility lines provide electricity, communications, oil, gas and water services (Table 7.7).

Table 7.7 Utility lines of Garadag District that ACG FFD PWD pipeline will cross

Description	Owner/User
Communication Cable (flooded)	SOCAR Onshore Oil and Gas Production Association's Communication Department
Communication Cable (not in working order)	Baku Telephone Network Production Association
Communication Cable (1), Oil pipelines (2)	SOCAR MOLPU
Communication Cable	Unidentified
Communication Cable (2 cables)	Technical Unit of Cable Trunks
Gas pipeline (5 lines, 1 cut)	CJSS AZERIGAS
Gas pipeline (1), Condensate Line (1)	SOCAR Bulla offshore gas pipeline
Water Pipeline (5 lines, 1 abandoned)	Apsheron Water Company
Water Pipeline	SOCAR Amirov Oil and Gas Production Department (O&GPD)
High Voltage Overhead Line (HVOHL)	Azerbaijan Railways
High Voltage Overhead Line (HVOHL) (4 lines)	AZENERGI JSC (Joint Stock Company)
Unidentified pipelines (3 lines)	Unidentified

Note: Data adapted from URS, 2004.

The Baku-Alyat electric railway, owned and operated by Azerbaijan Railways, runs parallel to the Salyan Highway and is one of the main transportation corridors for Azerbaijan, running to the Georgian and Iranian borders, and towards Armenian administered districts (the latter railroad line ceasing operation in 1993).

The Salyan Highway runs parallel to Sangachal Bay forming a main access route from Baku to the village of Boyuk Kesik (Agstafa District) at the Republic of Georgia border (a distance of 510 km) and south from Baku to the city of Astara at the Iranian border (a distance of 313 km). The majority of the highway is in good condition providing a total of three asphalt-covered lanes that carry two-way traffic.

7.4.2 Offshore infrastructure

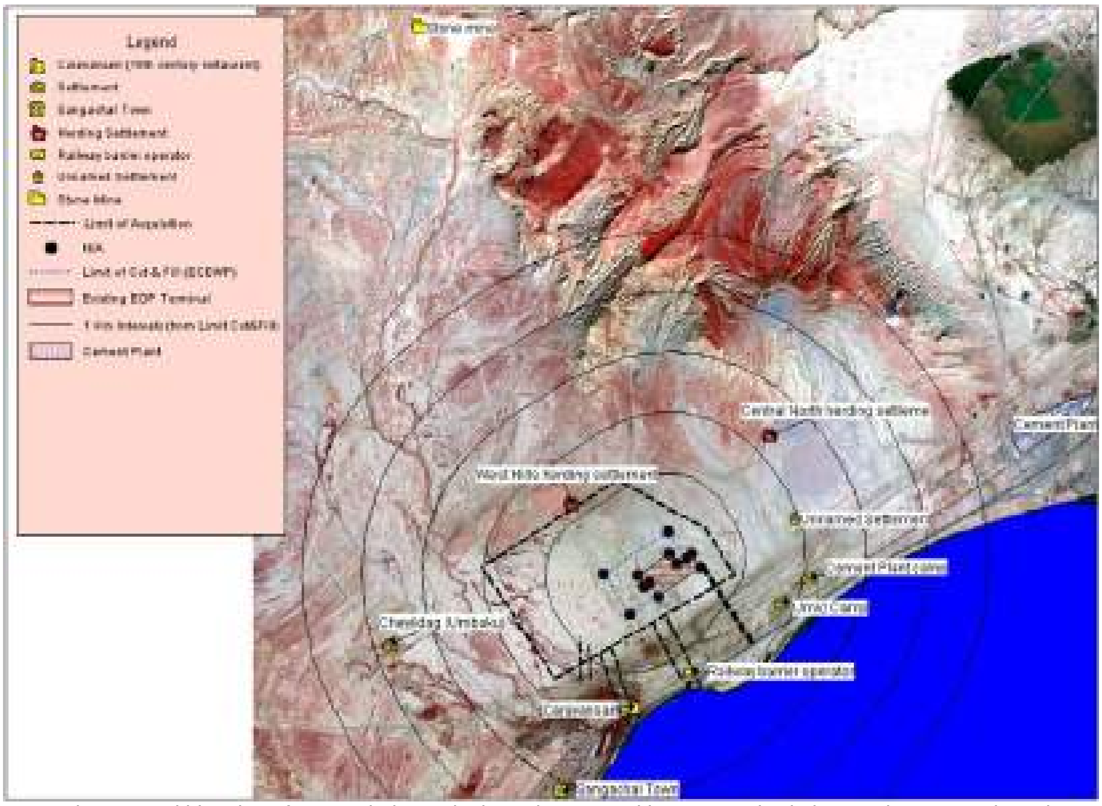
Offshore infrastructure in the vicinity of the proposed ACG FFD PWD pipeline consists of the oil and gas pipelines installed as part of the ACG FFD and SD Projects. In addition, a number of seabed obstructions and the offshore Sangachal and March 8th oilfields are located to the south of the proposed landfall site. The locations of these in relation to the proposed ACG

FFD PWD pipeline route (which follows the Early Oil Project, or EOP, pipeline) are shown in Figure 7.7.

7.5 Socio-economic receptors in the vicinity of project

A number of nearby sensitive socio-economic receptors were identified near the terrestrial and coastal segments of the proposed ACG FFD PWD pipeline (Figure 7.5). A majority of these are located in proximity to the coast, with some receptors located inland of the Sangachal Terminal area.

Figure 7.5 Location of project area and nearby sensitive receptors



Note: Distances within 5 km of Sangachal Terminal are demarcated by concentric circles, each representing 1 km radius from the Terminal boundary (URS, 2004).

7.6 Socio-economic activity relevant to the ACG FFD PWD project

The following Section provides an overview of industry sectors relevant to the ACG FFD PWD project. For the proposed pipeline installation, these comprise rail and road transportation, shipping, and fishing activity.

7.6.1 Rail transportation

The maximum carrying capacity[14] of the Baku-Alyat railroad amounts to 109 million tonnes per annum, or up to 180 trains (roughly 35 cars each, URS 2005) in each direction every day. The railroad is, however, significantly under-utilised. In total, the Baku-Alyat section of the railroad transportation load in 1997 was approximately 4 million tonnes, or 9 trains in each direction daily. These data are, however, outdated and it is expected that the number of trains today is higher; the railroad has been undergoing repairs for the last two years.

7.6.2 Road traffic

The Salyan Highway carries two-thirds of all road freight through Azerbaijan. Passenger traffic along the Salyan Highway in 1999, the most recent year in which traffic data is available, amounted to 40,000 persons travelling from Baku and 35,000 going to Baku per day (URS, 2004). It can be expected that this has since increased with the onset of fabrication and construction activities associated with the ACG FFD projects.

7.6.3 Shipping

Shipping activities in Azerbaijan waters include commercial trade, passenger and vehicular ferry transport, military, scientific and research operations, and service and supply operations to the offshore oil and gas industry. Merchant shipping levels have varied in the last decade, with a substantial increase seen in recent years due to the offshore oil and gas projects, particularly those of AIOC.

Azerbaijan has four main ports (IMO 2006):

- Baku deepwater platform plant (off the SPS fabrication yard, 18 km west-southwest of the city centre).
- Baku International Sea Trade Port. A deepwater port which supports cargo, ferry, passenger, container and Oil Terminal support vessels (directly adjacent to the city centre).
- Canubtikintiservice Baku: A port predominantly for the construction of floating platforms (5 km south of the city centre).
- Specialized Sea Oil Fleet Base. A port servicing the vessels required for support of the offshore oil industry (just south of the Old City of Baku).

In addition to these, a number of smaller ports operate, primarily in support of the fishing industry.

The State Maritime Administration governs vessel activity in Azerbaijan; the AzPetrol Terminal does not have the power of a port authority to regulate tanker operations as they approach the terminal. Two registered shipping lanes pass in proximity to the proposed pipeline landfall location. These are shipping lanes N24 from Primorsk, and N35 from the AzPetrol Terminal. In addition to the shipping lanes, a number of prohibited areas are located in Sangachal Bay due to tanker movements to and from the AzPetrol terminal. The locations of these shipping lanes and prohibited areas are shown in Figure 7.7, and their coordinates are detailed in Table 7.8.

Table 7.8 Shipping route coordinates near pipeline landfall location

Number	Latitude	Longitude	Easting	Northing
1	40°07'47"	49°30'00"	372147	4445090
2	40°07'47"	49°30'00"	372667	4445088
3	40°12'00"	49°40'00"	386471	4452888

A quantitative risk analysis (QRA) performed for shipping hazards found that the only vessels of concern with a routine need to cross the pipeline route in Sangachal Bay were tankers operated by the Caspian Shipping Company (CSC) servicing the AzPetrol Terminal south of the pipeline landfall (Table 7.9 – EPCONSULT, 2005). These tankers typically come from Aktau, Kazakhstan, and after passing close to the tip of the Absheron Peninsula, navigate through normal shipping lanes to Baku Bay. From there, they approach Primorsk Harbor on the north end of the terminal before following a BP-recommended course into the AzPetrol Terminal.

Table 7.9 Characteristics of CSC tankers visiting the AzPetrol Terminal

Type/class [3]	Qty. in fleet	Vessel age (years)[4]	Dead-weight (tonne)[1]	Gross tonne [2]	Est. cargo (tonne)	Length overall (m)	Beam (m)	Draught laden (m)	Draught in ballast (m)	Speed (kt)
President Haydar Aliyev	2	2	13,470	7,833	12,000	149.9	17.3	8.20 [5]	2.5	12.00
Kafur Mamedov	3	32-34	12,334	8,621	11,525	150.0	17.4	8.00	2.5	13.75
Professor Aziz Aliyev	2	3	8,062	5,143	7,970	141.0	16.9	5.09	1.5	11.00
Apsheron	7	17-24	7,410	5,944	6,772	147.0	17.4	5.30	1.5	13.33
General Shikhinsky	20	17-39	5,387	4,136	4,600	125.6	16.3	4.43	3.0	12.30

Note: Data is derived from EPCONSULT, 2005.

1 Deadweight denotes the weight of the cargo, bunker, and movable equipment the vessel is capable of carrying.

2 Gross tonnes denote the entire internal cubic capacity of the ship (except certain exempted spaces) expressed in tonnes (100 cubic feet = 1 tonne). This value is really a measure of volume rather than mass, and it is an important vessel characteristic used in the shipping industry for calculation of pilot, harbour, and canal fees. As such, it is the most common means used to describe the size of a ship and available casualty data for gross tonnage categories.

3 Dimensions and capacities applied to a particular class of vessel may be marginally different for specific vessels within the class.

4 The age of vessels are based on 2006 estimates derived from data taken from the Fairplay Encyclopaedia of World Shipping (EPCONSULT, 2005).

5 The draught for the President Heydar Aliyev class is an estimate. AzPetrol Terminal maintains a dock depth of 9 m, which is suitable for vessels of up to 8.2 m draught, assuming a standard allowance of 10 percent for under-keel clearance. Based on this, a laden draught of 8.2 m has been assumed for this class of vessel.

The quantity of ships that are expected at the AzPetrol Terminal bringing in crude from Kazakhstan are expected to increase to a maximum of 1,200 arrivals a year in 2007 (roughly 3-4 times a day). This figure was based on the increasing capacity of the AzPetrol Terminal (which tripled its berths to 6 in the past two years), the time it takes for shipping to cross the 540 nm round trip distance to Aktau, an estimate of 12 hours for discharge and loading, and downtime for maintenance, weather, and terminal logistics (Table 7.10).

Table 7.10 Estimated visits per year to AzPetrol Terminal by each tanker type

Vessel type (class)	Quantity of vessels	Cargo per vessel (tonnes)	Assumed number of trips per vessel-year	Total number of vessel visits per year	Total cargo transported (million tonnes per year)
President Heydar Aliyev	2	12,000	100	200	2.40
Kafur Mamedov	3	11,525	100	300	3.46
Professor Aziz Aliyev	2	7,600	100	200	1.52
Apsheron	7	5,955	34	238	1.42
General Shikhinsky	20	4,600	13.1	262	1.20
Total	**34**			**1,200**	**10.0**

Note: Data is derived from EPCONSULT, 2005.

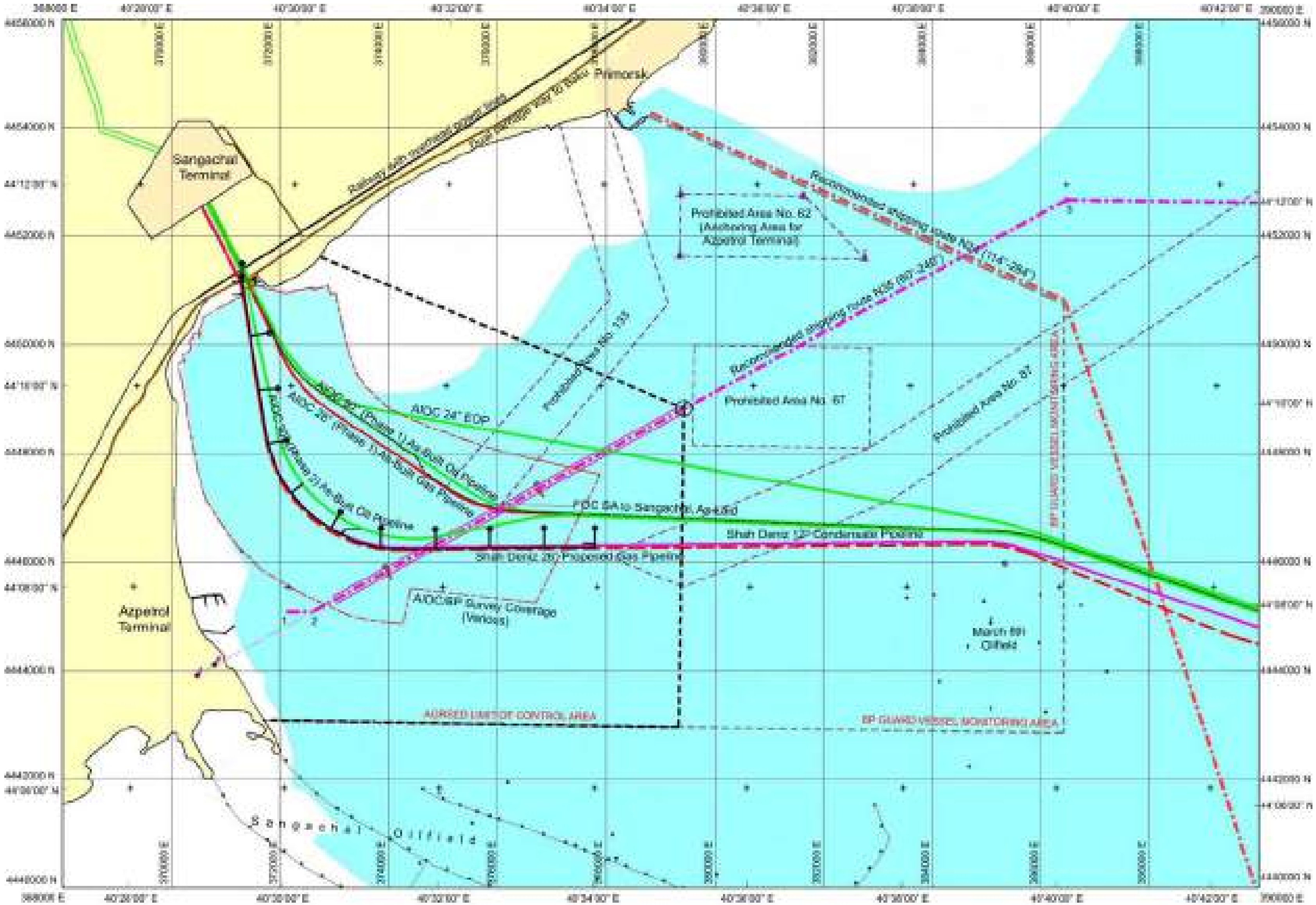
It is possible that older tankers (such as the Kafur Mamedov class and General Shikhinsky class) may be phased out of service over the life of the project. Worldwide, the average duration of a vessel service life is 21 years; the oldest CSC vessels in service have been in operation for more than 150 percent of this average. Further, a BP audit of CSC vessels revealed generally poor standards of maintenance and operation when compared with modern European standards, indicating that breakdowns of the older ships are likely to increase and the service life is likely to diminish as vessel cost of operation increases. It is expected that the Kafur Mamedov class ships and the older General Shikhinsky class vessels will be replaced with new President Heydar Aliyev class vessels in the foreseeable future (EPCONSULT, 2005).

Figure 7.6 Newly constructed President Heydar Aliyev class tanker

Note: Data is derived from EPCONSULT, 2005.

Other vessel traffic within Sangachal Bay was analysed in the same QRA for shipping hazards. On occasion, vessels may anchor off of Primorsk Harbour northeast of the pipeline landfall in order to service the SPS fabrication yard and other industrial clients in the area; these ships have been known to anchor near the pipelines either out of ignorance or indifference (EPCONSULT, 2005).

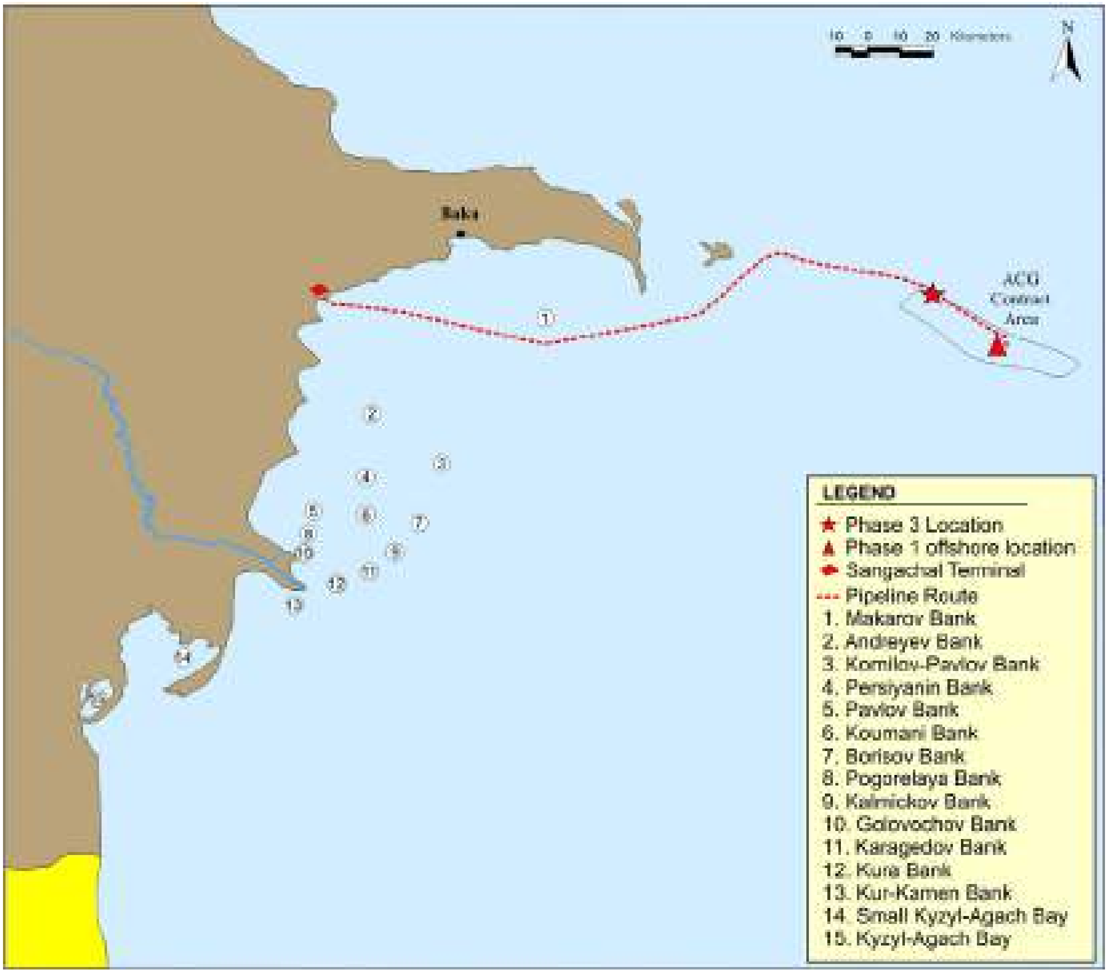
Figure 7.7 Infrastructure and control areas in Sangachal Bay (Numbers 1-3 referring to shipping lane coordinates as detailed in Table 7.8)



7.6.4 Fishing

The Caspian Sea is an important fishing area, with fishing representing 1 percent of Azerbaijan GDP. The main fishing activities involve commercial catches of sturgeon, sprat, carp, darters, gobies, herring, salmon and mullet (URS, 2004). There are a number of fishing grounds in the vicinity of Sangachal Bay, as shown in Figure 7.8. Whilst only one of these is located in the vicinity of the proposed ACG FFD PWD pipeline route, there is potential for fishing vessels to be present in the vicinity of the PWD pipeline as they journey to and from these areas.

Figure 7.8 Fishing grounds in the vicinity of the ACG FFD PWD pipeline



Since the advent of independence among the littoral states, Caspian fish stocks have fallen substantially. The industry today is in decline, not only as a result of falling stocks, but also disrupted export routes and markets, and inadequate supplies of materials for processing and packaging. It is widely considered that the primary reason for the reduction in fish stocks within the Caspian is a lack of regulation and control of the fishing industry, which has lead to increased illegal and excessive fishing. Another contributing factor is contamination.

The most recent information about Sangachal Bay fishing activity was identified within a recent risk assessment produced to identify hazards associated with shipping. The study noted that bottom trawling did not take place within Sangachal Bay, but maps from the same study did identify navigational hazards that prevented nearshore surveying, which included stationary fish traps and nets (EPCONSULT, 2005). However, the quantity and type of catch was not identified.

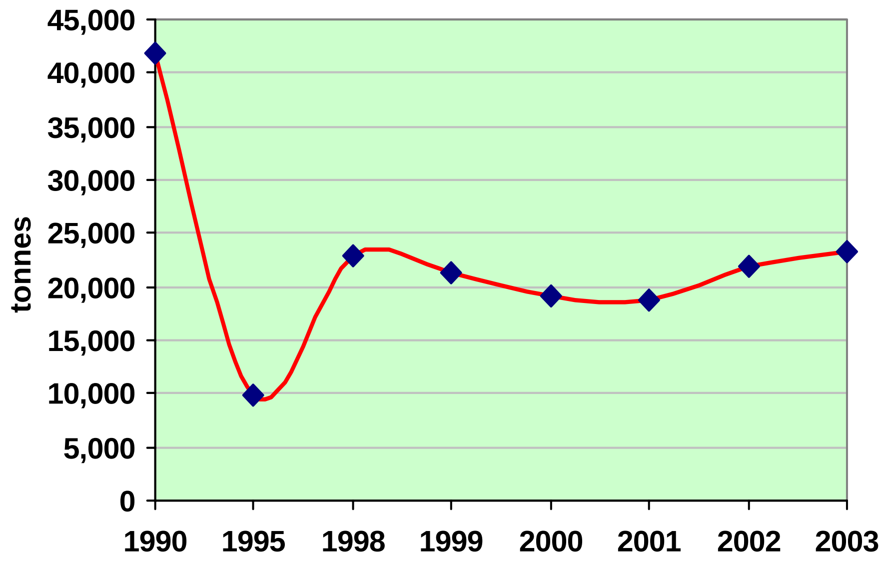
Figure 7.9 provides details of the number of fishing enterprises in Azerbaijan (2000-2004) and the recorded fish catch in Azerbaijan from available data between 1990 and 2003. These figures however are unlikely to reflect the actual numbers of fish caught, as has been highlighted through inspection checks. It is estimated that legally caught fish amount to only 30 percent of the total catch (URS, 2004).

Table 7.11 Number of registered fishing enterprises

Year	No. registered enterprises	Ownership	
		State/municipality	Private
2000	65	28	37
2001	68	28	40
2002	70	26	44
2003	71	27	44 (1 joint owned)
2004	79	27	52 (1 joint owned)

Note: Data adapted from ASSC, 2006.

Figure 7.9 Fish catch in Azerbaijan 1990 –2003



Note: Data adapted from URS, 2004.

In the Garadag District, fishing is relatively limited with activities concentrated around the settlements of Elet, Sangachal, and Lokbatan. It is estimated that approximately 25-30 people are employed in the fishing industry in the area between Baku and Gobustan, the majority of whom are employed at a fish hatchery at Sahil. Salaries in the fishing sector are determined on a quota basis and the fishermen are allowed to keep a portion of their catch as an additional income source. Specifically fishing activities in the region can be summarised as:

- Fish Hatchery - The only authorised commercial fishing in Sangachal Bay supports a nearby fish hatchery, which is operated by the Azerbaijan Ministry of Environment and Natural Resources, or MENR (formerly operated by the Azerbalyk State Fisheries Concern). Since 1976, the hatchery has bred salmon and white sturgeon fry, with the goal of releasing them into the Caspian. The farm is also involved in salmon and white sturgeon fishing along the coastline up to the town of Alyat, with most of the fishing done using nets spaced every few hundred metres. Occasionally boats and fishing platforms are used. The fish found in this area include sturgeon, salmon, herring, carp, and mullet.

- Sander Fishing - The area used to be a significant source for sanders, with 7-10 tonnes of sanders being produced annually. However in recent years the level of sanders has drastically reduced and there are now none. Whilst offshore developments have been blamed for this loss, the role of uncontrolled fishing and the use of banned fishing equipment is also recognised as having contributed to the decline. The majority of the fishing grounds are based in and around the coast areas of Neftchilar District.
- Non-Commercial Fishing – The majority of fishing in Sangachal Bay are both recreational and subsistence rather than for commercial purpose. Rod fishing is the only type of fishing allowed for leisure purposes and nets are banned. Fishing takes place primarily on weekends either from the jetty in Sangachal Bay built for the EOP, or from the fishing platforms that are situated slightly further out into the sea. There are six platforms, which are in a state of disrepair, but provide a useful position from which to fish.
- Unregulated fishing – The number of fishermen involved, their domicile, the size of fish catches, and composition and the contribution of the catch to their livelihoods and incomes is not known accurately. It is possible that they may number between 150-200 in total (URS, 2004).

Offshore fishing vessels typically target the catch kilka species. The fish are caught using a combination of lights and nets to attract the sprats. Historically, between 140-150 boats were active fishing for sprats, but this level has now decreased to approximately 100 boats and the fleet is in the process of restructuring. The main fishing ports are Baku port, Neftchala, Lenkoran, and Siyazan (URS, 2004).

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8 Consultation and Disclosure

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Figures

8.1 Introduction

The Azeri, Chirag, and Gunashli (ACG) Full Field Development (FFD) Produced Water Disposal (PWD) project is an extension of an existing work programme for ACG; a work programme that has already undertaken extensive consultation during Phase 1, 2, and 3. As a result, consultation for the ACG FFD PWD project was able to build on this existing framework of consultation, while at the same time, drawing on the lessons learnt during this process. Undertaking the consultation process for the ACG FFD PWD project in this manner allowed it to be highly effective in communicating both information about the development and receiving feedback from stakeholders.

8.2 ACG consultation and disclosure process

8.2.1 Overview

The approach adopted for the consultation programme for the ACG FFD PWD project had the following characteristics:

- It made use of the existing framework of consultation and infrastructure established earlier in FFD and other BP projects in Azerbaijan, e.g., Shah Deniz (SD) and used for consultation and disclosure during the earlier phases of the ACG project.
- It was developed with reference to accepted international guidance on expectations of Environment and Socio-economic Impact Assessment (ESIA) consultation and disclosure.
- It considered the extent of consultation and disclosure already undertaken in recent years and thus was sensitive to stakeholder fatigue from continued consultation on different Phases of the project.
- It incorporated recommendations made from a 'Lessons Learned' review of earlier consultations.

Consultation with the Azerbaijan Ministry of Ecology and Natural Resources (MENR) and key stakeholders occurred throughout the ESIA process. However, early consultation meetings with Non-Government Organisations (NGOs), and local scientists took place during the assessment of different options for PWD (as discussed in Chapter 4) to obtain their views on the environmental and socio-economic aspects of these options. Consultation with these parties continued after selection of the project option when a detailed, informed, and comprehensive presentation of the proposed activities could be made, inviting further questions and comments (Section 3.4).

In accordance with the procedure established during ACG FFD Phase 3 in response to requests from scientific and NGOs participants, these groups were invited to a workshop consultation session midway through the ESIA. This was intended to report on the status of the project definition since Scoping and promote discussion and the exchange of ideas on key project aspects (Section 3.4).

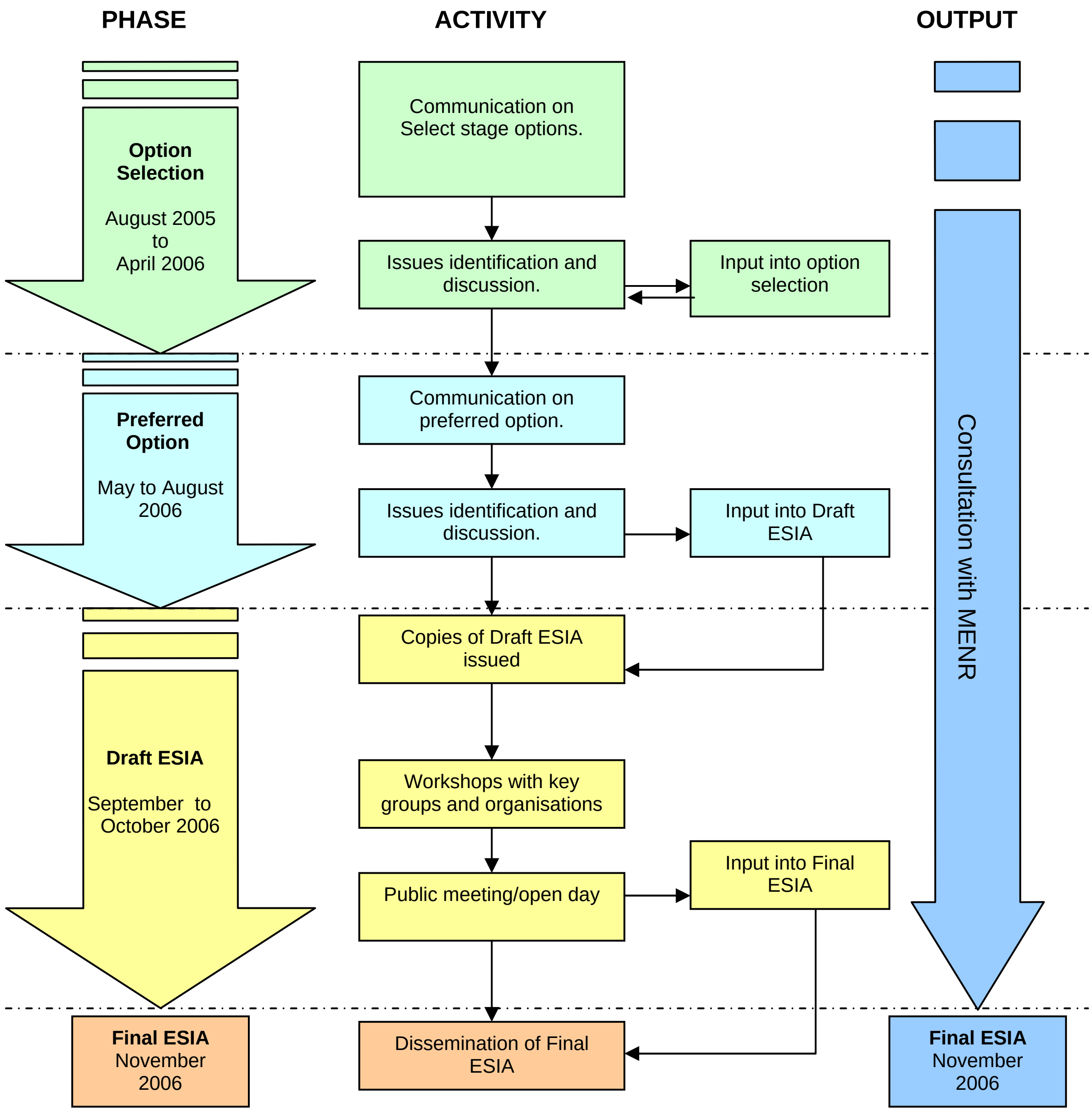
Full details of the consultation and disclosure process undergone during the Produced Water Disposal pipeline project ESIA are contained within the ACG FFD PWD project Public Consultation and Disclosure Plan (PCDP), located within the BP website at http://www.bp.com/subsection.do?categoryId=9006656&contentId=7013370. The ACG FFD PWD project PCDP was initially drafted during the option selection phase of the ESIA to ensure adequate consultation was conducted by the project with relevant stakeholder groups.

Figure 8.1 summarises the consultation and disclosure process for the ACG FFD PWD project from option assessment to final ESIA delivery. This identifies 3 phases of consultation held with various stakeholder groups to discuss the following:

- Option Selection; Consultation on Select stage options (Chapter 4)
- Preferred Option; Consultation on preferred option selected (Chapter 5)
- Draft ESIA; Consultation on final ESIA document

The final outputs from each phase of stakeholder consultation contributed to the development of the preparation of the ESIA report. This chapter goes on to provide a summary of the level of communication at each phase of engagement including stakeholders involved and comments raised specific to the preferred project option.

Figure 8.1 The ACG FFD PWD project consultation and disclosure programme



8.3 Option selection consultation and disclosure

During the option selection stage of the ACG FFD PWD project, the SELECT stage project options (identified in Chapter 4) were discussed with various stakeholder groups. These meetings allowed for early stakeholders engagement in the project selection and evaluation process. In addition any stakeholder concerns relating to the options identified could be alleviated by open discussion.

Full details of the consultation and disclosure meetings, including minutes, questions and BP responses are included as appendices to the ACG FFD PWD project PCDP, a plan developed to coordinate and track project stakeholder engagement.

The following subsections summarise the stakeholder groups that have been engaged during the option selection consultation.

8.3.1 Azerbaijan Ministry of Ecology and Natural Resources (MENR)

Senior technical and management members from the ACG FFD PWD project have conducted a number of formal consultation sessions with key representatives from the Azerbaijan MENR to communicate project progress, provide updates on option selection, and gain official feedback on the project.

Monthly consultation meetings were held during the option selection stage of the project from August 2005, culminating in the acceptance of the offshore pipeline option for offshore reinjection of Produced Water in April 2006. Following this meeting, the MENR identified that further monthly meetings on the ACG FFD PWD project would not be required unless there were any major project options changes prior to ESIA disclosure (Section 8.4).

8.3.2 Produced Water Working Group (PWWG)

The Produced Water Working Group (PWWG) was established in April 2005 and is comprised of authorized representatives from the State Oil Company of Azerbaijan Republic (SOCAR), the Azerbaijan MENR, and the Caspian Complex Ecological Monitoring Administration (CCEMA). It aims to provide experienced feedback and input into the project.

The PWWG was updated on project progress through monthly project reports between June 2005 and April 2006. In addition this group has been engaged by consultation meetings with the ACG FFD PWD project to provide a productive environment to discuss the challenges of the project and the option selection in the form of collaborative sessions, promoting the free exchange of ideas and pursuit of solutions in the long-term management of Produced Water.

During the option selection process, three formal engagement sessions were held during 2005 on August 9, September 20, and December 7, between the ACG FFD PWD project team and the PWWG.

8.3.3 Research and Monitoring Group (R&MG)

The Research and Monitoring Group (R&MG) was established in 1995 in accordance with the ACG Production Sharing Agreement (PSA). Currently this group comprises a number of respected senior level representatives from the Azerbaijan International Operating Company (AIOC) and BP, Shah Deniz (SD), SOCAR, the Azerbaijan MENR, the GiproMorNefteGaz Institute, and the Azerbaijan National Academy of Sciences.

The ACG FFD PWD project members met with members of the R&MG on the morning of December 8, 2005, to discuss project options and the selection process. Following this meeting the project responded through written follow-up to requests from group members for further clarification of project information. In addition the project made a formal work request for the group to review and comment on the Environmental Risk Assessment (ERA) conducted for the biological treatment option (Section 4.5.3). While this option was not selected for the ACG FFD PWD project, option analyses of the studies undertaken are valuable to provide a review on the quality of this work.

8.3.4 National scientists

The ACG FFD PWD project members met with members of the Azerbaijan national scientific community on the afternoon of December 8, 2005, to discuss project options and the selection process. Following the formal presentation from project representatives the group were invited to informal table discussions on specific project options, lead by each of the project representatives. The allowed for those interested in specific options to ask more detailed technical questions on the project options discussed.

8.3.5 Non-Governmental Organisations (NGOs)

The ACG FFD PWD project members met with members of Azerbaijani Non-Governmental Organisations (NGOs) on the morning of December 9, 2005, to discuss project options and the selection process. This group was also provided with a press release summarising the details of the options that would be discussed. In addition comments forms were made available to complete should the any member of the group wish to request additional information.

8.4 Preferred option consultation and disclosure

The questions raised during the option selection consultation meetings showed that concerns existed around all options with the exception of the installation of a dedicated PWD pipeline to transport Produced Water from Sangachal Terminal to the offshore platforms for reinjection offshore. In all meetings stakeholders expressed a preference for the selection of the pipeline option as the best environmental option.

The project held a preferred option consultation meeting with the PWWG on the afternoon of April 25, 2006. This included a technical presentation from project representatives providing an overview of defined engineering scope, Health, Safety, and Environment (HSE) deliveries and project schedule. Following this meeting the group identified that further monthly reporting on the ACG FFD PWD project during the preparation of the draft ESIA would not be required unless there were any major project options changes prior to ESIA disclosure.

8.5 Draft ESIA consultation and disclosure

Following completion of the Draft ESIA an internal and partner review was completed to check technical details. Following this the draft document was made available for comment and discussion at a variety of venues and locations within the 60-day consultation period from August to September 2006. Copies of the Draft ESIA were made available at:

- The BP website (http://www.bp.com/subsection.do?categoryId=9006656&contentId=7013370);
- Information centres at Sangachal, Umid, and ATA fabrication yard;
- The Enterprise Centre, Baku;
- BP Villa Petrolea reception, Baku;
- Sangachal Terminal; and
- OSCE Environmental Information Centre at the Azerbaijan MENR.

Full details of those involved in the consultation and disclosure of the Draft ESIA are contained in the ACG FFD PWD project PCDP, including minutes of these meetings. During the ESIA drafting meetings/workshops were held with:

- MENR on 10th October 2006;
- AIOC R&MG on 17th October 2006;
- Azerbaijani NGOs on 19th October 2006;
- Azerbaijani scientific community on 20th October 2006; and
- the general public on 20th October 2006.

These consultation sessions presented each stakeholder group with the technical details of the preferred project option and welcomed questions should further clarification be required. Feedback from attendees was considered in completing the ESIA process and finalising the ESIA report for submission to MENR.

Comments received on the Draft ESIA were collated and analysed using a standard reporting template to record comments from all stakeholders and the AIOC responses provided. A list of meetings held is provided within the ACG FFD PWD project PCDP. Questions raised and the responses provided are summarized in the PCDP.

8.6 Final ESIA consultation and disclosure

Copies of the Final ESIA Report will be made available at:

- The BP website;
- Information centres at Sangachal, Umid, and ATA fabrication yard;
- The Enterprise Centre, Baku;
- BP Villa Petrolea reception, Baku;
- Sangachal Terminal; and
- Organisation for Security and Cooperation in Europe (OSCE) Environmental Information Centre at MENR.

8.7 Post-ESIA project consultations

Following the issue of the Final ACG FFD PWD project ESIA there may be a need to continue consultation and disclosure during the construction stages of the PWD pipeline, in agreement with the PDCP. Should this be required, there is already a well-established consultation and disclosure process provided in the Sangachal Terminal Expansion Programme (STEP) and it is proposed that this is used as the basis for consultation and disclosure during the construction period of the PWD pipeline, while bearing in mind the differences in geographical scope specific to that pipeline.

When the development enters its operations phase the consultation will be revisited to check that it is effective and appropriate.

8.8 Consultation under the Espoo Convention

As discussed in Section 2 Legislation, Azerbaijan is a signatory to the Espoo Convention (the UNECE Convention on Environmental Impact Assessment in a Transboundary Context, established in Espoo, Finland, in 1991). This requires the Azerbaijan Government to provide initial notification to countries that may be subject to transboundary environmental impacts as a result of a development within Azerbaijan. Scoping identified potential for transboundary impacts related to PWD pipeline development in the event of a major environmental disaster (e.g., pipeline rupture).

AIOC has formally informed the Azerbaijan Government of the PWD pipeline project ESIA via provision of the ESIA Scoping documentation for the project. Additionally, through the Caspian Environmental Programme (CEP) initiative, AIOC informally shared information on the PWD pipeline project with the littoral states, bordering the Caspian Sea, to facilitate participation in the ESIA process where requested. At the time of writing, AIOC has not been made aware of any responses from littoral states indicating a desire to participate in the ESIA process.

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9 Environmental and Social Impact Assessment

Contents

Figures

Tables

9.1 Introduction

This Chapter identifies and assesses the potential environmental and socio-economic impacts associated with the Azeri, Chirag, and Gunashli (ACG) Full Field Development (FFD) Produced Water Disposal (PWD) Project. The impact assessment methodology followed is described in Chapter 3. The assessment considers the project according to a number of project phases as identified in Table 9.1 and described in the following subsections.

Table 9.1 Impact assessment section references

Project Phases	Sub-Section Reference
International equipment and pipeline fabrication, procurement, and transportation	**9.3.1**
Sangachal Terminal ACG FFD PWD project facilities	**9.3.2**
PWD pipeline installation, commissioning, and operation	**9.3.3**
Offshore facilities hook-up and commissioning (HUC) and operation	**9.3.4**

9.2 Impact assessment steps

As discussed in Chapter 3, the following steps were undertaken in the assessment:

9.2.1 Identification of project activities and aspects

Routine, planned non-routine, and unplanned or accidental activities of the ACG FFD PWD Project were identified, and the potential environmental and socio-economic aspects[1] associated with these activities were discussed with project engineers through the Environmental Issues Identification (ENVIID) workshops.

9.2.2 Impact assessment

For each activity and aspect, potential impacts[2] were identified, and the effect of mitigation measures established through the design process and/or mitigation workshops were then taken into account. These measures comprise either specific design components or operational management procedures intended to eliminate or reduce the potential for impacts from the identified activities.

Cumulative impacts were also assessed. These are defined as the potential for ACG FFD PWD Project activities to contribute to an accumulation of activities from all Azerbaijan International Operating Company (AIOC) projects in the region, resulting in an accumulation of aspects such as noise, air emissions, and wastes. The assessment of potential cumulative impacts considered those that may result from the combined or incremental effects of past, present, or future activities on environmental or socio-economic receptors.

The potential for unplanned or accidental events to occur during the different stages of the ACG FFD PWD Project has also been assessed in terms of probability of occurrence and the resulting consequence of these accidents. Accidental events can occur as a result of a number of factors, such as human error, technical failure, natural events (e.g., seismic activities), or a combination of these. As with the assessment of routine events, the impact assessment process for unplanned or accidental events considered mitigation measures already in place for the project to reduce the probability of these accidents occurring, as well as management measures designed to reduce the environmental or socio-economic impacts should an event occur. By assessing the probability and consequence in this way, an

[1] Environmental aspect defined as "*An element of an organisation's activities, products, or services that can interact with the environment*", Environmental Management Standard ISO 14001.

[2] Environmental impact defined as "*Any change to the biophysical environment, positive or negative, that wholly or partially results from a project activity or associated process*", Environmental Management Standard ISO 14001.

assessment of risk was allocated to each unplanned or accidental event (as described in Chapter 3).

9.2.3 Residual impact significance

Residual impacts are defined as those remaining after consideration of established mitigation and management measures. Where the potential for residual impacts was identified, these were assessed and their significance ranked, as described in Chapter 3. Key comments and feedback from the stakeholders through consultation between AIOC and these groups during the Environmental and Socio-economic Impact Assessment (ESIA) process for the ACG FFD PWD Project (Section 8) as well as experience from issues raised during ACG FFD Phases 1, 2, and 3 were also included in the impact assessment process.

Where the residual impact was found to be of low significance, no further mitigation measures were considered necessary, unless the impact had been raised as being of concern during consultation (including previous consultation for ACG FFD Phases 1, 2, or 3). For these perceived impacts as well as those identified as being of medium or higher significance, discussion is provided and where necessary additional management measures are identified in the Mitigation and Monitoring chapter of this ESIA (Chapter 10).

9.3 ACG FFD PWD Project impact assessment results

The ACG FFD PWD Project represents the latest project in a phased development of the ACG Contract Area. As such, mitigation and management measures have been developed during these earlier phases and improved based on actual experience, as these projects have passed from construction, installation and commissioning into operation. This system of continual improvement based on actual experience has resulted in the improved reduction of impacts associated with each of the ACG FFD Phases and their effective management.

The ACG FFD PWD Project incorporates activities also conducted during the earlier ACG FFD projects, such as pipeline fabrication and installation, pipeline testing and commissioning. As such, the system of environmental and social management Contractor Control Plans (CCPs) and Contractor Implementation Plans and Procedures (CIPPs), developed during ACG Phase 1 and enhanced through subsequent phases, represent the key mitigation measures with which to avoid or reduce impacts that may occur during the ACG FFD PWD Project. Details of the CCPs and CIPPs are discussed in the ACG FFD Phase 3 ESIA Chapter 11 and are not repeated here. The role of the CCPs and CIPPs within the ACG FFD PWD Project is discussed in Chapter 10.

Consideration of the mitigation and management measures from ACG FFD Phases 1, 2, and 3 in the impact assessment process for the ACG FFD PWD Project shows that the majority of proposed activities are not deemed to present significant impacts under routine conditions.

Matrices showing activity/receptor interactions and the quantitative results of the environmental and social impact assessment are provided in Appendix IV. This includes routine activities and unplanned or accidental events.

The key elements of these matrices specific to each stage of the project have been summarised in separate tables for the environmental and socio-economic impact assessments and are included in the following sub-sections. As discussed above, each section provides a discussion of the significant findings, identifying any residual issues that need to be addressed. Impacts are categorised as Low (L), Medium (M), High (H) and Critical (C), as defined in Chapter 3 Methodology.

9.3.1 International equipment and pipeline procurement, fabrication, and transportation

The results of the environmental and socio-economic impact assessment of routine and planned non-routine activities associated with the international equipment and pipeline fabrication and transportation concluded that only environmental impacts of low residual significance would result from the activities. Despite the low significance ranking this exercise identified, a number of issues have been raised previously during consultation in previous Phases of ACG FFD and these are discussed in the following sub-sections.

Table 9.2 details the environmental, socio-economic, and unplanned/accidental impacts identified for the international equipment and pipeline fabrication and transportation.

Table 9.2 Summary of impact assessment for international equipment and pipeline fabrication, procurement, and transportation

9.2a Environmental impacts

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
INTERNATIONAL PLANT/EQUIPMENT PROCUREMENT, FABRICATION AND TRANSPORTATION								
E1	Manufacture/ Fabrication	• Wastes • Resource Use	• Contamination potential Demand on infrastructure/depletion of resources	• Plant/equipment will be fabricated out of country so there will be little in-country disturbance • Procurement and Supply Chain Management Plan	-	L	• Plant/equipment will be fabricated out-of-country	None
E2	Vessel transportation of pipe lengths (Japan, Brazil, Italy) to Varna (Mediterranean/Black) and Sangachal Terminal equipment to Azerbaijan	• Canal transportation and discharge of ballast water • Atmospheric emissions • Discharges (ballast, bilge, sewage)	• Risk of introduced species • Deterioration of air quality • Contamination potential	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Marine Management Plan • Ballast water management plan • Bilge water, sewage water standards and control (MARPOL) • Waste implementation planning and procedures	▲	L	• Localised impacts that are not readily dispersed. • Ballasting operations will be in compliance with IMO guidance	Ballast water raised in previous ACG Phases (Section 9.3.1.2)
E3	Rail transportation of pipe lengths and Sangachal Terminal equipment to Baku	• Atmospheric emissions • Noise	• Deterioration of air quality	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • CCPs/CIPPs	▲	L	• Low contribution to overall air emissions from the project	None
E4	Vehicle transportation of pipe lengths and Sangachal Terminal equipment within Azerbaijan	• As E3	• As E3	• As E3	▲	L	• Transportation will be direct to the laydown areas to reduce multiple trips	Atmospheric emissions raised in previous ACG Phases (Section 9.3.1.3)

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
E5	Laydown/storage location in Azerbaijan (EUPEC)	• Waste	• Contamination potential	• CCPs/CIPPs • Laydown within existing industrial sites (EUPEC and Sangachal Terminal) • Use of existing established waste collection points (CWAA), transportation routes and disposal sites	▲	L	• Laydown will be in close proximity to the site where the equipment is required to reduce disturbance (with all laydown within the existing terminal facility boundary) • Existing terminal facility - waste reception facilities present onsite	None
E6	Pipeline coating (concrete coating)	• Waste • Atmospheric emissions	• Contamination potential • Deterioration of air quality	• CCPs/CIPPs • BP approved site, used for all previous phases of ACG FFD • Use of existing established waste collection points (CWAA), transportation routes and disposal sites	▲	L	• Existing terminal facility - waste reception facilities present onsite	None
E7	Supply support vessel refuelling, waste transfer (EUPEC)	• Atmospheric emissions • Sewage discharges • Bilge water discharges	• Deterioration of air quality • Contamination potential	• CCPs/CIPPs/Marine Management Plan • Liaison with Baku Port authority • Sewage - ship to shore • PLBG diesel generators, support vessels engines - MARPOL standards (sulphur content) • Bilge water to shore • Existing vessel supply base and onshore waste reception facilities used	▲	L	• Use of existing vessel supply base • Low contribution to overall atmospheric emissions • Short duration with small numbers of vessels	None

9.2b Socio-economic impacts

ID	Activity	Aspects	Social Impacts	Existing Socio-economic Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
INTERNATIONAL PLANT/EQUIPMENT FABRICATION AND TRANSPORTATION TO AZERBAIJAN								
S1	Procurement of materials	• Employment, training	• Positive national income generation	• CCPs/CIPPs • Procurement and Supply Chain Management	▲	L	• Positive: Large quantities of goods and services will be purchased within Azerbaijan.	Maximising national income generation (Section 9.3.1.1)
S2	Mobilisation of workforce	• Indirect employment	• As S1	• CCPs/CIPPs • Extension of existing contracts established for prior Phases of ACG FFD	▲	L	• Positive: An extension of construction activities leading to extended employment for existing employees	Employment raised during previous ACG Phases (Section 9.3.1.4)
S3	Vessel transportation of pipe lengths (Japan, Brazil, Italy) to Varna (Mediterranean/ Black Sea) and Sangachal Terminal equipment to Azerbaijan	• Physical presence • Noise • Emissions	• Interference/disturbance to other users	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Marine Management Plan • Bilge water, sewage water standards and control (MARPOL) • Waste implementation planning and procedures	-	L	• Environmental mitigation will ensure air quality not affected detrimentally • Liaison with Port Authorities	None
S4	Rail transportation of pipe lengths and Sangachal Terminal equipment to Baku	• Rail usage	• Increased demand on overburdened infrastructure	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) Liaison with Azerbaijan Rail Authority Liaison with AzerTrans (cargo transportation authority)	-	L	• Use of existing rail network (with sufficient capacity)	Load sizing and management (Section 9.3.1.2)
S5	Vehicle transportation of pipe lengths and Sangachal Terminal	• Vehicle use • Physical presence	• Increased demand on road infrastructure	• Logistics and Supply Management Plan (from earlier ACG FFD Phases)	-	L	• Environmental mitigation will ensure air quality not affected	Atmospheric emissions raised in previous ACG

ID	Activity	Aspects	Social Impacts	Existing Socio-economic Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
	equipment within Azerbaijan	• Noise Emissions	• Interference/disturbance to other users • Deterioration of air quality	• Large/oversized loads will be scheduled to avoid periods of heavy congestion (Transportation Management Plan) • Liaison with Municipal Authorities			detrimentally • Transportation routes are well established and the loads are not oversized.	Phases (Section 9.3.1.3)
S6	Supply support vessel refuelling, waste transfer (EUPEC)	• Vessel use • Physical presence • Noise • Emissions	• Interference/disturbance to other users • Deterioration of air quality	• CCPs/CIPPs/Marine Management Plan • Liaison with Baku Port authority • Existing vessel supply base and onshore waste reception facilities used	-	L	• As S3 • Use of existing vessel supply base	None

9.2c Unplanned/accidental events impacts

ID	Activity	Aspects	Accidental Impacts	Existing Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
INTERNATIONAL PLANT/EQUIPMENT FABRICATION AND TRANSPORTATION TO AZERBAIJAN								
A1	Vessel transportation of pipe lengths (Japan, Brazil, Italy) to Varna (Mediterranean/Black) and Sangachal Terminal equipment to Azerbaijan	• Vessel accident and: - Spill - Fire - Explosion	• Contamination potential	• CCPs/CIPPs • Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Marine Management Plan • Oil Spill Contingency Plan (OSCP)	-	L	• Low probability and significance due to controls in place	None
A2	Rail transportation of pipe lengths and Sangachal Terminal equipment to Baku	• Rail accident and: - Spill - Fire - Explosion	• Contamination potential	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Liaison with Azerbaijan Rail Authority • Liaison with AzerTrans (cargo transportation authority)	-	L	• Low probability and significance due to controls in place	None
A3	Vehicle transportation of pipe lengths and Sangachal Terminal equipment within Azerbaijan	• Vehicle accident and: - Spill - Fire - Explosion	• Contamination potential	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Transportation Management Plan • Liaison with Municipal Authorities • OSCP	-	L	• Low probability and significance due to controls in place	None
A4	Supply support vessel refuelling, waste transfer (EUPEC)	• As A1	• Contamination potential	• As A1 • Liaison with Baku Port authority	-	L	• As A1	None

9.3.1.1 International procurement and fabrication

The ACG FFD PWD Project fabrication programme will be carried out at national yards that operate to international standards. The programme will also use the lessons learned from ACG FFD Phase 1, 2, and 3 to assist in the effective management of procurement activities with the equipment being bought internationally only where it cannot be sourced within Azerbaijan to the same technical specifications and cost.

The ACG FFD PWD Project will need to procure a variety of goods and services during the construction phase. The total estimated cost of procuring and constructing the PWD Project is $300-400 million. It is not possible at present to provide the in-country and out-of-country spending allocation for construction work before the Project obtains approval and enters into the contracting strategy. Nevertheless, in fulfilment of the commitment of AIOC/BP to maximise the procurement of goods from Azerbaijani companies when all technical and other requirements are met, the ACG FFD PWD Project will adopt the following measures developed for earlier Phases of the ACG FFD:

- Use of established local yards such as ShelProjectStroi (SPS) for national fabrication, storage, and supply base requirements;
- Contractual requirements on contracted companies to source goods and materials locally;
- Continued use of the skills and experience of Azerbaijani based companies gained during earlier phases of the ACG FFD;
- Development of a procurement strategy for sourcing goods and services for the project; and
- Continued support to local businesses through the above measures and also through the use of the Business Enterprise Centre in Baku.

As a result of the current effective management, the ACG FFD PWD Project international procurement and fabrication programme will result in only low environmental and social impacts however; positive social impacts will result from incountry project spending resulting in increased income for national businesses, companies and suppliers.

9.3.1.2 International transportation

ACG FFD PWD Project components will be transported to Azerbaijan through international waters and via rail networks.

From lessons learned during ACG FFD Phases 1, 2, and 3, there was concern over the possibility of international shipping to lead to the introduction of non-native marine species to the Caspian via ballast and bilge waters, engine cooling waters, and through hull and anchor fouling. Of concern was the introduction and export of non-native species that have the potential to feed on or out-compete native species within the local ecosystem of the Caspian environment. This issue is of particular importance since the discovery of the planktonic comb jelly *Mnemiopsis leidyi* in the Caspian in recent years. The comb jelly has caused a noticeable change in the ecosystem of the Caspian, as the species feeds on the zooplankton that forms a primary diet of sprat. Sprat is an important commercial species in the Caspian and also forms a key component of the diet for other fish species such as sturgeon.

ACG FFD PWD Project will adopt Azeri Project ballast water management measures designed to reduce the potential for alien species introduction. In view of this and the low numbers of vessels that are required for ACG FFD PWD Project, the environmental impacts from international shipping for the project will be low.

Rail transportation will be conducted in consultation with the national rail network authorities and loads will be sized and scheduled in accordance with the carrying capacity of the infrastructure, which has a capacity that exceeds current transportation levels. In view of the number of rail cars required for transportation of equipment into Azerbaijan the impacts will be of a low significance.

9.3.1.3 Transportation within Azerbaijan

Disturbance to road users
The ACG FFD PWD Project will result in an increase in surface transportation, through the movement of materials and of the workforce by road. The contractors will be required to adopt the project transport management procedures established during Phase 1, which include the requirement to size loads accordingly so as to minimise interference from transportation.

Atmospheric emissions
Transportation within Azerbaijan will result in the following atmospheric emissions:

- Products of fuel combustion, such as carbon monoxide (CO), carbon dioxide (CO_2), sulphur dioxide (SO_2), and oxides of nitrogen (NO_x including predominantly NO and NO_2);
- Particulate Material resulting from the combustion of hydrocarbons;
- Noise; and
- Local dust generation from vehicle use.

In common with previous phases of ACG FFD, air quality monitoring will be conducted at sites where this is a perceived issue in relation to the presence of sensitive receptors. For example, monitoring is not conducted at the SPS yard, as no receptors exist in proximity to the site. Where monitoring is deemed necessary it will record the following parameters:

- Entrained dust as a result of human disturbance;
- Records of fuel consumption of each engine and vehicle;
- Daily records of hours and location of operation of each engine; and
- Primary source emissions and aerosol species (e.g., CO, NO_x).

All contractors will be required to implement a system of frequent maintenance of equipment with the expectation they will ensure compliance with vendor performance standards and minimise emissions.

Dust generation will be minimised through the use of established roads and access tracks. In addition, SPS and Sangachal Terminal have laid aggregate cover across most vehicle tracks. Air monitoring will also monitor dust levels in and around sensitive receptors, where appropriate.

Once released, emissions will be rapidly diluted and dispersed in the atmosphere and no deterioration in air quality will be expected.

9.3.1.4 Mobilisation of workforce

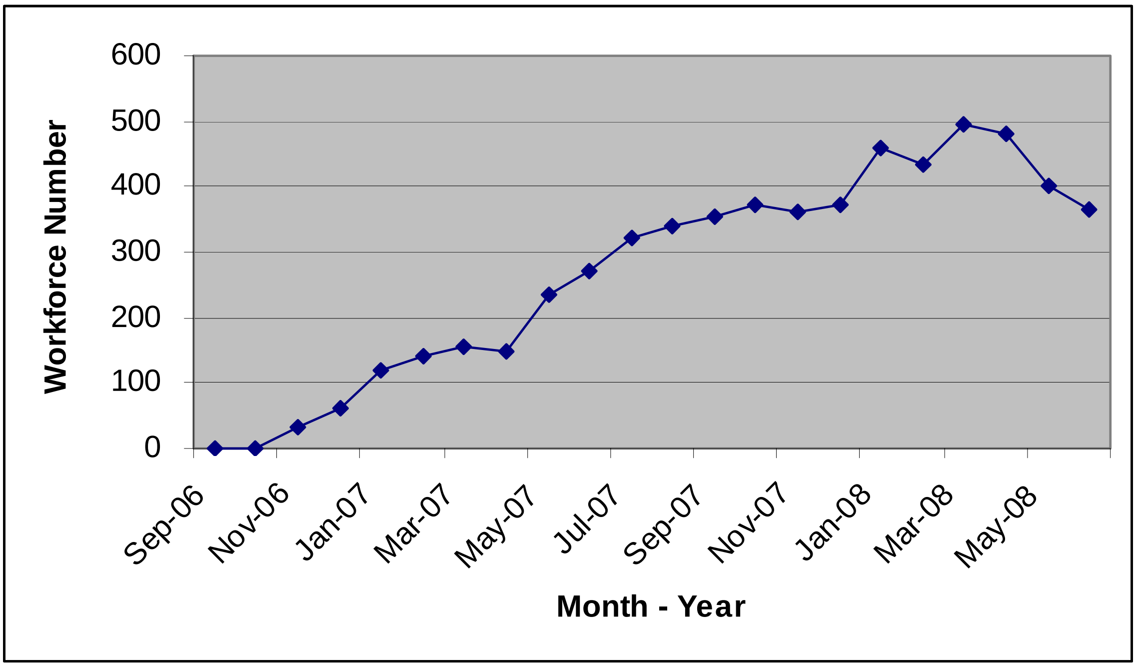
The personnel needs required for the ACG FFD PWD Project will largely be provided from the workforce developed for the previous ACG FFD Phases. This will be achieved through extension of current employment contracts or supplementation from the employee database where possible. Consequently, requirements for any additional personnel will be limited and few people are expected to be attracted to the area. This impact is a beneficial one through the continued employment of the Azerbaijani workforce. To maximise the positive impact from employment, the ACG FFD PWD Project will also adopt the following measures already in place for ACG FFD Phases 1, 2, and 3:

- Targets for employment of Azerbaijani nationals. Contractors will be contractually committed to employing a 70 percent national workforce. In many cases the actual numbers of Azerbaijani workers within the contractor companies exceed 80 percent.

- Preferences for recruiting from local communities to ensure the people living nearest to the facility see benefits from it. Previously over 50 percent of the ACG FFD workforce at Sangachal Terminal was from the Garadag Region.
- Continued use of information centres within local communities for information on employment associated with the Project. The centres, located in Sangachal, Umid, and Sahil have developed a database of over 18,000 potential employees.
- Training of unskilled or semi-skilled workers to meet specialised demands of the ACG FFD PWD Project. Training by previous Phases of ACG FFD has resulted in the generation of a substantially skilled workforce, many of whom have or continue to work on elements of the current construction programmes at Sangachal for the Azeri project.

As a result of these management measures, the ACG FFD PWD Project represents a beneficial impact on local employment and income generation. Figure 9.1 illustrates the planned personnel needs for the ACG FFD PWD Project construction programme. For the operation of the ACG FFD PWD Project, employment requirements will be met by Terminal staff and offshore personnel on the Central Azeri platform, as described in the ACG FFD Phase 1 ESIA.

Figure 9.1 Planned workforce for the ACG FFD PWD Project construction programme



9.3.1.5 Unplanned accidental events

The results of the environmental and socio-economic impact assessment for international equipment and pipeline procurement, fabrication, and transportation predicted that all potential impacts would be of low significance if the ACG FFD PWD Project follows the current management measures that are in place.

9.3.2 Sangachal Terminal ACG FFD PWD Project facilities

The equipment required for the ACG FFD PWD Project (Chapter 5) will be located entirely within the existing boundary of Sangachal Terminal established during the ACG FFD Phase 1 Project. These areas were partially prepared for the future ACG project requirements during the Early Civil Works Programme for the FFD and all areas were cleared of vegetation as initial preparation for future construction activities. Therefore there will be no further impacts in terms of loss of vegetation, habitat loss, or earthworks outside the existing boundaries of the Terminal.

The results of the environmental and socio-economic impact assessment of routine and planned non-routine activities associated with the modification and operation of Sangachal Terminal concluded that only environmental impacts of low residual significance would result from the activities (Table 9.3). However, despite the low significance ranking, a number of issues have been raised during consultation in previous phases of ACG FFD and these are discussed in the following sub-sections.

Table 9.3 Summary of impact assessment for ACG FFD PWD facilities at Sangachal Terminal

9.3a Environmental impacts

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
SANGACHAL TERMINAL								
Facilities construction/commissioning								
E8	Grading of site	• Ground disturbance • Noise • Emissions • Dust • Wastes	• Loss of vegetation • Deterioration of air quality • Contamination potential	• CCPs/CIPPs • Dust suppression will be used (wetting to reduce emissions) • All earthworks and vehicle movements within the terminal boundary	-	L	• Use of cleared area already established - no new losses of vegetation or terrestrial habitat • Existing waste management facility at Sangachal Terminal (reception, storage, transportation to approved disposal facility) • Approved waste disposal facilities are clearly identified and used by all contractors	Atmospheric emissions and waste management raised in previous ACG Phases (Section 9.3.2.1)
E9	Digging of foundations and trenching of lines within terminal boundary	• Emissions from equipment • Noise • Emissions • Dust • Wastes	• Deterioration of air quality • Contamination potential	• As E8 • Soil disposed of at Sangachal Terminal (no transportation to external site)	-	L	• As E8	As E8
E10	Metal works (grinding welding and	• Noise Emissions Dust	• As E9	• CCPs/CIPPs • Shielding	-	L	• Existing waste management facility at Sangachal Terminal	As E8

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
	hammering) and excavation may be carried out during night shifts (possible)	Wastes					(reception, storage, transportation to approved disposal facility) • Approved waste disposal facilities are clearly identified and used by all contractors	
E11	NDT	• Radioactive sources • Hazardous wastes (x-ray film)	• Contamination potential	• CCPs/CIPPs • Controlled radiation sources • Shielding • Testing at night	-	L	• Low quantities of waste • Existing waste management facility at Sangachal Terminal (reception, storage, transportation to approved disposal facility)	None
E12	Flushing with water prior to hydrotest	• Water use • Potential chemical use	• Demand/depletion of resources • Contamination potential	• Re-use of water where possible (reduce discharges) • Water not inhibited if left in pipework for <30days	-	L	• Reuse where possible to minimise discharges • No chemical additives in the water	None
E13	Hydrotest for pressure and leak detection	• Water use	• As E12	• Reuse of water (reduce demand from municipal supply) from tank for line testing • Water to go to drains at pig receiver to catch debris • Use of water from the fire water system	-	L	• Water use quantified and within the capacity of Sangachal Terminal fire water system • Reuse where possible to minimise discharges • No chemical use	Discharge of hydrotest waters (Section 9.3.2.1)

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
E14	Performance testing of pumps with large amounts of potable water on recycle	• Disposal of hot potable water to environment	• Contamination potential	• Reuse of water (reduce demand from municipal supply) from tank for line testing (closed loop with pumps on recycle) • Testing only on main export and transfer pumps	-	L	• Recycling of test water and minimisation of water required for disposal • Water temperature will be ambient on final disposal	None
Terminal operation								
E15	Disposal of contaminated water to open drains system	• Potential discharge to environment	• Contamination potential	• No discharge of untreated contaminated water (all routed via drains to a treatment unit • Treatment to World Bank effluent quality standards • Testing prior to soakway/irrigation of terminal land	-	L	• No discharge of untreated water • Testing to ensure compliance prior to discharge	None
E16	Fuel gas blanketing (BFG) of new Produced Water storage tank	• BFG will be flared via existing EOP flare	• Deterioration of air quality	• Only during filling/emptying of the tank with Produced Water Tank will be maintained with low volumes (only filled during offshore failure)	-	L	• One time operation • No filling/emptying of tank (no flaring of fuel gas) during routine operations • Flaring of fuel gas under planned non-routine operations does not exceed standards for atmospheric emissions	None
E17	Temporary pumps potential to use diesel or gas turbines	• Atmospheric emissions	• Deterioration of air quality	• If required base scope to connect to Sangachal Terminal existing power supply (electric drive) • If diesel pumps are required these will only be used temporarily	-	L	• Does not exceed atmospheric emissions standards • Diesel pumps if required will be phased out by gas turbine (GT)	None

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
							driven or electric pumps	
E18	Vehicles deliveries	• Traffic and combustion emissions	• Deterioration of air quality	• As E4	-	L	• As E4	None
E19	Chemical storage	• Potential for fuel gas blanketing, depending on chemicals selected	• Deterioration of air quality	• CCPs/CIPPs • Chemicals in tote tanks Storage at supplier, delivery based on usage	-	L	• Small volume usage Closed tote tanks (minimal atmospheric emissions)	None
E20	Second Produced Water holding tank will also need to be blanketed with fuel gas which will also need to be flared	• Atmospheric emissions	• Deterioration of air quality	• As E16	-	L	• As E16	None
E21	Frequent pigging (once every 2 weeks). Drainage of pig launcher each time it is opened	• Hazardous liquid/solid wastes	• Contamination potential	• CCPs/CIPPs • Waste removal to Sangachal Terminal waste reception facility (CWAA) • Linked into suite of 5 launchers so tie in to existing facilities (closed drain system so no release of wastes)	-	L	• Use of existing/approved waste disposal route	None
E22	Solids removal from de-oiler package by hydrocyclone and further solids removal in IGF	• As E21	• As E21	• CCPs/CIPPs • Waste removal to Sangachal Terminal waste reception facility (CWAA)	-	L	• As E21	None
E23	Desanding of Produced Water holding tank (removal	• As E21	• As E21	• As E22	-	L	• As E21	None

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
	as required based on inspection frequency averages every 7 years)							
E24	Decommissioning plan to be produced	• Wastes, emissions • Demand on infrastructure/ facilities	• Contamination potential • Depletion of resources	• Field Abandonment Plan (FAP) covering decommissioning when 70% of the field is depleted Base case is handover to SOCAR (from PSA)	-	-	• Plan not yet produced - site may be left to SOCAR to continue to operate	None

9.3b Socio-economic impacts

ID	Activity	Aspects	Social Impacts	Existing Socio-economic Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
SANGACHAL TERMINAL								
Facilities construction/commissioning								
S7	Metal works (grinding welding and hammering) and excavation may be carried out during night shifts (possible)	• Noise • Emissions • Dust	• Interference/disturbance to local populations • Deterioration of air quality	• CCPs/CIPPs • Shielding • Avoidance of nightime work where possible (subject to programme) • Schedule noisy operations during day shifts • Community Complaints Procedure	-	L	• Work will be intermittent and of short duration • Environmental mitigation will reduce social impacts from dust generation (E8) • Use of existing terminal facility (within boundaries previously established under ACG Phase 1) • Closest socio-economic receptor is Umid camp, 1.6 km from the terminal drainage boundary. • No disturbance complaints from previous Phases of ACG	Atmospheric emissions raised in previous ACG Phases (Section 9.3.2.1)
S8	Flushing with water prior to hydrotest	• Water use from municipal supply	• Increased demand on infrastructure, depletion of resources • Potential interference/disturbance to other users	• Agreement to draw water from municipal supply (based on pre approval on predicted levels of water use under routine and no-routine conditions) • Re-use of water where possible (reduce demand from municipal supply)	-	L	• Water use quantified and does not present a problem considering the capacity of the municipal line • Reuse where possible to minimise water take	None

9.3c Unplanned/accidental events impacts

ID	Activity	Aspects	Accidental Impacts	Existing Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
SANGACHAL TERMINAL								
Facilities construction/commissioning								
A5	Digging of foundations and trenching of lines	• Damage to existing 'Live' project facilities	• Contamination potential • Interference with other users	• CCps/CIPPs • Full construction Risk assessment carried out • Main facilities (Produced Water tank) located outside operational areas, minimising requirement for working within this area. • Pipework requires working in operation side - permitting system, HSE management	-	L	• Low probability of occurrence due to controls in place	None
A6	Welding works	• Risk of sparks causing fire, explosion in operational area (atmospheric emissions, spills)	• Contamination potential	• CCps/CIPPs • Fenced off work area • Designated weld station • Bridging document will be produced between operational site and adjacent area	-	L	• Low probability of occurrence due to controls in place	None
A7	Welding (Produced Water tank)	• Risk of relief valve lifting on adjacent Produced Water tank - release of hydrocarbons to the air causing potential fire, explosion (atmospheric emissions, spills)	• Contamination potential • Deterioration of air quality	• CCps/CIPPs • Gas detectors • Meteorological monitoring	-	L	• One time event (during construction). • Low consequence of occurrence due to potential volume of gas released	None

ID	Activity	Aspects	Accidental Impacts	Existing Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
A8	Connection to live facilities	• Spill	• Contamination potential	• CCps/CIPPs • Partial shut down (Produced Water tank)	-		• Low probability of occurrence due to controls in place	None
A9	Chemical injection first fills	• Spill	• Contamination potential	• CCps/CIPPs • Bunding around plant • Closed drains	-	L	• Low probability of occurrence due to controls in place	None
Terminal operation								
A10	Storage of Produced Water in PWD tank 2	• Damage to tank/liner and potential spill of Produced Water	• Contamination potential	• Tank will be lined • Bunding will be provided	-	L	• Low probability of occurrence due to controls in place	None
A11	PW distribution around plant using carbon steel pipe	• Corrosion potential • Spill of Produced Water	• Contamination potential	• Integrity management system (frequency determined during inspection) • Corrosion Management Operations Bunding around terminal operational areas • Drainage systems (not discharged) for any spills • Spill clean up equipment located at multiple points	-	L	• Low probability of occurrence due to controls in place	None
A12	Frequent chemical loading from either tankers or TOTE tanks to inject at least 5 chemicals for pipeline corrosion prevention and separation aid.	• Spill	• Contamination potential	• CCps/CIPPs • Bunding at delivery/storage locations (as per ACG FFD Phase 1) • Good ventilation, 14 days storage	-	L	• Low probability of occurrence due to controls in place	None

9.3.2.1 Terminal facilities construction/commissioning

Atmospheric emissions

During construction of ACG FFD PWD Project facilities at Sangachal Terminal, the atmospheric emissions will be small; sources include:

- Cranes;
- Excavators;
- Trucks;
- Minibus / cars / pick-ups; and
- Auxiliary plant.

Total emissions predicted during construction, along with the duration of the Sangachal Terminal Expansion Programme (STEP) and the required plant, equipment, and vehicle use are shown in Chapter 5, Figure 5.13. Concentrations emitted during Terminal construction and commissioning activities for the ACG FFD PWD Project will be low and within ambient air quality standards.

Once released, emissions will be rapidly diluted and dispersed and no deterioration in air quality will be expected. STEP currently calculates emissions from diesel usage and conducts an air-monitoring programme at various sites within and around the Terminal. This programme will be reviewed and aligned with ongoing monitoring plans.

Dust

Issues such as dust generation will not be as significant for the ACG FFD PWD Project Terminal construction programme, as the only earthworks required for the project involve the provision of foundations for some facilities, such as the new PWD storage tank. Wetting will be used in these areas to further reduce the potential for dust generation.

Noise

During construction of the ACG FFD PWD facilities at Sangachal Terminal a variety of activities will result in additional noise at the Terminal, including:

- Excavation of foundations for the PWD tank;
- Metal works (grinding welding and hammering); and
- The installation of underground services.

The closest social receptor to Sangachal Terminal is the Umid Camp for Internally Displaced Persons (IDPs), which is located approximately 1.6 km from the Sangachal Terminal boundary (Chapter 7.1). During earlier phases of ACG FFD, noise surveys were conducted to establish background noise levels in the vicinity of the Terminal. These demonstrated that noise levels were generally high, primarily as a result of the heavy traffic on the Salyan (Baku-to-Astara) Highway, exacerbated by the prevailing windy conditions.

Currently noise measurements are recorded on a regular basis at potential receptors. Overall, noise levels recorded are within World Bank Guidelines, although short-term exceedances have occurred in part due to third party activities (including passing trains and road traffic) and the prevailing windy conditions. Based on this information, together with monitoring at sensitive receptors, it is anticipated that short-term impacts will be low because of the limited number of receptors and the temporary nature of construction work. In addition, construction activities from previous phases of ACG FFD have been much larger in the nature and duration of activities, and these have not resulted in any noise-related complaints from the surrounding communities.

Hydrotesting and commissioning

Once constructed the ACG FFD PWD Project Terminal facilities will be tested and commissioned. In majority of the cases, hydrostatic tests will be performed using potable water and will not require chemicals due to the short duration of the test.

Hydrostatic test water will be reused in several tests wherever possible for pipeline testing. When testing is complete the water will be directly discharged to land within the Terminal. If chemical use is determined as necessary, after the test the hydrostatic test water will be stored in the lined holding pond and will be subject to a monitoring programme to ensure representative samples are within acceptable limits prior to discharge. As a result, there will be no significant residual impacts associated with hydrostatic testing and subsequent discharge of test waters.

Waste management

Sangachal Terminal has a proven waste management system in place. This comprises the Central Waste Accumulation Area (CWAA), which will be used for all construction stages and operations at the site prior to their transportation to approved waste disposal facilities. All disposal routes are to BP approved sites. The types of wastes and disposal routes utilised are detailed in Table 9.4.

Waste production figures are available for Terminal construction activities taking place over a six-month period during 2003. The data indicates that the vast majority of wastes that will be generated during this period are non-hazardous (9,000 m^3 per month), compared to hazardous wastes of only 22 m^3 per month.

Table 9.4 Waste categories and disposal routes generated during Sangachal Terminal facilities construction[3]

Category/Type	Treatment	Current disposal route
Non-hazardous waste		
General waste	EU standard landfill	Municipal Waste Site
Drums metal	Wash and re-use	Baku Steel Company or re-use by originator or Karvan L
Drums plastic	Wash and re-use	Re-used by originator or Karvan L
Electrical cables	Recycle	Baku Steel Company
Used Air filters	Landfill	Municipal waste site
Plastic	Reuse	Municipal waste site
Stainless steel	Recycle	Baku Steel Company
Hazardous waste*		
Absorbent materials (including oily rags)	Incineration	Ecoservices
Batteries	Temporary storage	Serenja
Bilge water / oily water	Treatment and re-use	Ecoservices
Chemicals	Temporary storage	Serenja
Grease	Temporary storage	Serenja
Hydraulic oil / lubricants / used oil	Re-use	Karvan-L Factory
Used oil filters	Incineration	Ecoservices
Oily soils	Temporary storage	Serenja
Solvents (including thinners)	Re-use	Karvan-L Factory

*BP is currently developing its strategy for hazardous waste disposal.

[3] These disposal routes are based on the contractors used for previous phases of ACG FFD. This list may change as new companies become known and fulfil all the necessary criteria.

9.3.2.2 Terminal operation (ACG FFD PWD Project facilities)

Atmospheric emissions

Atmospheric emissions during the operation of the ACG FFD PWD Project facilities are from:

- Gas turbines required to drive the pumps for the export the Produced Water offshore through the PWD pipeline (main source of atmospheric emissions); and
- Flaring of blanketing fuel gas from PWD storage (during non-routine planned operational filling or emptying of the tank).

Total emissions during Terminal operations are presented in Chapter 5, Figure 9.3. Concentrations emitted during operation of the ACG FFD PWD Project facilities fall within the emission limits and air quality standards for Sangachal Terminal. Emissions will be rapidly diluted and dispersed and will be subject to the Terminal air-monitoring programme at various sites within and around the Terminal.

Wastes

As with the onshore fabrication and construction sites, wastes arising from the operation of ACG FFD PWD Project Terminal facilities will be managed through the CWAA and system of approved waste contractors and sites (Section 9.3.2.1).

Wastes generated during the operation of ACG FFD PWD Project facilities comprise pigging and filter wastes from the pipeline maintenance programme (Chapter 5, Section 5.5.2). Predicted volumes of onshore solid wastes are presented in Chapter 5, Figure 5.17. All other wastes generated during the operation of Sangachal Terminal are described in the ESIA documents for ACG FFD Phase 1, 2, and 3 as approved under these projects and are not repeated here.

These wastes are classed as hazardous and will be transported via an approved hazardous waste contractor to an approved hazardous waste landfill for disposal.

The cumulative contribution to overall waste generation at Sangachal Terminal and the final disposal of these wastes in Azerbaijan is a managed issue and will not result in significant impacts.

9.3.2.3 Unplanned accidental events

The results of the environmental and socio-economic impact assessment of unplanned or accidental events for the construction, and commissioning of ACG FFD PWD Project facilities at Sangachal Terminal predicted that all potential impacts would be of low significance if the ACG FFD PWD Project follows the management measures identified during the impact assessment. The operation of the PWD facilities falls within the day-to-day operation of Sangachal Terminal as described in previous ACG FFD ESIAs and no accidental events have been identified specific to the ACG FFD PWD Project.

9.3.3 PWD pipeline installation, commissioning, and operation

As discussed in Chapter 5, the PWD pipeline has undergone a route selection procedure, which resulted in the siting of the line within the same ROW as the previous ACG FFD pipelines between Sangachal Terminal and the beach location. At the beach location in Sangachal Bay the PWD pipeline selected landfall is within the boundary of the existing landfall site for the ACG FFD Phase 1 and 2 oil and gas lines, and where construction activities are ongoing for the SDGE Project. These areas will be subject to a reinstatement plan once construction activities have been completed.

Offshore, the PWD pipeline will run parallel to the EOP pipeline, with a safety distance of minimum 20 m to the Compression and Water-injection Platform (CWP) in the Central Azeri (CA) location (ACG FFD Phase 1).

The results of the environmental and socio-economic impact assessment of routine and planned non-routine activities associated with the dedicated PWD pipeline concluded that only environmental impacts of low residual significance would result from the activities (Table 9.5). However, despite the low significance ranking a number of issues have been raised during consultation in previous phases of ACG FFD and these are discussed. For the assessment impacts associated with potential unplanned/accidental events, the management of corrosion, and potential for a release of Produced Water during the long-term operation of the pipeline is classed as of medium significance (Section 9.3.3.5).

Table 9.5 Summary of impact assessment for PWD Pipeline (onshore, coastal, and offshore)

9.5a Environmental impacts

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
PW PIPELINE								
Installation/commissioning (onshore)								
E25	Onshore works Preparation of the pipeline corridor and third party line crossings	• Removal of vegetation • Alteration of topography • Emissions • Dust • Noise • Waste	• Loss of vegetation • Habitat degradation • Disturbance to fauna • Deterioration of air quality • Contamination potential	• CCPs/CIPPs • Siting of the pipeline within the existing onshore ROW and exclusion zone (no development zone) • Dust suppression (wetting to reduce emissions) • The spoil from the trench excavation will be used to backfill the trench following installation of the pipeline • Waste removal to Sangachal Terminal waste reception facility (CWAA) • Vehicle use in approved areas/access tracks • Mob/demob of equipment daily from Sangachal Terminal • Reinstatement Plan	-	L	• Localised impact - Small area of physical disturbance • Existing construction site in an area of existing pipelines (EOP, ACG, SD) • Low contribution to overall atmospheric emissions • Short duration • Use of existing/approved waste disposal route • Area will be reinstated	None
E26	Onshore works Pipelaying	• Atmospheric emissions • Emissions • Dust • Noise • Waste	• Disturbance to fauna • Deterioration of air quality • Contamination potential	• CCPs/CIPPs • Siting of the pipeline within the existing onshore ROW and exclusion zone (no development zone) • Waste removal to Sangachal	-	L	• As E25	None

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
				Terminal waste reception facility (CWAA) • Vehicle use in approved areas/access tracks • Mob/demob of equipment daily from Sangachal Terminal • Reinstatement Plan				
E27	Onshore works - rail crossing (directional drilling through embankment)	• AS E26	• AS E26	• As E25 • Rail crossing will be by directional drilling (no disturbance to rail track	-	L	• As E25 • Directional drilling through manmade embankment	None
E28	Onshore works Third party crossings (road). Road to a depth of 1.5 m	• As E26	• As E26	• As E25 • Hand excavation of the highway • Equipment storage at landfall site • Reinstatement Plan	-	L	• As E25 • Road will be reinstated to former condition	None
E29	Hydrotest of onshore pipeline section	• Discharge of treated water with possible chemical use (biocide, oxygen scavenger, dye)	• Contamination potential	• Use of hydrotest pond which will be lined • Partial emptying of hydrotest water to perform tie-in (not total) • Retention of majority of test water for subsequent tests • Discharge to hydrotest holding pond at Sangachal Terminal	-	L	• Discharge will be minimised by partial emptying of the pipeline (to use the treated water is subsequent tests of the line) • Hydrotest pond will be used and test water kept to ensure degradation of chemicals • Testing prior to disposal of water • Discharge of test water under Sangachal Terminal current permit conditions	None

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
Installation/commissioning (coastal)								
E30	Coastal landfall site preparation	• Removal of vegetation • Alteration of foreshore topography • Equipment and traffic movement • Emissions • Dust • Noise • Waste	• Loss of vegetation • Habitat degradation • Disturbance to fauna • Deterioration of air quality • Contamination potential	• CCPs/CIPPs • Landfall of the pipeline within the existing beach construction site (already cleared and disturbed) • Dust suppression (wetting to reduce emissions) • Excavated material will be replaced for backfill • Waste removal to CWAA reception facility • Vehicle use in approved areas/access tracks • Reinstatement Plan			• As E25	None
E31	Excavation of trench on foreshore (to a trench depth of 0.5 m cover TOP)	• As E30	• As E30	• As E30 • Reduced TOP cover from 1 m to 0.5 m reducing the depth of trenching required			• As E25	None
E32	Construction of temporary berm (to 3 m) approximately 200 m (175 m) anticipated <6 months	• Disturbance to seabed • Alteration of nearshore hydrography and sediment deposition against berm	• Turbidity and disturbance to marine fauna • Sedimentation and blanketing of benthos • Contamination potential	• CCPs/CIPPs • Construction of berm in time for beachpull to avoid long presence of structure			• As E25 • Berm will be removed	Seabed disturbance (Section 9.3.3.1)
E33	Marine Works Excavation of trench in the shallow marine environment	• Loss of seabed • Turbidity • Noise • Emissions	• As E32	• CCPs/CIPPs • Route selection to maximise bathymetric gradient and minimise length of trench • Waste removal to CWAA			• As E25	Benthic disturbance (Section 9.3.3.2)

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
	(1 m deep x 4.7 km trench length to the 11 m water depth)	• Waste		reception facility				
E34	Marine vessel support close to the shore Operation of pipelay barge and support vessels. (2 anchor handling, 6 pipe carrying, one supply, DBA)	• Physical presence (anchoring/propeller action) • Noise • Atmospheric emissions • Sewage discharges • Bilge water discharges	• As E32	• CCPs/CIPPs/BP Marine Management Plan • Anchor Handling Management Plan • Sewage will be shipped to shore • PLBG diesel generators, support vessels engines will operate to MARPOL standards (sulphur content) • Bilge water will be brought to shore • Existing vessel supply base and onshore waste reception facilities used			• ROW is in an exclusion zone • Pipelay will occur over a short timescale • All wastes will be brought ashore for appropriate disposal	
E35	Beach pull of pipeline	• Noise • Atmospheric emissions • Waste	• Deterioration of air quality • Contamination potential	• CCPs/CIPPs			• Localised impact - Small area of physical disturbance • Low contribution to overall atmospheric emissions	
E36	Hydrotest of pipeline section on foreshore	• Discharge of chemically treated test water into Sangachal Bay	• Contamination potential	• Hydrotest water will be recycled • Troskill approved chemical recipe will be used (Caspian specific tox tested) • Partial emptying of hydrotest water to perform tie-in (not total) • Use of test water for subsequent tests (only partial emptying of the pipeline)			• Chemical dosing will be calculated to match the volume of hydrotest (so no large volumes of active biocide remaining) • Partial discharge to enable use of hydrotest for subsequent tests of the same pipeline	

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
							• Approval will be obtained prior to discharge of test water	
E37	Removal of temporary berm	• Disturbance to seabed • Sedimentation	• As E32	• As E32 • Removal of all berm material to allow seabed to recover naturally to pre-installation condition			• As E25	
Installation/commissioning (offshore)								
E38	Prelay survey/post build survey	• As E34	• As E34	• As E34			• Survey will be progressive so will not prevent vessel activity over a large area • ROW is in an exclusion zone • Pipelay will occur over a short timescale • All wastes will be brought ashore for appropriate disposal	
E39	Marine Works Installation of pipelines on the seabed (offshore)	• Physical disturbance (pipelay, trenching, anchoring) • Emissions • Wastes • Noise	• As E34	• As E34			• As E34	
E40	Marine Works Pipeline crossings (11)	• Physical disturbance (of the seabed) • Atmospheric emissions • Waste	• As E34	• As E34 • CCPs/CIPPs/BP Marine Management Plan • Crossing Management Plan			• As E34	

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
E41	NDT	• Radioactive sources	• Contamination potential	• No radiation sources used, ADT (automatic)			• No waste generation • No radioactive sources	
E42	Hydrotest of pipeline	• Discharge of chemically treated test water into the Caspian	• As E36	• As E36			• As E36	
Pipeline operation								
E43	Start up and pigging	• Generation of hazardous wastes from pipeline cleaning. • Interim storage on platform of hazardous wastes.	• Contamination potential	• CCPs/CIPPs • Interim storage on platform of hazardous wastes • Closed system - waste will fall into the pig receiver and waste will be bagged for shipment onshore • Waste Management Procedure • Use of approved waste reception/disposal facilities (Hazardous waste landfill)			• No discharge of wastes (total containment and ship to shore to approved waste disposal facilities)	
E44	Vessel activity during surveying and monitoring	• As E34	• As E34	• As E34			• As E34	
E45	Decommissioning plan to be produced	• As E24	• As E24	• As E24			• As E24	

9.5b Socio-economic impacts

ID	Activity	Aspects	Social Impacts	Existing Socio-economic Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
PW PIPELINE								
Installation/commissioning (onshore/coastal)								
S9	Third party line crossings (21 crossings, 23 lines). - excavation (by hand) to 3.5 to 4m	• Vehicle use • Dust • Noise	• As S5	• CCPs/CIPPs Full construction Risk assessment Crossing Management Plan Liaison with Municipal Authorities Survey of existing infrastructure	-	L	• Environmental mitigation will ensure air quality not affected detrimentally • Short term, localised activity (with prior experience from earlier Phases) • Directional drilling through manmade embankment • No problems experienced from previous Phases of ACG	None
S10	Onshore works - rail crossing (directional drilling through embankment)	• Atmospheric emissions • Dust • Noise	• Possible interference with rail traffic • Deterioration of air quality	• As S9 • Rail crossing will be by directional drilling (no disturbance to rail track • Drilling will be undertaken in consultation with rail authority to avoid periods of high rail traffic	-	L	• As S9	None
S11	Onshore works - road crossing to a depth of 1.5 m	• Atmospheric emissions • Dust • Noise	• Interference with road traffic • Deterioration of air quality	• As S9 • Hand excavation of the highway • Partial closure of highway (not total) to maintain traffic flow. • Safety/security personnel for	-	L	• Environmental mitigation will ensure air quality not affected detrimentally • Excavation will involve	None

ID	Activity	Aspects	Social Impacts	Existing Socio-economic Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
				traffic watch • Cones/signs for notifying traffic • Only during daylight hours (lit construction area at night) • Equipment storage at landfall site			closure of one side of the highway only • Road will be reinstated to former condition • No problems experienced from previous Phases of ACG	
S12	Coastal landfall site preparation	• Interference with public access • Atmospheric emissions • Dust • Noise	• Disturbance to other users • Deterioration of air quality	• As S9 • Security control/fencing	-	L	• No coastal social receptors in vicinity of existing landfall site • Extension of existing work programme (impacts addressed under earlier Phases of ACG • Site will be restored and public access resumed	None
Installation/commissioning (offshore)								
S13	Vessel activity during pre-lay/post build survey, during pipeline installation and commissioning	• As S6	• As S6	• As S6	-	L	• As S6 • Vessel activity will be progressive so will not prevent vessel activity over a large area	None
S14	Vessel transportation of pipe lengths	• As S6	• As S6	• As S6	-	L	• As S6	None
Pipeline operation								
S15	Physical presence of pipeline	• Physical presence of pipeline	• Obstacle to fishing activity • Safety exclusion zone for anchoring	• Pipeline route selection parallel to existing EOP, ACG FFD, and SD lines in an existing exclusion zone • Recording of pipeline position on Admiralty Charts	-	L	• Existing anchoring exclusion zone • No known fishing grounds in the vicinity of the pipeline	None

ID	Activity	Aspects	Social Impacts	Existing Socio-economic Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
				• Liaison with Port Authority			• No restriction on vessel movements over the live line once in place	
S16	Vessel activity during surveys and monitoring	• As S6	• As S6	• As S6	-	L	• As S6	None

9.5c Unplanned/accidental events impacts

ID	Activity	Aspects	Accidental Impacts	Existing Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
PW PIPELINE								
Installation/commissioning (onshore)								
A13	Onshore works Cross over of existing pipelines/subsea cables onshore (risk of spontaneous bursts)	• Damage to third party infrastructure and • Spill	• Interruption of third party services • Contamination Potential	• Full construction Risk assessment carried out • Hand excavation (3 to 4 m)	-	L	• Low probability of occurrence due to controls in place	None
A14	Onshore works Third party crossings (road)	• Road accident and - Spill	• Contamination potential	• Partial closure of highway (not total) to maintain traffic flow. • Safety/security personnel for traffic watch • Cones/signs for notifying traffic Only during daylight hours (lit construction area at night) • Equipment storage at landfall site (no road crossing)	-	L	• Low probability of occurrence due to controls in place	None
A15	Pipeline hydrotest (450 bar)	• Spill risk of inhibited water • Potential contamination of surface/ground water	• Contamination potential	• Use of hydrotest pond which is lined • Partial emptying of hydrotest water to perform tie-in (not total) • Use of treated test water for subsequent tests of same line	-	L	• Low probability of occurrence due to controls in place	None

ID	Activity	Aspects	Accidental Impacts	Existing Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
Installation/commissioning (offshore)								
A16	Vessel collision	• As A1	• As A1	• As A1 • Liaison with Baku Port authority	-	L	• As A1	None
A17	Collision with live pipelines/Damage from vessel anchoring (laybarge) during installation	• Spill • Fire • Explosion	• Contamination potential	• Construction risk assessment • Minimum 20 m up to 200 m spacing • Anchor handling plan	-	L	• Low probability of occurrence due to controls in place	None
A18	Marine works Installation and tie in to risers	• Spill • Potential loss to sea Contamination	• Contamination potential	• Hydrotest water treated with approved chemicals only • Shut down on hook up to Central Azeri and DWG platforms	-	L	• Low probability of occurrence due to controls in place	None
Pipeline Operation								
A19	Presence of the pipeline on the seabed and spanning	• Damage by vessel grounding (nearshore) • Impact from vessel anchors/fishing gear (offshore) • Breach of pipeline and uncontrolled release of Produced Water	• Contamination potential	• Recording of pipelines on Admiralty Charts • Pipeline surveys • Concrete coating provides some protection for anchors (but not intended as mitigation for grounding) • Trenching of pipeline in water depths<11m	-	L	• Low probability of occurrence due to controls in place but would result in critical financial loss to the Company and media attention	None
A20	Corrosion and failure of pipeline	• Gross loss of product to environment	• Contamination potential	• Sacrificial anodes/concrete coating • Chemical addition • Pigging • Pipeline survey • Leak detection	-	M	• Would result in critical financial loss to the Company, fines and media attention	Corrosion Management (Section 9.3.3.5)

ID	Activity	Aspects	Accidental Impacts	Existing Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
A21	Vessel activity during surveys and monitoring	• As A1	• As A1	• As A1 • Liaison with Baku Port authority	-	L	• As A1	None

9.3.3.1 Construction of a temporary berm at the landfall site

The construction of the temporary berm (Chapter 5, Section 5.3.6) required to enable pipeline installation in water depths of less than 3 m will result in disturbance to the seabed and temporary changes in the hydrological regime from the presence of the barrier, potentially affecting sediment erosion and accretion in the immediate area in the short term. The berm will be approximately 200 m long, approximately 5 m wide at the surface and will taper in the width of the base from 12.5 m wide at the shore to 7 m wide at the seaward end. This will result in the direct seabed disturbance of approximately 0.2 ha[4] (assuming an average berm width of 9.75 m). The fully constructed berm is scheduled to be in place for two months and will take one month to assemble and one month to remove.

As discussed in Chapter 6, the hydrodynamic regime in Sangachal Bay is dynamic and complex. As a result of wind driven waves, significant changes may be observed along the coastline, with sediment build up observed during summer months and erosion in winter months during periods of higher winds. A number of assessments have been made of the bay, including current studies and sediment transport studies (Chapter 6). These studies enabled an assessment of the potential effects of the construction of a temporary berm during the ACG FFD Phase 1 and 2 ESIAs. The results of these studies combined with management measures developed for the berm construction concluded that any impacts from sediment accretion along the structure would be mitigated by the total removal of the structure. This requirement formed part of the approval conditions issued for ACG FFD Phase 1 and 2 and will be adhered to in the ACG FFD PWD Project.

In addition to the mitigation and management measures established during ACG FFD Phase 1 and 2, the length of the berm required for the ACG FFD PWD Project has been reduced by approximately 100 m. This is due to the selection of a route intended to maximise use of the bathymetric gradient in Sangachal Bay. The water depth gradient is more pronounced to the north of EOP compared to that existing at the south of the landfall site where the ACG and SDGE lines were brought ashore. As a result of this increased gradient, water depths increase within a shorter distance of the shoreline enabling the installation vessels to approach closer to the shoreline and reducing the requirement for such a long temporary berm. As a result, the footprint of seabed disturbance, as well as the potential changes in hydrodynamic conditions and resulting sedimentation patterns will also be reduced.

It should also be noted that as the berm will be constructed in an area of previous and ongoing construction activities, the impacts would be lower than construction at an undisturbed landfall location. In fulfilment of the commitments from earlier ACG FFD Phases, the landfall site will be subject to a restoration plan, which includes the removal of any seabed obstructions in addition to restoration of the coastline to pre-construction conditions.

Given that the berm will only be in place for two months (as a complete structure) and will be removed following pipeline installation, the degree of disturbance will be limited and natural processes would return the seabed to its former state. Any adverse changes to coastline configuration that may occur while the berm is in place will be subject to the rehabilitation plan developed for the landfall site. As a result, the impacts from construction and presence of the berm will be of a low significance.

9.3.3.2 Pipeline trenching in the shallow marine environment

Excavation of the pipeline trench is required for protection of the PWD pipeline in water depths of less than 11 m. Given the trench specifications discussed in Chapter 5 of 1.2 m deep x 1.5 m wide and 5 km [5] trench length to the 11 m water depth, these activities will result in the removal of 9,000 m^3 of seabed sediment and direct loss of seabed habitat over an area of approximately 0.75 ha. Deposition of excavated material adjacent to the trench is estimated to impact an area of at least the same size and possibly up to twice as large. Trench construction activities are therefore, estimated to directly impact 1.5 ha of benthic habitat.

[4] 200 m x 9.75 m = 1,950 m^2. = 0.195 ha (10,000 m^2 = 1 hectare)
[5] 1.5 m x 5000 m = 7,500 m^2. = 0.75 ha

As discussed, in order to mechanically excavate the trench, a berm will be constructed from the shoreline out to the 3 m water depth contour. Therefore, the direct seabed disturbance from trenching is in addition to that disturbed by the physical presence of the berm.

Previous studies and surveys (Chapter 6) have shown that approximately 450 ha (i.e., 12 percent of Sangachal Bay) are covered by seagrass habitat. The direct loss of between 1.4 and 1.6 ha of nearshore habitat from construction of the finger pier, trenching, deposition of excavated material, pipeline installation, and vessel operation is therefore very small (i.e., <1 percent) and of low significance.

Benthic habitat may also be indirectly impacted as a result of increased turbidity in the bay during pipeline trench construction activities. Depending on the strength of currents at the time of trench construction, sediments could be mobilised, transported and deposited at potentially considerable distance from the immediate construction area. As discussed above, the environment of Sangachal Bay is highly dynamic and marine benthic flora and fauna are expected to be able to sustain low to medium level disturbance. Therefore, whilst the deposition of significant amounts of sediment may lead to the smothering of marine flora and fauna with potential mortality of some impacted species, these impacts are considered to be localised, short term and not significant as the benthic community will recolonise the area once the disturbance returns to background levels.

9.3.3.3 Pipeline installation in the marine environment

Localised disturbance of the seabed will occur during pipeline installation from the contact of the pipeline with the seabed and during placement of anchors and mooring chains for the pipeline lay barge (PLBG). In addition, the installation of concrete mattresses for freespan correction and to build crossing points for existing subsea services (Chapter 5) as well as the actual laying of the pipeline would all result in a degree of physical disturbance of the seabed.

The offshore component of the planned PWD pipeline is taken as being the section between the offshore platform at Central Azeri and the 11 m water depth contour (i.e., the depth at which trenching stops). The offshore section of the pipeline amounts to a length of approximately 181.5 km. Assuming that pipeline installation activities would disturb the seabed over a 50 m wide corridor along the pipeline route, the total area that would be disturbed as a result of offshore pipeline installation and associated activities would be approximately 908 ha. Benthic communities in this area would be directly impacted resulting in a loss of benthic biomass.

Survey work conducted to date (Chapter 6) shows that benthic communities are characterised by endemic amphipods, cumacea, and gastropod communities, all of which are resilient to a degree of physical disturbance due to their reproduction rates. After seabed disturbance and subsequent loss of benthos, restoration of natural community structure gradually takes place from undisturbed areas.

The offshore portion of the pipeline would not be buried and as a result, its surface would provide an additional substrate for colonisation by populations of barnacles and bivalve molluscs in areas where they would be otherwise unlikely to occur and become established. This implies that in the offshore environment through which the pipeline passes, a slight change in structure of marine faunal community may be incurred.

While the total area that would be impacted as a result of pipeline installation is appreciable, the fact that the installation operations would be relatively short-term and that the disturbed areas would be free to rehabilitate without further disturbance, the overall impact on the seabed and benthos from offshore installation is considered to be of low significance.

9.3.3.4 Hydrotesting and commissioning

Once in place, the PWD pipeline will be flooded with seawater drawn from the open sea in order to test the pipeline's integrity (Chapter 5). The water will be treated with the following chemicals, which are added in order to avoid any internal corrosion of the pipe whilst the seawater is in the line:

- Oxygen scavenger;
- Tracer dye; and
- Biocide.

It is currently anticipated that the ACG FFD PWD Project will adopt the same chemical recipe for treating the hydrotest water as was approved by MENR for use in previous phases of the ACG FFD. The chemicals to be used for dosing the hydrotest water are carefully selected using the BP Chemical Selection Management System to ensure that the chemicals selected on the basis of lowest toxicity, using the Offshore Chemical Notification Scheme (OCNS), a ranking system (originally used for UK offshore platforms) which classifies chemicals based on a number of parameters such as toxicity, potential for biodegradation, and bioaccumulation by organisms. The details of these chemicals are provided in Table 9.6.

Table 9.6 Pipeline hydrotest water chemicals

Chemical function	Proprietary name	Composition	OCNS category[1]
Biocide	TROSKILL 88	THPS (tetrakishydroxymethylphosphonium sulphate) and quaternary ammonium	D
Oxygen Scavenger	TROS TC 1000	Ammonium bisulphite	E
Tracer Dye	TROS SEADYE	Fluorescein	E

[1]Offshore Chemical Notification Scheme. OCNS Category E is the lowest rating. Category E chemicals are of low toxicity, readily biodegradable and non-bioaccumulative.

On completion of hydrotesting of the pipeline, the inhibited seawater will be discharged to sea near the CWP. The discharged hydrotest water will contain residues of chemical additives, which on discharge will disperse. As category D and E chemicals under OCNS, the oxygen scavenger and biocide chemicals hydrolyse and degrade almost entirely within in the pipeline, with a proportion being adsorbed on the pipeline surfaces.

OCNS is an international scheme with the chemical characteristics based on testing on species not endemic to the Caspian Sea. As a result, the chemical components in the hydrotest water were also subjected to Caspian specific toxicity tests, as follows:

- The hydrolysis, adsorption or degradation of the individual chemicals were tested over 48 hours;
- The hydrolysis, adsorption, or degradation of selected chemical mixtures within seawater, at the actual doses to be used, were tested over 48 hours.

The results of the tests are presented below in Table 9.7, to Table 9.9. If further information indicates that different chemicals are required, these chemicals will be subject to the toxicity tests described and the results submitted to MENR for approval.

Table 9.7 Hydrotest water single chemical tests (EC/LC_{50}, $mg.l^{-1}$)

Type	Name	Zooplankton		Phytoplankton	
		Standard	WAF[2]	Standard	WAF[2]
Dye	TROS Seadye Fluoroscein	>5,600	1,095	672.6	1,007.3
Oxygen scavenger	TROS Oxygen Scavenger	397.5	>560	608.2	525.5
Biocide	TROSKIL 88 Biocide THPS	13.3	13.3	Approx. 1	2.10

Table 9.8 Hydrotest package, zooplankton toxicity tests (LC_{50}, $mg.l^{-1}$)

Name	Dose[3]	Standard		WAF	
		LC_{50} (%)[3]	Equivalent	LC_{50} (%)	Equivalent
TROS Oxygen Scavenger	100	4.36	4.36	4.77	4.77
TROSKIL 88 Biocide THPS	300		13.08		14.31
TROS Seadye	100		4.36		4.77

Table 9.9 Hydrotest package, phytoplankton toxicity tests (EC_{50}, $mg.l^{-1}$)

Name	Dose[3]	Standard		WAF	
		EC_{50} (%)	Equivalent	EC_{50} (%)	Equivalent
TROS Oxygen Scavenger	100	3.44	3.44	3.96	3.96
TROSKIL 88 Biocide THPS	300		10.32		11.88
TROS Seadye	100		3.44		3.96

1 Laboratory ecological tests are designed to evaluate both acute and chronic effects. In toxicity testing, LC_{50} represents the Median Lethal Concentration, with EC_{50} representing an adverse response other than death (Median Effective Concentration). In both tests the concentration or the dose of the chemical that is required to produce lethal or non-lethal effects in 50 percent of the population is determined.
2 WAF (Water Accommodated Fraction) is derived from test preparations where the chemical or mixture is added to the seawater and allowed to equilibrate for 24 hours before the commencement of the toxicity tests.
3 Dose refers to the manufacturer's recommended concentration in the hydrotest package. The tests were carried out on a series of percentage dilutions of this package. The 'equivalent' concentration of biocide is estimated from the dose and the 50 percent effects concentration.
4 Toxicity value as a concentration of the entire fluid in seawater expressed as a percentage.
5 Test species: Zooplankton - Calanipeda aquae dulcis. Phytoplankton - Chaetoceros tenuissimus

The single chemical test results show very low toxicity to both zooplankton and phytoplankton from the tracer dye and the oxygen scavenger.

For biocide, phytoplankton were more sensitive than zooplankton, showing results for EC_{50} values ranging between 1 and 2.1 $mg.l^{-1}$ compared to zooplankton LC_{50} values of approximately 13 $mg.l^{-1}$. However, testing of the dosage regime as detailed in Table 9.6, produced very consistent results, with the EC_{50} values in the range of 3.4- 4.8 percent; that is, the percentage concentration of the whole package in seawater.

The above evidence confirms that no significant impact on the receiving environment will result from the discharge of the hydrotest water package tracer dye or oxygen scavenger This, along with the low biocide dosage rates in the hydrotest waters indicate that any residual impacts associated with this discharge would be low.

9.3.3.5 Unplanned accidental events

The results of the ESIA for the PWD pipeline installation, commissioning, and operation programme predicted that the accidental release of Produced Water into the Caspian Sea through the potential for pipeline corrosion is of medium impact significance.

Dispersion modelling was carried out to investigate the behaviour of an uncontrolled release of Produced Water from the following accidental events:

- Scenario 1: Single large uncontrolled release of untreated Produced Water over a period of 18 minutes from a breach in the pipeline, e.g., from vessel or anchor impact (pipeline failure); and
- Scenario 2: Continuous uncontrolled release of untreated Produced Water as a result of pipeline corrosion (pipeline leak).

For each of the two scenarios, modelling was conducted in the nearshore marine environment of Sangachal Bay and in the offshore marine environment at the Central Azeri platform location. Initial modelling simulated the behaviour of Scenario 1 and 2 close to the point of release (near-field) to investigate the behaviour of the Produced Water based on its high salinity compared to the Caspian Sea.

The results of the near-field modelling for Scenario 1 were used to initiate a model to assess the far-field behaviour of the Produced Water over a two-day period, after a single uncontrolled release from pipeline failure. Far-field modelling was not conducted under Scenario 2, as a continuous uncontrolled release of Produced Water into the Caspian Sea would be unacceptable with respect to an environmental impact, AIOC Corporate Standards or national legislation (Chapter 2). As such, the requirement for project mitigation for corrosion control and leak detection presented in Chapter 5, Table 5.3 will be followed to ensure a release will be effectively avoided. These measures include chemical injection and inspection using intelligent pigs to permit the ready detection of corrosion products. These mitigation measures are discussed in Chapter 10.

Appendix 7 provides detailed results and interpretation of the modelling results. Table 9.10 summarises the Produced Water discharge modelling specifications for Scenario 1 (pipeline failure) and Scenario 2 (pipeline leak).

Table 9.10 Produced Water discharge specifications

Parameter	Scenario 1: Pipeline failure	Scenario 2: Pipeline leak
Location	(1) Sangachal Bay: 40° 11’ 43” N 49° 29’ 42” E (2) CWP Primary location: 40° 01’ 52” N 51° 21’ 04” E	
Discharge Rate	80,000 barrels/day (modelled loss over period of discharge, 1,000 barrels)	3200 barrels/day
Period of Discharge	18 minutes	Indefinite
Release Hole diameter	0.36 m	0.05 m
Pipe Diameter	0.36 m	
Pipe Depth	5 m from bottom	
Orientation	Horizontal	
Water Depth	(1) 7.5 m Sangachal Bay (2) 242 m CWP location	
Produced Water Discharge Temperature	(1) 20°C: Sangachal Bay (2) 5°C: CWP location	
Produced Water Salinity	35 psu	
Assumed Caspian Sea Salinity	12 psu	

The near-field modelling for both the pipeline failure and the leak scenarios is summarised in Table 9.11. In both Scenarios the model showed the Produced Water quickly descending to the seabed in a plume, once it was released into the Caspian Sea. This was due to the hypersaline nature of the Produced Water effluent being negatively buoyant in comparison the ambient salinity of the receiving seawater. The distance for the Produced Water plume to reach the seabed in both scenarios was less than 6 m from the point of release. Corresponding salinities at this point were rapidly reduced from 35 psu to 14 psu and lower within this 6 m distance (Table 9.11).

Table 9.11 Summary of near-field dispersion modelling results

Flow (barrels/day)	Location	Duration of release (mins)	Distance for plume to reach the seabed (m)	Time to reach seabed	Salinity (psu) at maximum extent of plume	Dilution factor
Scenario 1: Large-scale release from pipeline failure event						
80,000	Nearshore	18	5.9	20	13.99	10.6
80,000	Offshore	18	5.8	19	14.00	10.5
Scenario 2: Continuous leak from pipeline corrosion						
3200	Nearshore	Continual	5.6	50	12.30	78.0
3200	Offshore	Continual	5.6	50	12.28	81.0

For Scenario 2: pipeline leak due to corrosion, the salinity was diluted to near the ambient level of 12 psu within 5.6 m and within 50 seconds of release. This was due to the slower release rate associated with a leak, as opposed to a failure in the pipeline. As discussed such a leak is unacceptable therefore the residual impact of a pipeline leak is of medium significance, requiring further mitigation measures (as discussed in Chapter 10).

The far-field modelling results show the behaviour of the Produced Water release over time in terms of dilution factors. By interpreting these modelling results with toxicity data for produced water, it is possible to assess the potential environmental effect of the uncontrolled release due to a hypothetical pipeline failure. The Caspian Environmental Laboratory (CEL) conducted Caspian specific toxicity tests on a series of representative Produced Water samples in June 2005 (Table 9.12).

Table 9.12 COD and toxicity of untreated Produced Water samples tested by CEL on Caspian Specific Species

Date	COD ($mg.l^{-1}$)	Phytoplankton 72h EC_{50} (%)	Zooplankton 48h LC_{50} (%)
09 June	50,200	5	1.9
09 June	5,300	14	2.4
15 June	4,000	4.3	3.1

The analysis shows zooplankton to be more sensitive than phytoplankton. Although there is a variation in both COD and toxicity in the results, the zooplankton tests indicated that the average LC_{50} of untreated Produced Water to Caspian test organisms was approximately 2.5 percent (i.e., Produced Water diluted 40 times in Caspian water caused 50 percent lethal effect on the test organisms).

Using the toxicity tests, it is possible to estimate the maximum concentration of the Produced Water that we can be confident will cause no environmental harm over any time period, called the No-Observable Effect Concentration (NOEC). The NOEC is conventionally derived from the LC_{50} data by applying a safety factor that reflects the nature and duration of exposure. Using the CHARM (Chemical Hazard and Risk Management) model, which is used to estimate risk for oil industry chemicals used in the North Sea, a standard safety factor of 10 is applied to the LC_{50} data, where the release is a single event of limited duration. Therefore, under Scenario 1 pipeline failure, applying a safety factor of 10 to the LC_{50} zooplankton data of 2.5 percent (or dilution 40 times), correspond to a NOEC dilution of 0.25 percent (or 400 times).

Far-field models were run for a pipeline failure in Sangachal Bay and at the CWP Primary location under summer and winter conditions. Under a PWD pipeline capacity of 80,000 barrels/day, 1,000 barrels were released over 18 minutes, the time for the pipeline pressure to equalise after a total failure and therefore the total release. One hundred simulations (50 for each location) were run to obtain the worst-case results. The results from the far-field model are presented as plots showing coloured contours representing dilution factors, based on the initial Produced Water salinity of 35 psu and average ambient salinity of 12 psu for the Caspian Sea. The dilution factors of most interest were those of 100x and 400x, as these enable comparison with the toxicity tests LC50 of 40x and the NOEC of 400x (applying the safety factor of 10). Corresponding salinities under the different dilution factors are shown in Table 9.13.

Table 9.13 Salinities for different dilution factors

Dilution factor	Salinity (psu)
0	35.0
10	14.30
100	12.23
400	12.058

Under a pipeline breach (Scenario 1) in Sangachal Bay simulated under summer conditions, the Produced Water release was diluted by a factor of 100 (i.e. from 35 psu to 12.23 psu) within 0.5 km of the release location. Under winter conditions the model simulations show the dilution of the Produced Water release by a factor 100 within 0.4 km of the release location. The predicted area enclosed by the dilution contour of 100 was 0.146 km^2 for both seasons.

In terms of timescale for dilution, once released the Produced Water was rapidly diluted. In both summer and winter seasons the Produced Water was diluted to a factor of 100 in only 3 hours after release. Looking at the No Effects Concentration (NOEC) safety factor of 400, the model showed that the Produced Water was diluted to this level within 7.5 hours to 7.6 hours, in summer and winter respectively (Figure 9.2).

For the offshore Scenario 1 simulations the model showed the Produced Water spreading in a roughly circular pattern with little advective transport due to the predicted weak current field in the region compared to that of the nearshore release. In summer, the Produced Water release was diluted to a factor of 100 within 300 m of the release location, with dilution factors of less than 100 covering an area of 0.133 km^2. For the worst case winter simulations, a 100x dilution occurred within 300 m of the release location, with dilution factors of less than 100 covering an area of 0.111 km^2.

Offshore, dilution of the Produced Water to the NOEC safety factor of 400 occured 12.5 hours and 12.25 hours after release, in summer and winter respectively. This longer period for dilution of the Produced Water is attributable to the weaker current regime present in the deep offshore waters, compared to that in the shallow nearshore location. Figure 9.3 provides the temporally variation plots for the CWP offshore location for 16 hours after the accidental release.

The worst case results from the 100 model runs are summarised in Table 9.14 showing the maximum distance before the Produced Water release was diluted to a NOEC.

Table 9.14 Summary of far-field dispersion modelling results (worst-case)

Flow (barrels/day)	Season	Duration of release (mins)	Time to reach NOEC (hours)
Scenario 1: Sangachal Bay			
80,000	Summer	18	7.5
80,000	Winter	18	7.6
Scenario 1: CWP Primary location			
80,000	Summer	18	12.5
80,000	Winter	18	12.25

Figure 9.2 Sangachal Bay, 8 hours after a Scenario 1 release

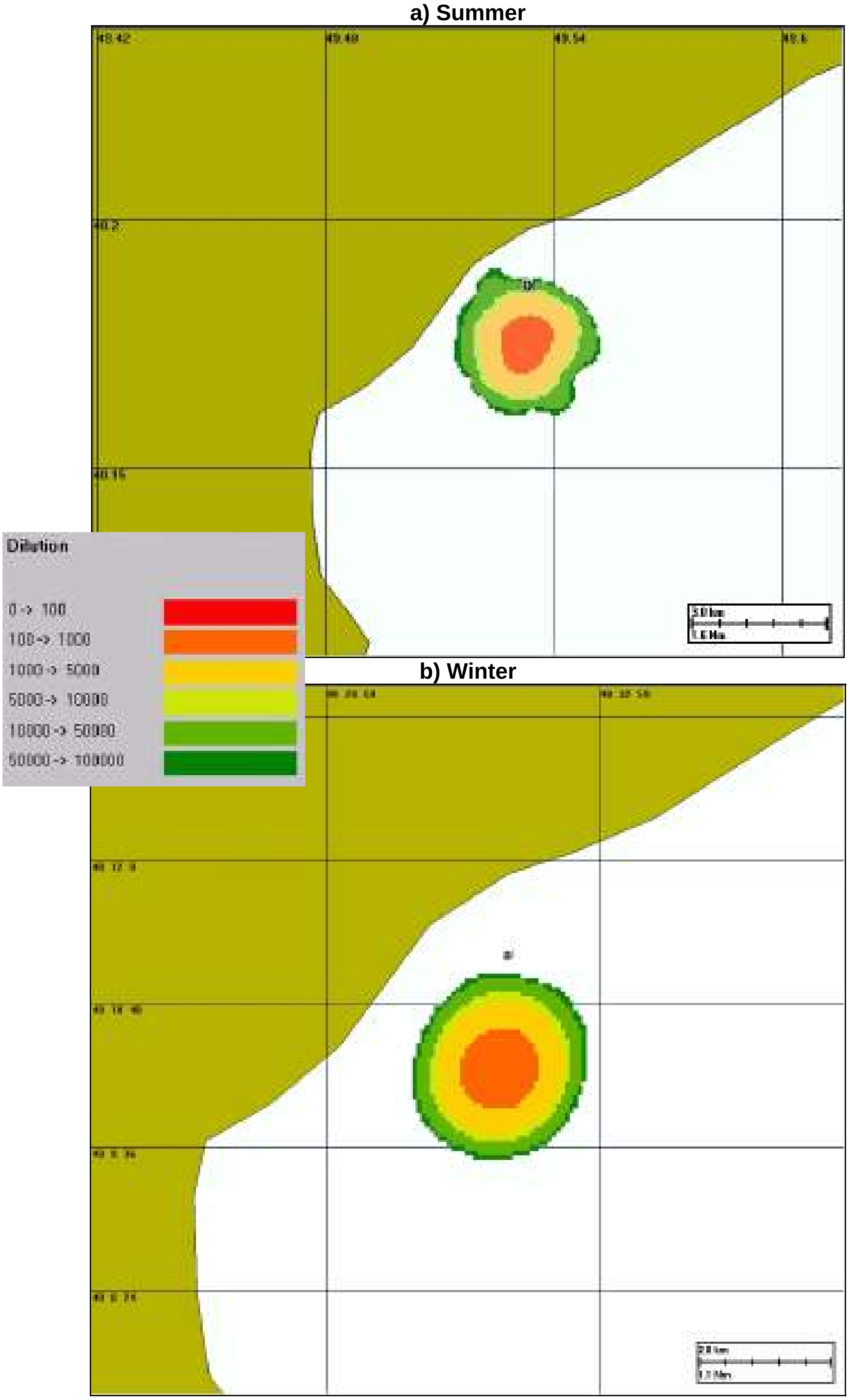
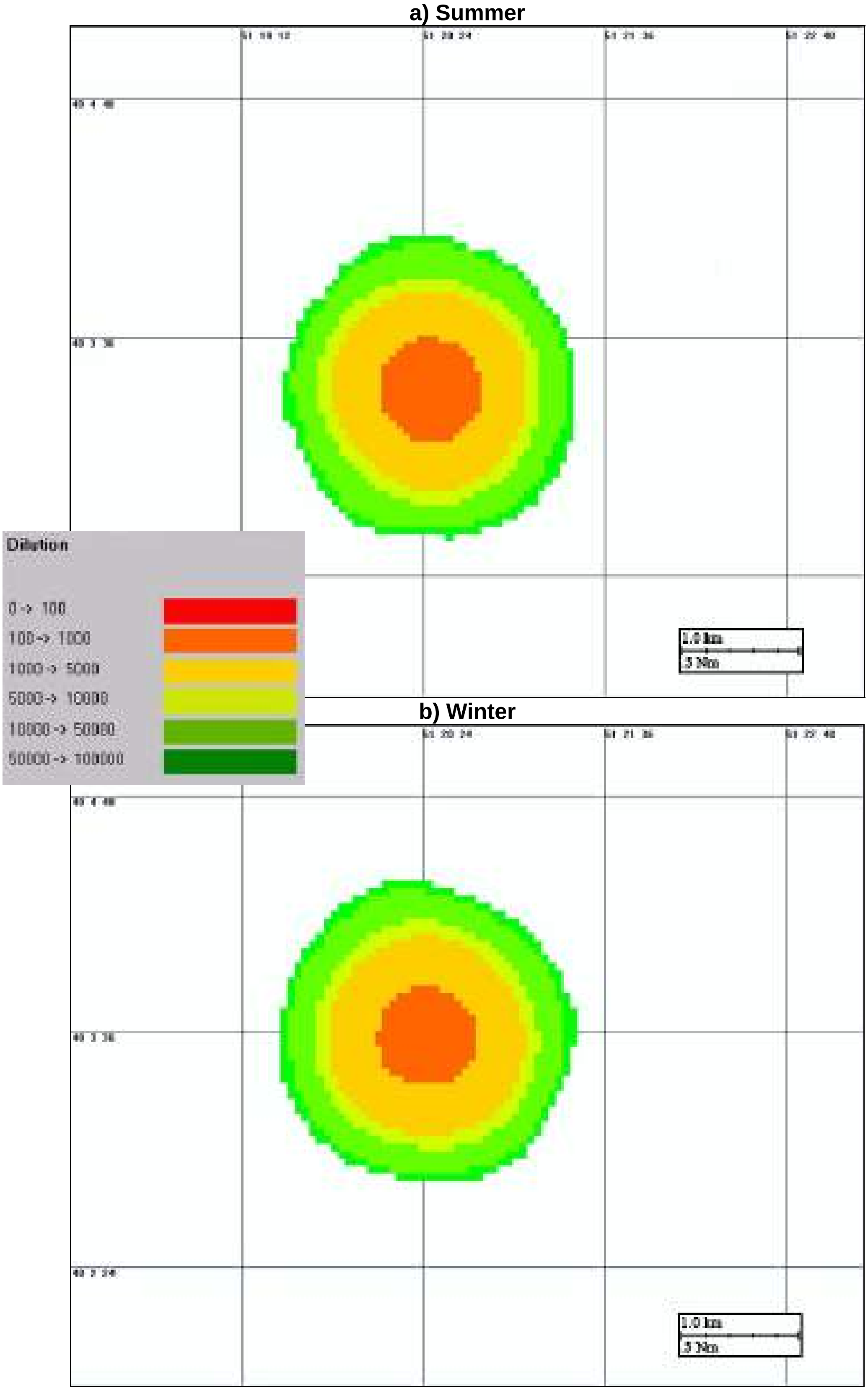


Figure 9.3 CWP location, 16 hours after a Scenario 1 release



9.3.4 Offshore facilities HUC and operation

The results of the environmental impact assessment of routine and planned non-routine activities associated with the hook-up and commissioning (HUC) and offshore operations associated with the ACG FFD PWD pipeline concluded that only environmental impacts of low residual significance would result from the activities. However, despite the low significance ranking, a number of issues have been raised during consultation in previous phases of ACG FFD and these are discussed. It should be noted that as the ACG FFD PWD pipeline will be connected to existing ACG FFD Phase 1 facilities at CA, no socio-economic impacts are associated with installation or presence of those facilities beyond those identified as part of the ACG FFD Phase 1 ESIA. All impacts from accidental or unplanned events associated with these offshore facilities as part of the PWD pipeline operation are of low significance.

Table 9.15 details the result of the environmental impact assessment for the offshore facilities HUC.

Table 9.15 Summary of impact assessment for offshore facilities HUC and commissioning for PWD Pipeline

9.12a Environmental impacts

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
OFFSHORE FACILITIES								
HUC and commissioning (offshore)								
E46	NDT	• Radioactive sources	• Contamination potential	• No radiography offshore	-	L	• No waste generation • No radioactive sources	None
Operation								
E47	Pigging of line once every 2 weeks (28-30 days for travel at low rate of 0.1m/s)–drainage of water at pig trap offshore	• PW waste from pig trap when draining to hazardous open drains. Hazardous chemicals to sea	• As E43	• As E43	-	L	• As E43	None
E48	Filter maintenance-disposal of filters and residue	• Hazardous solid waste	• As E43	• As E43	-	L	• As E43	None
E49	Pigging of line once every 2 weeks	• Hazardous solid waste (50 lb per run) to be disposed of onshore	• As E43	• As E43	-	L	• As E43	None
E50	Decommissioning plan to be produced	• As E24	• As E24	• As E24	-	L	• Plan not yet produced - site may be left to SOCAR to continue to operate	None

9.12c Unplanned/accidental events

ID	Activity	Aspects	Accidental Impacts	Existing Mitigation	Cumulative Contribution ▲	Residual Impact Significance	Impact Justification	Residual Issues to be Addressed
OFFSHORE FACILITIES								
HUC and commissioning (offshore)								
A22	Lifts of equipment over live facilities	• Dropped object on facilities - Spill - Fire - Explosion	• Contamination potential	• CCPs/CIPPs • Lifting plans	-	L	• Low probability of occurrence due to controls in place • Low consequence due to shut down of facilities	None
Operation								
A23	Pigging of line once every 2 weeks. – Potential blockage of filter	• Potential for surge being directed overboard to hazardous open drain caisson • Hazardous chemicals to sea	• Contamination potential	• Fast acting shut down value will be installed to block the filter (and prevent hazardous discharge) • Sparing provided by second online filter (if required)	-	L	• Medium probability of occurrence due to controls in place • Operational procedures in place to reduce consequence of impacts to low	None
A24	Failure at riser, process pipework, filters.	• Loss of containment	• Contamination potential	• Sparing (two filter system) and bypass built in • No failure at riser	-	L	• Low probability of occurrence due to controls in place	None
A25	Failure of injection system (pump)	• Disposal of Produced Water overboard	• Contamination potential	• No sparing but possible to inject less seawater (CWP) and discharge seawater overboard	-	L	• Low probability but low consequence of occurrence due to controls in place (seawater only discharged)	None

10 Environmental and Socio-economic Mitigation and Monitoring

Contents

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10.1 Introduction

The impact assessment for the Produced Water (PW) Disposal Project presented in Chapter 9, considers existing mitigation measures that have been designed into the project, in order to eliminate or reduce the potential for impacts from these activities. These measures include mitigation through engineering design, through existing environmental and social management plans and procedures that were developed as part of the Azeri project and implemented through the existing Environmental and Social Management System (ESMS) for the construction stage of the project (Chapter 5). For management of commitments, environmental and social assurance during operations, BP is currently finalising Environmental Management System (EMS) framework which will see a move from the Azerbaijan Business Unit described in Chapter 11 of the ACG Phase 3 ESIA to a new organisational structure under the Azerbaijan Strategic Performance Unit (AzSPU).

The following sections provide detail on organisational responsibilities of BP as operator for AIOC, the ESMS and EMS that will form the framework to manage the ACG FFD PWD Project and mitigation and monitoring commitments to minimise environmental/social impacts of the Project. Based on the fulfilment of these mitigation and management measures, it has been found that the ACG FFD PWD Project will not result in significant residual environmental or social impacts.

10.2 BP responsibilities

BP as operator of AIOC is responsible for the environmental and social management of all ACG projects, implementing project commitments and verification that the project's environmental and social performance complies with applicable legal, regulatory and policy standards in all material respects. The Azerbaijan Strategic Projects Unit (AzSPU) maintains overall responsibility for the company's projects in the region and for coordinating and standardising the management measures adopted in the company's activities, in fulfilment of Corporate goals, objectives and policy.

In terms of environmental performance, AzSPU is responsible for the development, alignment and adoption of common environmental policy across all projects, including commitment to legislative compliance, continual improvement and pollution prevention. This responsibility will extend to the activities of the ACG FFD PWD Project as the latest project in the phased development of the ACG Contract Area. In common with the preceding Phases of ACG, commitments related to mitigating environmental or social impacts under the direct responsibility of BP will also form contractual responsibilities for ACG FFD PWD Project contractors. These commitments are detailed within the system of Contractor Control Plans (CCPs) that contractors illustrate through compliance with the Contractor Implementation Plans and Procedures (CIPPs). Contractors working on aspects of the ACG FFD PWD Project will be audited against these CIPPs to ensure environmental and social compliance with the project standards (Appendix II).

10.3 Construction Environmental and Social Management System

The ESMS provides a structured framework to manage the environmental performance of the project and ensures:

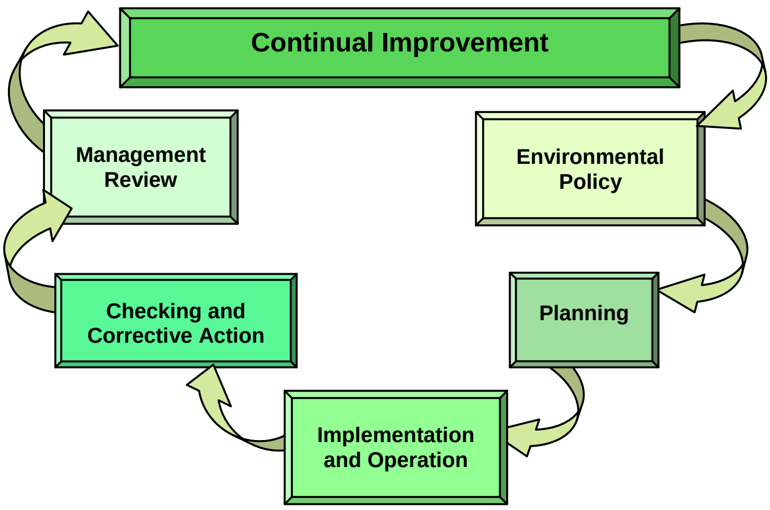
- That the project is constructed in accordance with relevant legal and regulatory standards;
- There is a focus on complying with the environmental and social commitments and objectives identified in this ESIA; and
- The commitments made relating to the project are implemented.

The construction ESMS is aligned with ISO 14001, the international standard for EMS, which contains the following key elements:

- Establishing objectives and targets;
- Defining organisation and responsibilities;
- Identifying legal and other requirements;
- Identification of significant environmental impacts;
- Establishing environmental management programmes and improvement plans;
- Operational control;
- Control of contractors and suppliers;
- Document control and records;
- Monitoring and measurement;
- Emergency preparedness and response;
- Training, awareness and competence;
- Communication;
- Non-conformances, corrective and preventative actions;
- Auditing and continuous improvement.

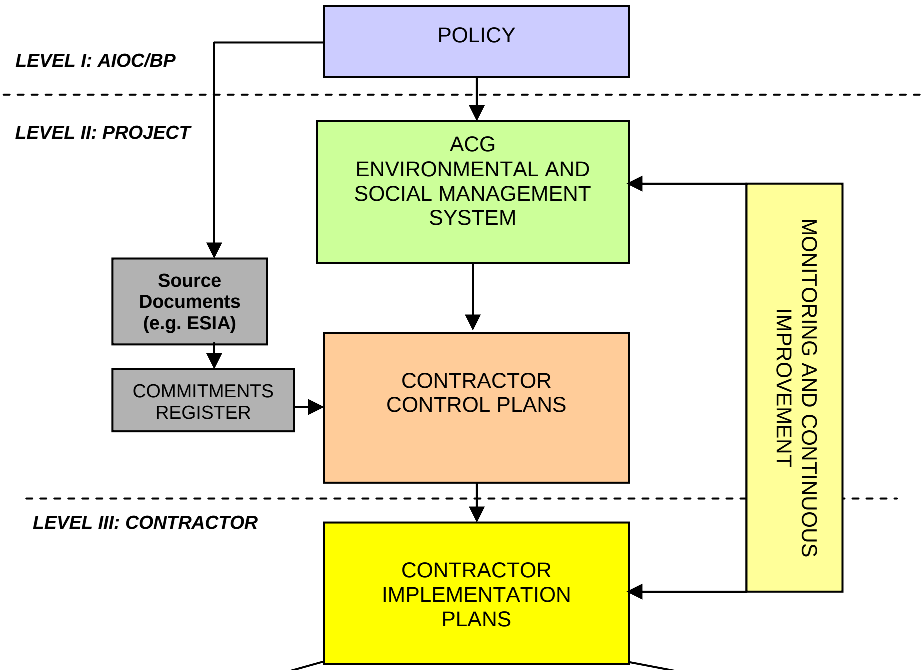
Figure 10.1 illustrates continuous environmental improvement as an integral part of the management system philosophy.

Figure 10.1 Continuous improvement philosophy of the construction EMS



As discussed, during construction the ACG FFD PWD Project will be managed within the Azeri Project Environmental and Social Management System (ESMS). The ESMS provides the framework for mitigation and monitoring of environmental and social management matters through the Contractor Control Plans, as discussed in Chapter 11 of the ACG Phase 3 ESIA and summarised in Figure 10.2.

Figure 10.2 Construction ESMS for the ACG FFD PWD Project



Contractor Control Plan title	
Environmental focus	**Social focus**
Pollution Prevention - requirements and minimum standards for measures required for the prevention of pollution to land, air and water during implementation of the Project.	Construction Camp - requirements and minimum standards for construction camp management during the construction programme.
Waste Management – requirements and minimum standards for waste management during the Project that will ensure that all wastes are minimised, handled, recycled and disposed of in accordance with Project requirements.	Communicable Diseases Awareness and Prevention - requirements and minimum standards for communicable disease awareness and prevention for all workforce personnel associated with the construction programme and communities near to the project workforce.
Fauna Management - requirements and minimum standards against which potential impacts vulnerable fauna in the area of Phase 1 construction activity may be managed and hence reduced or eliminated.	Recruitment, Employment and Training - requirements and minimum standards for recruitment, employment and training during the construction programme.
Aggregates Management - approach and procedures to be followed by Contractors for aggregate management.	Procurement and Supply Chain - requirements and minimum standards for the purchasing and supply of materials, goods and services during the construction programme.
Transport Management - requirements and minimum standards for transport and traffic management during implementation of the Project with particular emphasis on construction activities.	
Spill Response (construction) - requirements for response to land-based spills during implementation of the Project.	

10.4 Operations Environmental Management System

As BP Operations expand and new facilities are commissioned through 2005 to 2008, the existing EMS framework discussed in the ACG Phase 3 ESIA is being modified to allow easier integration of new operations. This is being achieved through the development and implementation of the BP Exploration Caspian Sea Ltd AzSPU Integrated Management System for HSSE and Compliance. The certification of the system will be in accordance with ISO 14001 requirements. The management system has the following main focus areas and content:

Management System improvements

- Enhanced ISO system with compliance focus which will:
  - Be built on other BU documents and learning
  - Provide examples of increased systematic compliance focus
  - Detail 'Legal and Other Requirements' procedure
  - Increase requirements for operational controls for compliance obligations
  - Provide compliance monitoring and measuring, including internal and external audits

Compliance matrix

- The identification of applicable National and International legal requirements and those within project specific documents.
- Identification of specific actions required as 'compliance tasks'
- Assigning compliance tasks
- Clear communication to responsible parties
- Provision of operational controls to ensure understanding

Document control

- Document Management System to record appropriate management system information and make it accessible to the appropriate persons.

Integrated Environmental Monitoring Programme

All environmental monitoring work undertaken by BP is managed under an integrated environmental monitoring programme (IEMP). This programme is intended to co-ordinate and rationalise existing monitoring activities, with the aim of ensuring that issues of compliance, effective environmental management and reputation are adequately addressed.

The integrated monitoring programme is based on the following principles:

- Set clear, common and consistent monitoring objectives across all projects
- Set clear, common and consistent processes and criteria for evaluation of outputs and common approach to reporting across all PUs
- Co-ordinate monitoring activities across PUs, to ensure a consistent technical approach and to ensure that shared interests and objectives are accounted for
- Provide outputs which can be used effectively within the ESMS in the avoidance, mitigation or remediation of impacts
- Provide outputs which can be used to report on environmental performance in a way which is consistent and which meets relevant external expectations
- Establish a process for regular synthesis of monitoring results to ensure the best practicable interpretation and understanding of environmental status and regional environmental trends in BP's operational areas

- Progressively adapt and adjust monitoring design to most cost-effectively meet the requirements of future operations
- Achieve, where practicable, alignment and complement other Caspian environmental monitoring activities and initiatives (i.e. Caspian Environmental Programme, Russian-Kazakh Caspian Monitoring Centre) as and when information on such activities becomes available.

In more general terms, the monitoring programme aims to make the best use of methods, which are practicable and cost-effective and sets realistic objectives and targets, which serve as a basis for the design of individual studies. This will provide accurate, defensible and interpretable data that will:

- Reflect the actual environmental conditions and changes in relation to the baseline
- Stand up to international and national scrutiny
- Demonstrate the effectiveness of BP's Environmental Policy
- Provide information on the environment prior to and following Business Unit activities and make the most effective practicable comparisons with predictions in the ESIAs and other source documents
- Build upon past monitoring work and ensure that future operations have a solid basis of environmental and scientific data.

Monitoring work associated with produced water pipeline installation and operation activities will be managed within the IEMP. An overview of the monitoring activities that will be completed is provided in Section 10.7.

10.5 Commitments to action

The ACG FFD PWD Project ESIA represents the culmination of an extensive and rigorous environmental and social assessment process conducted for all Phases of the ACG Project. Lessons learned from ACG Phase 1, 2 and 3 have been incorporated at each step of the project design, planning and ESIA processes to maintain and where possible enhance environmental and social performance.

As with ACG Phase 1, 2 and 3, potential impacts identified from the ACG FFD PWD Project will require additional mitigation and management in the project construction and operation phases. These project specific mitigation and management measures will be formalised in the ACG FFD PWD Project Commitments Register, together with applicable commitments from the earlier ACG Phases and MENR project specific requirements issued in response to BP's request for approval. The Commitments Register is the primary tool in the EMS/ESMS to provide:

- Transparency in translating commitments to action;
- Clear assignation of responsibilities for commitments;
- Resourcing and allocation of budget to achieve commitments; and
- Definition of timeline for action.

10.6 ACG FFD PWD Project Environmental and Social Management

10.6.1 Current project control under ACG Phase 1, 2 and 3

As discussed, the ACG FFD PWD Project benefits from an established EMS/ESMS developed as part of the earlier Phases of ACG. These have been discussed in detail within the individual ESIA reports for ACG Phases 1 and 2 and additional information was provided in Chapter 11 of the ACG Phase 3 ESIA as the first Phase to benefit from actual construction/operations data from Phases 1 and 2. The description of the current level of project control from the earlier Phases of ACG is not repeated here (reference ACG Phase 3 ESIA Chapter 11).

10.6.2 ACG FFD PWD Project mitigation

When considered in isolation for the project, the majority of activities proposed for the ACG FFD PWD Project will not result in a significant residual environmental or social impact. This is due to the small scale of the activity or the distance of the activity from receptors or through the effective mitigation of impacts achieved in the design implemented by the earlier Phases 1, 2 and 3 projects.

The residual environmental impacts shown in Table 10.1 are those identified in Chapter 10 as being of medium or high significance if the ACG FFD PWD Project is considered independently of other projects. In addition, impacts ranked as low but which represent a cumulative issue for BP in combination with other projects, or are of concern considering wider issues in Azerbaijan have also been identified. The ACG FFD PWD Project will not result in any significant socio-economic impacts but rather will provide revenue and employment through the purchase of materials, goods and services in Azerbaijan and extended use of the existing workforce.

It should be noted that the assessment of residual impact significance considered all existing ACG control measures already identified by the project. These control measures are captured in the Commitments Register. Verification that these commitments are implemented and effective will be provided by the EMS/ESMS. The monitoring that will be conducted as part of this verification is described in section 10.7.

Table 10.1 Summary and classification of residual impacts and issues from ACG FFD PWD Project

Activity	Aspect	Significance/Justification
Accidental Events		
Pipeline operation	Corrosion and potential release of contaminated PW onshore/offshore	**Medium**: Contamination of onshore/offshore environments
Pipeline operation	Potential damage to line from impact (vessel grounding/anchor impact) and release of contaminated PW offshore	**Low:** Low probability of pipeline breach but anchor impact has occurred on the ACG Phase 1 lines
Decommissioning	Removal of facilities at the end of the project lifetime	**Low**: Wider issue for all BP projects

The mitigation and management of these are discussed in the following subsections.

10.6.2.1 Mitigation of impacts from ACG FFD PWD

Corrosion and potential release of contaminated Produced Water

As discussed in Chapter 9, the PW pipeline is of a steel construction and at risk of corrosion from the PW inventory. To mitigate against potential corrosion over the long-term leading to loss of integrity of the pipeline, the project has developed a corrosion management plan. This details the injection of chemicals into the PW pipeline to remove oxygen content and biological action. Over the lifetime of the project, chemicals will be injected into the PW pipeline to mitigate against the risk of corrosion (Chapter 5, Section 5.2.5).

During the operation of the pipeline, the line will be monitored by a leak detection system (Chapter 5, Section 5.2.2.7). Regular pigging, including intelligent pigging every few years, will be used to detect corrosion over the expected amount and any integrity issues with the pipeline. Regular surveying will also be conducted to monitor the condition of the pipeline as part of the operational pipeline-monitoring programme for the ACG Phase 1, 2 and 3.

Potential damage to line from impact (vessel grounding/anchor impact) and release of contaminated Produced Water offshore

The risk of the Produced Water pipeline becoming damaged and releasing inventory through direct impact from either vessel grounding in the nearshore zone or anchor impact is low. However, current experience from ACG Phase 1 has shown that anchor impact across the pipeline does occur. To date umbilicals installed to provide communications to the offshore platforms in CA have been damaged by anchor impact. In addition, the ACG Phase 1 oil line has received surface damage from anchor dragging, although not sufficient to comprise the structural integrity of the line. In addition, the EOP outfall line in Sangachal Bay has been damaged by a vessel-grounding incident.

The project design has incorporated measures to afford some protection to the ACG FFD PWD pipeline. Mitigation against potential vessel grounding will be provided by burying the pipeline in water depths less than 11 m to a buried depth of 0.5 m from the top of pipe to the seabed (Chapter 5, Section 5.2.6). This will ensure that the pipelines do not constitute a hazard to vessel navigation in the nearshore zone.

The Produced Water pipeline will be concrete coated along its entire length. Whilst the coating is primarily designed to provide negative buoyancy for maintaining the position of the line, it also provides anchor impact protection. To enhance the protection, the concrete coating will be of a greater thickness for the section of the pipeline in nearshore shallow waters. Offshore water depths are such that anchor velocity will be reduced as the anchor is deployed thereby reducing the potential impact on the pipeline.

The pipeline will be located within the safety exclusion zone that currently exists for the ACG and SD oil and gas lines. This exclusion zone prohibits certain activities such as anchoring in the location of the pipelines. In addition, once installed, the position of the pipelines and the safety exclusion zone will be plotted on Admiralty charts, which are made available to vessel operators in the region.

Decommissioning

Under the terms of the ACG PSA, AIOC is required to produce a field abandonment plan one year prior to completion of 70 percent production of identified reserves. SOCAR will assume ownership for all ACG facilities at the end of the PSA agreement in 2024. To address the financial burden associated with decommissioning and abandonment, all partners involved in the ACG projects are required under the PSA to contribute a proportionate share of the revenue raised from the projects to cover decommissioning costs. These funds will be used to establish an “Abandonment Fund” such that the funds can be accrued against the decommissioning costs. Under the terms of the PSA, SOCAR as future operators of the ACG development will inherit the Abandonment fund set aside for this purpose.

The PSA does not state specific requirements on the methodology of decommissioning and in view of the operational lifetime of the ACG project, it is not possible at this time to provide finalised details for the method or extent to which the facilities will be decommissioned. A review of generic decommissioning options and methodologies for offshore and onshore facility decommissioning and consideration of associated environmental impacts, are presented in the ACG Phase 1 ESIA (Chapter 10.7). It is recognised that technology, facilities and infrastructure will change over the lifetime of the project within the Caspian region, as will international experience in decommissioning oil and gas installations. The current international approach to decommissioning is to conduct a BPEO to provide a comparative assessment of available options. The purpose of the BPEO will be to consider both the potential alternative uses for facilities to extend their operational life and detailed options for field abandonment assessed in terms of environmental impact, health and safety, technical feasibility and cost effectiveness.

10.6.2.2 Mitigation of impacts from the cumulative contribution of ACG FFD PWD Project

No aspect of the Produced Water project will contribute to significant environmental impacts from a cumulative contribution with other BP projects in the region. Similarly, there are no significant socio-economic impacts associated with the ACG FFD PWD project. However as this project is part of the entire ACG FFD project it is appropriate to discuss the initiatives managed by the project to mitigate socio-economic impacts. As reported in the Phase 3 ESIA the project have committed to a 10 year programme to enhance economic and social capacity building.

ACG funding of the community investment began in 2002 and will continue to late 2007. It has a budget of $6.7 m and targets activities in the Garadag region concentrating on communities of Sangachal, Umid, Sahil, Lokbatan, Alyat, Gobustan, Korgoz and Gizildash as well as Bibi-Heybat. This programme targets areas of development including education, income generation, community development, health and associated infrastructure. In 2005, 31 micro-projects were implemented; 18 infrastructure projects, 8 health/environment projects and 5 education projects including the opening of a Business Development Resource Centre in Sahil.

10.7 Monitoring

As previously discussed in Section 10.4 all monitoring completed by BP will be managed under the IEMP. Prior to initiating any monitoring work the scope of the survey will be discussed and agreed with the following key stakeholders; AIOC R&MG, the MENR and Caspian Complex Environmental Monitoring Laboratory (Marine Surveys). This same group of stakeholders will be involved in the review of the final report. The environmental monitoring needs associated with the installation of the Produced Water have been incorporated into the IEMP work plan for 2006 and the surveys described below are in various stages of completion.

Prior to the start of construction work along the onshore ROW, a terrestrial ecological survey will be completed. The objective of the survey will be to assess the ecological quality of the ecosystems that the ROW traverses from the landfall site to the terminal. The survey will be completed in 4Q 2006 and the results of this coupled with the existing monitoring data sets will be used to confirm the baseline conditions and form the basis for restoration plans for the ROW.

A seagrass and seabed chemistry/macrobenthic ecological survey of the nearshore section of the pipeline within Sangachal Bay will be completed in 3Q 2006. These surveys are designed to improve BP's understanding of the marine ecosystem in the nearshore area and provide information on the status of the environment following ACG and Shah Deniz pipeline installation work and pre-installation of the produced water line. The data collected in 3Q 2006 surveys will be compared with previous year's data and will be used to develop long term monitoring plans of the area.

As part of the IEMP programme, an ACG offshore pipeline corridor survey is planned in 3Q 2006. The survey will involve the collection of seabed samples for chemical and particle size analysis and identification of macrobenthic fauna. The objective of the survey will be to provide information on the current sediment characteristics along the ACG Pipeline route, highlight any trends from nearshore to offshore along the route and make comparison to previous surveys in 1995 and 2000. The survey will also provide a baseline data prior to the installation of the produced waterline.

During installation and construction, the ACG FFD PWD Project will be subject to the controls committed to under the CCPs (detailed in Figure 10.2) and will be included within the general monitoring conducted as part of the IEMP programme for the onshore facilities. This will include air, dust and noise monitoring at key receptors in the vicinity of Sangachal Terminal.

11 Conclusion

Contents

11.1 Introduction

The oil produced from the ACG Contract Area contains water which requires removal. Offshore facilities can remove 95% produced water from oil for reinjection offshore therefore 5% produced water is sent onshore co-mingled with oil. This Produced Water, separated out of the product at the platform, is reinjected offshore and the percent remaining in the oil is received onshore at Sangachal Terminal. This Produced Water needs to be removed through further separation at the terminal in order to achieve the WIO specification required for delivery to the BTC export pipeline.

The ACG FFD PWD Project is proposed for the solution for the disposal of the Produced Water generated at Sangachal Terminal. The proposed Project will send the Produced Water back offshore via a dedicated pipeline for reinjection at the CA Complex.

This ES has described the options assessed in the concept development of the ACG FFD PWD Project and given a full technical description of the selected option. The baseline environmental and socio-economic conditions have been documented. All aspects of the project that have the potential for impacting the environment, including the socio-economic environment have been assessed, together with the mitigation and control measures already defined.

11.2 Impact Assessment Findings

The impact assessment methodology adopted for this assessment denotes any residual impact that was ranked as “medium”, “high” or “critical” as significant. The identification of potential significant residual impacts required the development and implementation of additional mitigation measures.

No impacts of high significance were identified from the proposed ACG FFD PWD Project. On assessment of all activities, routine, unplanned/non-routine or cumulative, the majority of activities proposed for under project will not result in a significant residual environmental or social impact, either due to the small scale of the activity, the distance of the activity from receptors or through the effective mitigation of impacts through careful design and procedural control.

One residual impact has been identified as of medium significance; an uncontrolled continual release of untreated Produced Water as a result of pipeline corrosion. Considering the implementation of the corrosion management plan and leak detection system developed for the project the likelihood of such an event occurring is low.

The ACG FFD PW Project will also result in beneficial or positive socio-economic impacts. The Project will need to procure a variety of goods and services during the construction phase. It is not possible at present to provide the in-country and out-of-country spending allocation for construction works before the Project obtains approval and enters into the contracting strategy. Nevertheless, local yards such as ShelProjectStroi (SPS) will be used for national fabrication, storage, and supply base requirements and goods and materials will be sourced locally where possible. As a result positive social impacts will result from incountry project spending resulting in increased income opportunities for national businesses, companies and suppliers. In addition, the personnel needs required for the ACG FFD PWD Project will be largely provided from the workforce developed for the previous ACG FFD Phases. This will be achieved through extension of current employment contracts or supplementation from the employee database where possible.

On consideration, the ACG FFD PWD Project within the context of ACG FFD is deemed to deliver a long-term environmentally and socially acceptable solution to the disposal of Produced Water in fulfilment of the commitments made under ACG Phase 1, 2 and of the conditional approval granted for ACG Phase 3.

APPENDIX I

ACG PSA Extract

ARTICLE XXVI

ENVIRONMENTAL PROTECTION AND SAFETY

26.1 Conduct of operations

Contractor shall conduct the Petroleum Operations in a diligent, safe and efficient manner in accordance with generally accepted International Petroleum Industry standards and shall take all reasonable actions in accordance with said standards to minimise any potential disturbance to the general environment, including without limitation the surface, subsurface, sea, air, lakes, rivers, animal life, plant life, crops, other natural resources, and property. The order of priority for actions shall be the protection of life, environment, and property.

26.2 Emergencies

In the event of emergency and accidents, including but not limited to explosions, blow-outs, leaks and other incidents which damage or might damage the environment, Contractor shall promptly notify the State Oil Company of the Azerbaijan Republic (SOCAR) of such circumstances and of its first steps to remedy this situation and the results of said efforts. Contractor shall use all reasonable endeavours to take immediate steps to bring the emergency situation under control, protect against loss of life and loss of or damage to property, and prevent harm to natural resources and to the general environment. Contractor shall also report to SOCAR and appropriate Government authorities on the measures taken.

26.3 Compliance

Contractor shall comply with present and future Azerbaijani laws or regulations of general applicability with respect to public health, safety, and protection and restoration of the environment, to the extent that such laws and regulations are no more stringent than the then current International Petroleum Industry standards and practices being at the date of execution of this Contract those shown in Appendix IX, with which Contractor shall comply. If Appendix IX specifies more than one standard with respect to a matter, Contractor will use the standard most appropriate relative to the ecosystem of the Caspian Sea. In the event any regional or multi-governmental authority having jurisdiction enacts or promulgates environmental standards relating to the Contract Area, the Parties will discuss the possible impact thereof on the project. The provisions of Article 23.2 shall apply to any compliance or attempted compliance by Contractor with any such standards that adversely affect the rights or interests of Contractor hereunder.

26.4 Baseline study and ongoing environmental monitoring

(a) In order to determine the state of the environment in the Contract Area at the Effective Date, Contractor shall cause an environmental baseline study (under the Minimum Obligatory Work Programme as referred to in Appendix X) to be carried out by a recognized international environmental consulting firm selected by Contractor, and acceptable to SOCAR. SOCAR shall nominate representatives to participate in preparation of the study in collaboration with such firm and Contractor representatives. The costs of such study shall be borne by Contractor, except that SOCAR shall be liable for all costs associated with the representatives nominated by SOCAR. The costs associated with this study shall be subject to Cost Recovery in accordance with Article XI. Contractor shall conduct ongoing environmental monitoring of its operations. Data collected will be evaluated at least annually to determine if any practices and discharge standards need to be revised.

The Environmental Strategy included in Appendix IX outlines the environmental program that Contractor (and SOCAR in the event it carries out operations on the Chirag-1 platform pursuant to Article 10.3 or operations with or without a Third Party pursuant to Article 15.2(e)) will follow during the course of Petroleum Operations within the Contract Area. The evaluation of data collected during the ongoing monitoring program, together with the baseline study, will provide a basis for determining whether any unacceptable environmental impact has been caused by Contractor in the course of conducting Petroleum Operations and for which Contractor may be liable under Article 20.2, or whether the conditions leading to such impact existed prior to the commencement of Petroleum Operations or otherwise from activities conducted by a party other than Contractor. SOCAR and Contractor shall review the environmental baseline study and consult to determine whether any remedial action is warranted to mitigate the effects of any impact which occurs or has occurred from such prior conditions, and if so, whether a programme of remediation could be carried out by Contractor, it being agreed among the Parties that Contractor shall not be liable for any of the expense of such a remedial programme. Any such remedial program undertaken will be considered outside the scope of the Environmental Strategy and will be conducted pursuant to the terms of a separate agreement between SOCAR and Contractor.

(b) In the event SOCAR operates the Chirag-1 platform as provided pursuant to Article 10.3 and/or SOCAR and/or any Third Party operates any other facilities with respect to development of Non-Associated Natural Gas pursuant to Article 15.2(e), then in connection with performance of the ongoing monitoring program Contractor shall have the right to make periodic inspections of the Chirag-1 platform and such other facilities and SOCAR's and/or any Third Party's operations with respect thereto, including, but not limited to, the placement of monitoring devices and collection of samples relevant to the monitoring program. Contractor's above referenced inspections, sampling, and placement of monitoring devices shall be performed by Contractor in a manner which does not unreasonably interfere with SOCAR's and/or any such Third Party's operations on the Chirag-1 platform or such other facilities.

26.5 Environmental damage

(a) Contractor shall be liable for those direct losses or damages incurred by a Third Party (other than the Government) arising out of any environmental pollution determined by the appropriate court of the Azerbaijan Republic to have been caused by the fault of Contractor. In the event of any environmental pollution or environmental damage caused by the fault of Contractor, Contractor shall reasonably endeavour, in accordance with generally acceptable International Petroleum Industry practices, to mitigate the effect of any such pollution or damage on the environment.

(b) Contractor shall not be responsible and shall bear no cost, expense or liability for claims, damages or losses arising out of or related to any environmental pollution or other environmental damage, condition or problems which it did not cause, including but not limited to those in existence prior to the Effective Date of this Contract, as well as any environmental pollution or other environmental damage, condition, or problems arising out of SOCAR's operation of the Chirag-1 platform pursuant to Article 10.3 and SOCAR's and/or any Third Party's development of Non-Associated Natural Gas pursuant to Article 15.2(d); and SOCAR shall indemnify and hold harmless Contractor, its Sub-contractors, and its and their consultants, agents, employees, officers, and directors from any and all costs, expenses, and liabilities relating thereto.

(c) Any damages, liability, losses, costs, and expenses incurred by the Contractor arising out of or related to any claim, demand, action, or proceeding brought against Contractor, as well as the costs of any remediation and clean-up work undertaken by Contractor, on account of any environmental pollution or environmental damage (except for such pollution or damage resulting from the Contractor's Wilful Misconduct) caused by the Contractor shall be included in Petroleum Costs.

APPENDIX IX

ENVIRONMENTAL STANDARDS AND PRACTICES

I. Environmental sub-committee

A. The formation and organization of an environmental sub-committee shall be set forth in a proposal of Contractor which will be submitted to the Steering Committee for approval. Once approved by the Steering Committee, the environmental sub-committee shall be formed in accordance with the approved recommendation and shall be composed of environmental representatives of Contractor Parties and SOCAR, GiproMorNefteGaz, other research institutes, and State Committee of the Azerbaijan Republic on Ecology and Control over the Use of Natural Resources.

B. Responsibilities of the environmental sub-committee

(i) Design Annual Monitoring Program for monitoring of selected environmental parameters

- Coordinate Annual Monitoring Program
- Review results and propose recommendations
- Publish annual report

(ii) Select research projects

- Administer environmental protection research projects
- Allocate funding as designated for this purpose in any Annual Work Programme and Budget
- Review progress
- Publish results

II. Environmental strategy

The environmental strategy to be pursued pursuant to Article 26.4 shall be as follows:

A. Baseline Data

1. Literature review

2. International standards review

3. Audit of existing operations and practices

4. Environmental data collection
   - Atmospheric
   - Water quality
   - Benthic
   - Flora and fauna
   - Meteorological and oceanographic
   - Sediment
   - Background radiation

B. Environmental Impact Assessment (existing facilities, exploration and production activities, and new facilities)

1. Project description

2. Environment description

3. Technology assessment

4. Air emission inventory

    - Dispersion modelling
    - Impact evaluation

5. Water discharge inventory

    - Fate and effects modelling
    - Impact evaluation
        - Treat and discharge offshore
        - Treat onshore and discharge
        - Injection onshore or offshore

6. Waste inventory

    - Disposal options
    - Impact evaluation
    - Offshore treatment and disposal
    - Transportation and onshore disposal

7. Abandonment studies

    - Disposal options
    - Impact evaluation

8. Cost benefit analysis

9. Environment statement of preferred options

C. Oil Spill Response Planning

1. Sensitivity mapping

    - Habitats
    - Fisheries
    - Birds
    - Animals
    - Benthic organisms
    - Marine flora

2. Risk Assessment

3. Prediction modelling

4. Equipment and material resourcing

5. Evaluation of chemical treatments

6. Response organizations

7. Treatment and disposal of oil and chemical contaminated material

III. Effluent guidelines

The following are general and specific guidelines relating to discharges associated with oil and natural gas exploration and production activities.

A. General guidelines

1. There shall be no discharge of waste oil, produced water and sand, drilling fluids, drill cuttings or other wastes from exploration and production sites except in accordance with the following guidelines.

2. There shall be no unauthorized discharges directly to the surface of the sea. All discharges authorized by these guidelines shall be controlled by discharging into a caisson whose open end is submerged, at all times, a minimum of sixty (60) centimetres below the surface of the sea.

B. Discharge guidelines and monitoring

1. Produced Water

(a) Contractor will endeavour to utilize produced water for reservoir pressure maintenance if, through standard compatibility testing with Caspian Sea water, no damage to the reservoir resulting in a reduction in overall hydrocarbon recovery would occur by mixing the two water streams. In the event that the two water streams are compatible, Contractor may only discharge a volume of produced water after treatment to the Caspian Sea that exceeds the total volume required for reservoir pressure maintenance or in the event of an emergency, accident or mechanical failure. In the event that the two water streams are not compatible, Contractor may discharge produced water to the Caspian Sea after treatment. Treatment of produced water will result in an oil and grease concentration that does not exceed 72 mg/l on a daily basis or 48 mg/l on a monthly average. The gravimetric (extraction) test method EPA 413.1 (79) shall be used to measure the oil and grease concentration.

2. Drill cuttings and drilling fluids

(a) There shall be no discharge of oil based drilling fluids, other than low toxicity and biodegradable drilling fluids.

(b) There shall be no discharge of drill cuttings generated in association with the use of oil based drilling fluids, invert emulsion drilling fluids, or drilling fluids that contain waste engine oil, cooling oil, gear oil, or other oil based lubricants, other than cuttings generated in association with the use of low toxicity and biodegradable drilling fluids.

(c) There shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than four (4) times the ambient concentration of the receiving water.

(d) Prior to the start of the drilling programme, a drilling mud system will be designed and laboratory tested under the U.S. EPA, 96-hour acute toxicity test using mycid shrimp. Those muds that achieve an LC_{50} value in concentrations of more than 30,000 ppm will be authorised for discharge during the drilling programme.

(e) During drilling operations, mud samples will be collected periodically to determine toxicity using procedures established for the Caspian Sea.

(f) The composition of the mud system may be altered as necessary to meet changes in the drilling operations. The modified mud system may be discharged if it has been shown to meet the above limits on oil, salinity, and toxicity.

3. Other wastes

(a) Sanitary waste may be discharged from a U.S. Coast Guard certified or equivalent Marine Sanitation Device (MSD) with total residual chlorine content greater than 0.5 mg/l but less than 2.0 mg/l as long as no floating solids are observable. The Hach method CN-66-DPD test shall be used to measure the residual chlorine.

(b) Domestic wastes and gray water may be discharged as long as no floating solids are observable.

(c) Monitoring of floating solids shall be accomplished during daylight by visual observation of the surface of the receiving water in the vicinity of the sanitary and domestic waste outfalls. Observations shall be made following either the morning or midday meals and at a time during daylight and maximum estimated discharge.

(d) Desalinization unit wastes shall be discharged.

(e) Deck drainage and wash water may be discharged as long as no visible sheen is observable.

(f) Trash shall not be discharged offshore. Trash shall be transported to an appropriate land-based disposal facility.

(g) Produced water

1. The volume of produced water discharged and concentration of oil and grease contained in the discharge will be monitored daily.

2. The daily maximum and monthly average oil and grease concentration will be reported monthly.

(h) Drill cuttings and drilling fluids

1. An inventory of drilling fluids additives and their volumes or mass added to the drilling fluid system will be maintained for each well.

2. Drilling fluid properties, including volume percent oil and concentration of chlorides, will be monitored daily for each well.

3. The estimated volume of drill cuttings and drilling fluids discharged shall be recorded daily and reported monthly.

(i) Other wastes

1. The estimated volume of other wastes discharged shall be recorded daily and reported monthly to include:

- Sanitary waste
- Domestic waste
- Deck drainage and wash water

IV. Air emission guidelines and monitoring

Contractor is authorized to discharge air emissions. Such discharges will be limited and monitored as follows:

A. Any building, structure, facility, or installation that emits or may emit nitrogen oxides (NO_x), sulphur dioxides (SO_x), carbon monoxide (CO), volatile organic compounds (VOCs), or particulate (PT) in an amount equal to or greater than 227 metric tons per year (MTPY) per individual pollutant (250 short tons per year) shall install the best available control technology on all equipment creating the emissions suitable for the equipment creating the emissions and its location. If the source is above 227 MTPY, screening modelling will be conducted to determine potential impacts on sensitive receptors. This trigger amount may be less in cases where sensitive receptors are in close proximity to the source. (NOTE: Any individual item of equipment emitting less than 23 MTPY (25 short TPY) or IC engines/turbines below 500 break horsepower would be exempt from this requirement.) Emergency flares on facilities will be designed to operate smokeless and with continuous pilots or equivalent ignition systems.

B. Any storage vessel with a capacity greater than 1,590 cubic metres (10,000 Barrels) used for petroleum or condensate storage shall install necessary control technology to minimize emissions.

C. IC engines/turbines larger than 500 HP should be monitored on an annual basis to assure that the NO_x and CO emissions are at the specified levels. Portable analyzers for monitoring the NO_x and CO should be calibrated before each test using a known reference gas sample.

All new facilities will comply with the above standards. Existing facilities within the Contract Area being operated by Contractor will be brought into compliance with these standards according to a schedule to be negotiated, taking into account the condition, function and economic viability of the facilities.

V. Safety Guidelines

Contractor shall take into account the following international safety and industrial hygiene standards in conducting its Petroleum Operations under the Contract:

A. Oil Industry International Exploration and Production Forum (E&P Forum) Reports – Safety.
B. International Association of Drilling Contractors (IADC) – Drilling Safety Manual.
C. International Association of Geophysical Contractors (IAGC) – Operations Safety Manual.
D. American Conference of Governmental Industrial Hygienists – Threshold Limited Values for Chemical Substances in the Work Environment.

APPENDIX II

ACG FFD Project HSE Design Standards

HEALTH

Descriptions	HSE Standards
Medicals	• All project personnel will be medically screened prior to starting work, with particular consideration to hearing and dermatitis checks. • Specific surveillance programs will be instituted for personnel potentially exposed to toxic or radioactive substances. • Medical support will be provided to all project construction work sites.
Hygiene	• Routine assessment of water quality and catering facilities will be conducted at project construction work sites in Azerbaijan. • Changing, toilet and washing facilities will be provided at project construction work sites in Azerbaijan. • Lunch will be provided at project construction work sites in Azerbaijan.
Noise	• During project execution, tasks and working environments will be assessed for noise and measures put in place to ensure that levels will be kept as low as possible. The codes used are Noise & Statutory Nuisance – EPA 1990 / 1995 and UK HSE "Control of Noise (COP for Construction and Open Sites Orders 1984 / 1987)" and "Noise at Work Regulations 1989". • The design will be assessed for noise and the following measures used: • 85 dBA (average level) exposure for a maximum of 12 hours. • 45 to 60 dBA inside the accommodation (depending upon location – such as office or sleeping areas).
Health Risk Management	• Workplace, environmental, and travel health hazards will be identified and risks assessed and managed.

SAFETY

Descriptions	HSE Standards
Training	• All project personnel will receive an appropriate level of safety and environmental training. • A training matrix will be developed for each site and will include training to cover operation of equipment, emergency survival and fire fighting, safe chemical handling and use of MSDSs, emergency response procedures, PPE, evacuation, and applicable regulatory requirements. • Project leadership will be trained in Advanced Safety Auditing and Accident and Incident investigation.
Design Safety Reviews	• A risk-based design approach will be adopted, supported by blast calculations, escape and evacuation assessments, **fire and explosion risk analysis,** Cs, Hazard Identification (HAZIDs - including supplier packages), formal project safety reviews, and Temporary Refuge impairment analysis. • A QRA will be carried out to confirm the Individual Risk and Temporary Refuge Impairment values achieved and to assist in demonstrating that risk has been reduced to As Low As Reasonably Practicable (ALARP).
Hazard Management Plan	• An overall Hazard Management **Register** to explain the hazards and the measures included to manage them will be prepared **by the design team** and approved by the Business Unit Leader.
SIMOPS	• Simultaneous Operations (e.g. drilling and HUC, drilling and production, installation and production) will be assessed and procedures will be prepared to control the identified risks to an acceptable level.
Manual Handling	• A lifting and access assessment of the design will be completed to eliminate the need for manual handling > 50 kg between two men in the operating phase. • During project execution, tasks will be assessed and the need for manual handling > 50 kg between two men will be eliminated.
Hazardous Substances	• The design will be based on eliminating the exposure of individuals to hazardous substances in the operating phase, including well work. • Particular emphasis will be placed, in the design phase, on assessing and eliminating the gaseous emission of the carcinogens benzene, toluene, and xylene (BTX) in the operating phase. • During project execution tasks will be assessed to ensure adequate controls are in place to minimise the impact of hazardous substances on individuals.
Seismic Event	• The platform will be designed to withstand the 50-year return period seismic event where no loss of life, no loss of containment and little or no damage to the platform is expected. • Design will be checked against the 3,000-year return period, where the platform can sustain damage but should not collapse and there should not be major health or safety consequences.
Storm	• The offshore design will be such that personnel can survive a 100-year storm without leaving the platform.
Road Safety	• A Road Safety Strategy will be developed and implemented for the Project in line with the Business Unit's Road Safety Management, with the aim of eliminating or minimising transportation risks. The strategy will focus on the areas of: • Safe driving procedures • transportation logistics and journey planning • vehicle standards and maintenance • training, competence and behaviour of drivers, passengers and others • road and access planning • safe driving performance measures and assessment • assurance that management of Road Safety is implemented and functioning as intended.

ENVIRONMENT

Description	HSE Standards
Applicable Guidelines	• The project will be designed to comply with the relevant health, safety and environmental guidelines, standards and practices of International Finance Institutions (IFIs) and Export Credit Agencies (ECAs).
Monitoring and Measurement	• The design will provide sufficient sample and measurement points to enable adequate monitoring of emissions and discharges during the operating phase.
Ozone Depleting Substances (ODS)	• These substances will not be used. • ODS are defined as those substances which are controlled by the Montreal Protocol on Substances that Deplete the Ozone Layer.
Other Halocarbons with Potential for Global Warming	• Other halocarbons that do not deplete the ozone layer, but which have other environmental concerns such as a high global warming potential (GWP) will not be used unless suitable alternatives are not available. These include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).
Water Based Drill Fluids and Cuttings	• Water based cuttings and fluids from the Top Hole (i.e. the conductor hole, nominally 36") will be discharged to sea in accordance with the Standards below. Note that it is not technically feasible or safe to return the fluid and cuttings from this section to the rig, and therefore in accordance with normal safe drilling practice they will continue to be discharged directly to the seabed in accordance with the PSA. • Options for the management and disposal of all other water based fluid and cuttings has been subject to a Best Practicable Environmental Option (BPEO) Assessment which has concluded that discharge to sea is the BPEO. This study will not be reassessed unless there is a significant change in the assumptions made with respect to the Phase 3 project. • Water-based drill cuttings and fluids shall be discharged to sea providing the following conditions are met: 1. The mud systems used are tested and meet US EPA 96 Hour LC 50 toxicity tests (i.e., > 30,000 ppm) or Caspian Specific Ecotoxicity Tests, should these be agreed; 2. Platform discharge is via a caisson that will be at a depth of at least 15m to 20m below the sea surface in all instances except where returns are directly to seabed. 3. All barite used will meet the following heavy metal criteria: Hg < 1 mg/kg and Cd < 3 mg/kg dry weight (Total). 4. Products known or suspected to cause taint, endocrine disruption or contain heavy metals as defined by UK Off-shore Chemical Notification Scheme (OCNS) will be avoided. In the event that suitable alternatives are not available, the impact of the chemical will be risk assessed and mitigation measures agreed as part of the EIA process. • There will be no discharge of drill cuttings or fluids unless the maximum chloride concentration is less than four times the ambient concentration in the receiving water.
Land-take at Sangachal	• The design of Sangachal will minimise the foot-print without compromising safety.
Nuisance at Sangachal	• During project execution the impact on the community of dust, noise, light, odours and general disruption will be minimised.
Open Drains Off-shore	• There will be no visible sheen on the surface of the sea from deck and open drain discharges.

Description	HSE Standards
Open Drains On-shore	• Clean drains will discharge to the Caspian at less than 10 mg/l monthly average and 19 mg/l on a daily basis. Any fluids discharged will be treated to ensure there is no significant or long-lasting impact on the environment. • Sample points will be provided to enable verification of the above standard (ie measurement of water quality and quantity). • Oily water from the contaminated open drains will be routed to the produced water disposal facility.
Venting Unburned Gas	• During project execution unignited emergency venting will not take place unless it is required for safety reasons. • The design will ensure that during normal operation there will be no disposal of gas by continuous venting.
Chemicals	• The design will challenge the need for all chemical use. • A management strategy will be put in place to minimise the environmental impact of chemicals through correct selection, transportation, storage, deployment and disposal. • Chemicals known or suspected to cause taint, endocrine disruption or contain heavy metals as defined by UK OCNS will be avoided. In the event that suitable alternatives are not available, the impact of the chemical will be risk assessed and mitigation measures agreed as part of the EIA process. • Only heavy metal-free pipe dope will be used. • Chemicals will be evaluated and tested, based on the European Harmonised Off-shore Chemical Notification Format (HOCNF) and UK OCNS classification, until such time as Caspian-specific standards are agreed. • No chemicals will be discharged to land or sea in the project execution phase (eg chemically treated hydrotest fluids) without complete identification and a thorough assessment of their impact. • The facility design will prevent, so far as reasonably practical, the need to discharge production and utility chemicals to land or sea.
Sewage	• Sewage from offshore will be discharged to sea following treatment using US Coastguard approved Marine Sanitation Device with an effluent of average residual chlorine concentration of 1 mg/l. Preference will be given to systems that avoid the use of chemicals. • The design will ensure that there are no floating solids. • Discharge will be via a caisson that is permanently submerged and at least 15 m below the surface.
Desalination Waste	• Desalination unit waste shall be discharged via a caisson that is permanently submerged and at least 60 cm below the surface.
Pipeline Construction	• Activities will be timed to ensure impact on the fish population and other marine life is minimised.
Sand	• The design will enable sand and any associated liquid to be re-injected off-shore. • In the event that re-injection is not possible, sand will be transported to shore, treated and recycled or disposed of on-shore at a location approved by the regulator.
Liquid and Solid Waste	• There will be no discharge of solid and liquid waste to sea during project execution or operations except as provided for elsewhere in these standards. • During project execution, waste will be managed according to the following hierarchy: reduction at source, re-use, recovery, re-cycle and render harmless through treatment. • The design will ensure waste production in the operating phase is minimised and waste can be handled safely. • Wax disposal and handling – Alternative methods of wax treatment and disposal will be reviewed using the BPEO process and taking into consideration BACT. An effective option will be selected so that the impact of wax waste on the environment is minimised. • In the event that sulphur is recovered as a by-product in the onshore sweetening process, appropriate means of sulphur handling and disposal will be reviewed using the BPEO process and taking into consideration BACT.

Description	HSE Standards
Cooling Water	• The effluent should result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution takes place. The boundary of the zone will be defined on a case-by-case basis taking into account factors such as the existing ecology.
Seawater Abstraction for Operations	• The design will allow seawater to be abstracted during operations at depths > or = 50m. • A BPEO will be conducted to determine minimization of chemicals in seawater discharged back to sea.
Produced Water Offshore	• In FFD the design will permit produced water to be re-injected. • Produced water will not be discharged to the Caspian.
Decommissioning	• Design will ensure that the facilities can be safely decommissioned in compliance with OSPAR and IMO regulations, without long-term impact on the environment.
Fugitive Emissions – Storage Tanks	• Fugitive emissions from the Sangachal oil storage tanks will be controlled using external floating roof technology with primary, secondary rim seals and low-loss fittings.
Fugitive Emissions – Compressors, Valves, Seals, Flanges	• The aim will be to minimise fugitive emissions throughout the design process by measures including: ⇒ Component evaluation and selection. ⇒ Material evaluation and selection. ⇒ Best Available Control Technology (BACT) – PSA.
Combustion Emissions	• The design will be based on minimising combustion emissions (eg SO_x, NO_x, CO_2, CO and particulates). • Options for minimizing combustion emissions will be assessed to determine Best Available Control Technology as required by the PSA. • Dry low emission technology will be adopted onshore.
Produced Water On-shore	• Re-injection of on-shore produced water from Sangachal Terminal is the Base Case but final disposal route will be subject to BPEO and BACT assessment. • The design implications and options for the disposal of onshore produced water during non-availability of the PW re-injection system will be reviewed using the BPEO process and taking into consideration BACT consistent with the PSA.
Routine Flaring – Onshore	• The flare will be designed to allow for continuous flaring and emergency relief. • Any flaring will be smokeless under normal operations. • Flare gas metering will be installed. • The design will minimise flaring from pilots without compromising safety. This will include installation of inert gas purge and conservation pilots. • Flare gas recovery will be installed. • Operational flare policy for Phase III will be developed in conjunction with Phase I and II. The policy will address the potential need to flare sour gas. • The design eliminates all routine non-emergency flaring, with the exception of pilots, without compromising safety.
Routine Flaring – Offshore	• The flare will be designed to allow for continuous flaring and emergency relief. • Any flaring will be smokeless under normal operations. • Flare gas metering will be installed. • Flare will be designed for >98% combustion efficiency. • The design will minimise flaring from purges and pilots without compromising safety. This will include installation of purge gas reduction devices and conservation pilots, or alternative if BACT and BPEO. • Source gas reduction measures will be implemented. • Options to address reduction in offshore flaring and combustion emissions will be evaluated. • Operational flare policy for Phase III will be developed in conjunction with Phase I and II.
Well Testing	• Well testing, resulting in emissions, will be 'by exception' and strongly challenged. If testing is justified, then all best available techniques will be utilised to minimise emissions to air, land and sea.

Description	HSE Standards
Energy Efficiency	• The Phase III design will be based on maximising energy efficiency in line with BPEO.
Non-water-based Drill Fluids and Cuttings	• For platform drilling, the base case is cuttings re-injection with a contingency option of shipment to shore and treatment or disposal on-shore at an approved location. • For drilling from a mobile offshore drilling unit the base case is shipment to shore and treatment or disposal on-shore at an approved location. • There will be no discharge of oil-based or synthetic-based drilling fluids or cuttings from the Phase 3 drilling programme. Should drilling fluids be developed that meet international and Caspian acceptability criteria for discharge then they will be evaluated and the option to use and discharge considered. • An operating policy will be developed to address the actions to be taken in the event of down-time of cuttings re-injection equipment. • All barite used will meet the following heavy metal criteria: Hg < 1 mg/kg and Cd < 3 mg/kg dry weight (total). • Products known or suspected to cause taint, endocrine disruption or contain heavy metals as defined by UK OCNS will be avoided. In the event that suitable alternatives are not available, the impact of the chemical will be risk assessed and mitigation measures agreed prior to use. • The system will be designed to prevent mud loss on cuttings so far as technologically practical and economically justifiable.

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APPENDIX III

ONSHORE EFFLUENT QUALITY LIMITS

These standards have been derived from relevant sources, including World Bank, European Bank for Reconstruction and Development (EBRD), and the European Union to ensure the best standards have been applied. The 'World Bank oil and gas developments onshore guidelines are for liquid effluents from onshore oil and gas production for direct discharge to surface waters' was the main source of relevant standards. Other international standards were compared with these and where relevant the more onerous standard was applied.

EFFLUENT DISCHARGE STANDARDS (Max value mg/l)		
PARAMETER	**STANDARD**	**COMMENTS**
pH	6 - 9	
BOD_5	25	At 20°C, Note 5
COD	150	Note 5
Total Suspended Solids (TSS)	20-30	Note 5
Temperature	+/-3°C of ambient	At edge of mixing zone. Note 2.
Oil and grease: Daily avg. Monthly avg.	 19 mg/l 10 mg/l	Taken from HSE standards
Residual Chlorine	0.2	Shock dosing. Note 3
Phenol	1	
Sulphide	0.35	
Total toxic metals	3	Note1
Cadmium	0.1	Note 4
Chromium	0.5	Note 4
Copper	0.5	Note 4
Lead	0.1	Note 4
Mercury	0.01	Note 4
Nickel	0.5	Note 4
Silver	0.5	Note 4
Zinc	2	Note 4
Ammonia	10	Note 4
Floatables	none	
Total Coliform	<400 MPN/ 100ml	MPN = Most Probable Number

Notes:

1. This is total toxic metals; the individual metals are taken from the World Bank general environmental guidelines and listed in the above table.
2. A mixing zone is a limited area or volume of water, beyond which standards must not be exceeded. In a waterway channel (river, etc.), this is to be taken as not more than 25 percent of the cross section of the channel. In open water, when zone is not defined, it shall be taken as 100 m from discharge point.
3. Shock dosing max.2 mg/l for up to 2 hours, not more than once in 24 hrs, with 24 hr. avg. of 0.2 mg/l
4. These standards are taken from 'World Bank general environmental guidelines for liquid effluents, for process wastewater, domestic sewage and contaminated storm water and runoff discharge to surface waters'.
5. EBRD standards

APPENDIX IV

Environmental and Socio-economic Impact Assessment Master Scoring Tables

Table AIV.1 Scoring of impact assessment for environmental impact significance

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
INTERNATIONAL PLANT/EQUIPMENT FABRICATION AND TRANSPORTATION TO AZERBAIJAN																													
E1	Manufacture/ Fabrication	• Wastes • Resource Use	• Contamination potential • Demand on infrastructure/ depletion of resources	• Plant/equipment will be fabricated out of country so there will be little in-country disturbance • Procurement and Supply Chain Management Plan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Plant/equipment will be fabricated out-of-country.
E2	Vessel transportation of pipe lengths (Japan, Brazil, Italy) to Varna (Mediterranean/ Black) and Sangachal Terminal equipment to Azerbaijan	• Canal transportation and discharge (ballast water) • Atmospheric emissions • Ocean transportation and discharges (ballast, bilge, sewage)	• Risk of introduced species • Deterioration of air quality • Contamination potential	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Marine Management Plan • Ballast water management plan • Bilge water, sewage water standards and control (MARPOL) • Waste implementation planning and procedures	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	-	4	4	-	-	4	4	▲	• Localised impacts that are not readily dispersed • Ballasting operations will be in compliance with IMO guidance
E3	Rail transportation of pipe lengths and Sangachal Terminal equipment to Baku	• Atmospheric emissions • Noise	• Deterioration of air quality	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • CCPs/CIPPs	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	▲	• Low contribution to overall air emissions from the project.

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E4	Vehicle transportation of pipe lengths and Sangachal Terminal equipment within Azerbaijan	• As E3	• As E3	• As E3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	▲	• As E3 • Transportation will be direct to the laydown areas to reduce multiple trips
E5	Laydown/storage location in Azerbaijan (EUPEC)	• Waste	• Contamination potential	• CCPs/CIPPs • Laydown within existing industrial sites (EUPEC and Sangachal Terminal) • Use of existing established waste collection points (CWAA), transportation routes and disposal sites	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Laydown will be in close proximity to the site where the equipment is required to reduce disturbance (with all laydown within the existing terminal facility boundary) • Existing terminal facility - waste reception facilities present onsite
E6	Pipeline coating (concrete coating)	• Waste • Atmospheric emissions	• Contamination potential • Deterioration of air quality	• CCPs/CIPPs • BP approved site, used for all previous phases of ACG FFD • Use of existing established waste collection points (CWAA), transportation routes and disposal sites	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Existing terminal facility - waste reception facilities present onsite

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																								Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine												
					Physical								Biological					Physical				Biological								
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E7	Supply support vessel refuelling, waste transfer (EUPEC)	• Atmospheric emissions • Sewage discharges • Bilge water discharges	• Deterioration of air quality • Contamination potential	• CCPs/CIPPs/Marine Management Plan • Liaison with Baku Port authority • Sewage - ship to shore • PLBG diesel generators, support vessels engines - MARPOL standards (sulphur content) • Bilge water to shore • Existing vessel supply base and onshore waste reception facilities used	4	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	-	4	4	-	-	4	4	-	• Use of existing vessel supply base • Low contribution to overall atmospheric emissions • Short duration with small numbers of vessels
SANGACHAL TERMINAL																														
Facilities construction/commissioning																														
E8	Grading of site	• Ground disturbance • Noise • Emissions • Dust • Wastes	• Loss of vegetation • Deterioration of air quality • Contamination potential	• CCPs/CIPPs • Dust suppression will be used (wetting to reduce emissions) • All earthworks and vehicle movements within the terminal boundary	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Use of cleared area already established - no new losses of vegetation or terrestrial habitat • Existing waste management facility at Sangachal Terminal (reception, storage, transportation to approved disposal facility) • Approved waste disposal facilities are clearly identified and used by all contractors

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E9	Digging of foundations and trenching of lines within terminal boundary	• Emissions from equipment • Noise • Emissions • Dust • Wastes	• Deterioration of air quality • Contamination potential	• As E8 • Soil disposed of at Sangachal Terminal (no transportation to external site)	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• As E8
E10	Metal works (grinding welding and hammering) and excavation may be carried out during night shifts (possible)	• Noise • Emissions • Dust • Wastes	• As E9	• CCPs/CIPPs • Shielding	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Existing waste management facility at Sangachal Terminal (reception, storage, transportation to approved disposal facility) • Approved waste disposal facilities are clearly identified and used by all contractors
E11	NDT	• Radioactive sources • Hazardous wastes (x-ray film)	• Contamination potential	• CCPs/CIPPs • Controlled radiation sources • Shielding • Testing at night	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Low quantities of waste • Existing waste management facility at Sangachal Terminal (reception, storage, transportation to approved disposal facility)
E12	Flushing with water prior to hydrotest	• Water use • Potential chemical use	• Demand/ depletion of resources • Contamination potential	• Re-use of water where possible (reduce discharges) • Water not inhibited if left in pipework for <30days	-	-	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Reuse where possible to minimise discharges • No chemical additives in the water

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																								Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine												
					Physical								Biological					Physical				Biological								
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E13	Hydrotest for pressure and leak detection	• Water use	• As E12	• Reuse of water (reduce demand from municipal supply) from tank for line testing • Water to go to drains at pig receiver to catch debris • Use of water from the fire water system	-	-	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Water use quantified and within the capacity of Sangachal Terminal fire water system • Reuse where possible to minimise discharges • No chemical use
E14	Performance testing of pumps with large amounts of potable water on recycle.	• Disposal of hot potable water to environment.	• Contamination potential	• Reuse of water (reduce demand from municipal supply) from tank for line testing (closed loop with pumps on recycle) • Testing only on main export and transfer pumps	-	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Recycling of test water and minimisation of water required for disposal • Water temperature will be ambient on final disposal
Terminal operation																														
E15	Disposal of contaminated water to open drains system.	• Potential discharge to environment	• Contamination potential	• No discharge of untreated contaminated water (all routed via drains to a treatment unit • Treatment to World Bank effluent quality standards • Testing prior to soakway/irrigation of terminal land	-	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• No discharge of untreated water • Testing to ensure compliance prior to discharge

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E16	Fuel gas blanketing (BFG) of new Produced Water storage tank	• BFG will be flared via existing EOP flare	• Deterioration of air quality	• Only during filling/ emptying of the tank with Produced Water • Tank will be maintained with low volumes (only filled during offshore failure)	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• One time operation • No filling/emptying of tank (no flaring of fuel gas) during routine operations • Flaring of fuel gas under planned non-routine operations does not exceed standards for atmospheric emissions
E17	Temporary pumps potential to use diesel or gas turbines	• Atmospheric emissions	• Deterioration of air quality	• If required base scope to connect to Sangachal Terminal existing power supply (electric drive) • If diesel pumps are required these will only be used temporarily	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Does not exceed atmospheric emissions standards • Diesel pumps if required will be phased out by gas turbine (GT) driven or electric pumps
E18	Vehicles deliveries	• Traffic and combustion emissions.	• Deterioration of air quality	• As E4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• As E4
E19	Chemical storage	• Potential for fuel gas blanketing, depending on chemicals selected	• Deterioration of air quality	• CCPs/CIPPs • Chemicals in tote tanks • Storage at supplier, delivery based on usage	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Small volume usage • Closed tote tanks (minimal atmospheric emissions)
E20	Second Produced Water holding tank will also need to be blanketed with fuel gas which will also	• Atmospheric emissions	• Deterioration of air quality	• As E16	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• As E16

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
	need to be flared																												
E21	Frequent pigging (once every 2 weeks). Drainage of pig launcher each time it is opened	• Hazardous liquid/solid wastes	• Contamination potential	• CCPs/CIPPs • Waste removal to Sangachal Terminal waste reception facility (CWAA) • Linked into suite of 5 launchers so tie in to existing facilities (closed drain system so no release of wastes)	-	4	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Use of existing/approved waste disposal route
E22	Solids removal from de-oiler package by hydrocyclone and further solids removal in IGF	• As E21	• As E21	• CCPs/CIPPs • Waste removal to Sangachal Terminal waste reception facility (CWAA)	-	4	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	As E21
E23	Desanding of Produced Water holding tank (removal as required based on inspection frequency averages every 7 years)	• As E21	• As E21	• As E22	-	4	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	As E21

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E24	Decommissioning plan to be produced	• Wastes, emissions • Demand on infrastructure/ facilities	• Contamination potential • Depletion of resources	• Field Abandonment Plan (FAP) covering decommissioning when 70% of the field is depleted • Base case is handover to SOCAR (from PSA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Plan not yet produced - site may be left to SOCAR to continue to operate

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
PRODUCED WATER PIPELINE																													
Installation/commissioning (onshore)																													
E25	Onshore works Preparation of the pipeline corridor and third party line crossings	• Removal of vegetation • Alteration of topography • Emissions • Dust • Noise • Waste	• Loss of vegetation • Habitat degredation • Disturbance to fauna • Deterioration of air quality • Contamination potential	• CCPs/CIPPs • Siting of the pipeline within the existing onshore ROW and exclusion zone (no development zone) • Dust suppression (wetting to reduce emissions) • The spoil from the trench excavation will be used to backfill the trench following installation of the pipeline. • Waste removal to Sangachal Terminal waste reception facility (CWAA) • Vehicle use in approved areas/ access tracks • Mob/demob of equipment daily from Sangachal Terminal • Reinstatement Plan	4	4	4	4	4	4	4	-	4	-	4	4	4	-	-	-	-	-	-	-	-	-	-	-	• Localised impact - Small area of physical disturbance • Existing construction site in an area of existing pipelines (EOP, ACG FFD, SD) • Low contribution to overall atmospheric emissions • Short duration • Use of existing/ approved waste disposal route • Area will be reinstated

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E26	Onshore works Pipelaying	• Atmospheric emissions • Emissions • Dust • Noise • Waste	• Disturbance to fauna • Deterioration of air quality • Contamination potential	• CCPs/CIPPs • Siting of the pipeline within the existing onshore ROW and exclusion zone (no development zone) • Waste removal to Sangachal Terminal waste reception facility (CWAA) • Vehicle use in approved areas/access tracks • Mob/demob of equipment daily from Sangachal Terminal • Reinstatement Plan	4	4	-	-	4	4	4	-	-	-	4	4	4	-	-	-	-	-	-	-	-	-	-	-	• As E25
E27	Onshore works - rail crossing (directional drilling through embankment)	• AS E26	• AS E26	• As E25 • Rail crossing will be by directional drilling (no disturbance to rail track	4	4	-	-	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• As E25 • Directional drilling through manmade embankment
E28	Onshore works Third party crossings (road). Road to a depth of 1.5 m	• As E26	• As E26	• As E25 • Hand excavation of the highway • Equipment storage at landfall site • Reinstatement Plan	4	4	-	-	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• As E25 • Road will be reinstated to former condition

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Residual Environmental Impact Justification
E29	Hydrotest of onshore pipeline section	• Discharge of treated water with possible chemical use (biocide, oxygen scavenger, dye)	• Contamination potential	• Use of hydrotest pond which will be lined • Partial emptying of hydrotest water to perform tie-in (not total) • Retention of majority of test water for subsequent tests • Discharge to hydrotest holding pond at Sangachal Terminal	• Discharge will be minimised by partial emptying of the pipeline (to use the treated water is subsequent tests of the line) • Hydrotest pond will be used and test water kept to ensure degradation of chemicals • Testing prior to disposal of water • Discharge of test water under Sangachal Terminal current permit conditions
Installation/commissioning (coastal)					
E30	Coastal landfall site preparation	• Removal of vegetation • Alteration of foreshore topography • Equipment and traffic movement • Emissions • Dust • Noise • Waste	• Loss of vegetation • Habitat degradation • Disturbance to fauna • Deterioration of air quality • Contamination potential	• CCPs/CIPPs • Landfall of the pipeline within the existing beach construction site (already cleared and disturbed) • Dust suppression (wetting to reduce emissions) • Excavated material will be replaced for backfill • Waste removal to CWAA reception facility • Vehicle use in	• As E25

Environmental receptors

ID	Terrestrial/coastal – Physical: Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial/coastal – Biological: Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Marine – Physical: Atmosphere	Seawater	Seabed	Subsurface geology	Marine – Biological: Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds	Cumulative contribution ▲
E29	-	-	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E30	4	4	4	4	4	4	4	-	4	-	4	4	4	-	-	-	-	-	-	-	-	-	-	-

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
				approved areas/access tracks • Reinstatement Plan																									
E31	Excavation of trench on foreshore (to a trench depth of 0.5 m cover TOP)	• As E30	• As E30	• As E30 • Reduced TOP cover from 1 m to 0.5 m reducing the depth of trenching required	4	4	4	4	4	4	4	-	4	-	4	4	4	-	-	-	-	-	-	-	-	-	-	-	• As E25
E32	Construction of temporary berm (to 3 m) approximately 200 m (175 m) anticipated <6 months	• Disturbance to seabed • Alteration of nearshore hydrography and sediment deposition against berm	• Turbidity and disturbance to marine fauna • Sedimentation and blanketing of benthos • Contamination potential	• CCPs/CIPPs • Construction of berm in time for beachpull to avoid long presence of structure	4	-	-	-	-	-	-	-	-	-	4	-	-	4	4	4	-	-	4	4	4	-	4	-	• As E25 • Berm will be removed
E33	Marine Works Excavation of trench in the shallow marine environment (1 m deep x 4.7 km trench length to the 11 m water depth)	• Loss of seabed • Turbidity • Noise • Emissions • Waste	• As E32	• CCPs/CIPPs • Route selection to maximise bathymetric gradient and minimise length of trench • Waste removal to CWAA reception facility	4	-	-	-	-	-	-	-	-	-	4	-	-	4	4	4	4	4	4	4	4	-	4	-	• As E25

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E34	Marine vessel support close to the shore Operation of pipelay barge and support vessels. (2 anchor handling, 6 pipe carrying, one supply, DBA)	• Physical presence (anchoring/ propeller action) • Noise • Atmospheric emissions • Sewage discharges • Bilge water discharges	• As E32	• CCPs/CIPPs/BP Marine Management Plan • Anchor Handling Management Plan • Sewage will be shipped to shore • PLBG diesel generators, support vessels engines will operate to MARPOL standards (sulphur content) • Bilge water will be brought to shore • Existing vessel supply base and onshore waste reception facilities used	-	-	-	-	-	-	-	-	-	-	4	-	-	4	4	4	-	4	4	4	4	-	4	-	• ROW is in an exclusion zone • Pipelay will occur over a short timescale • All wastes will be brought ashore for appropriate disposal
E35	Beach pull of pipeline	• Noise • Atmospheric emissions • Waste	• Deterioration of air quality • Contamination potential	• CCPs/CIPPs	4	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	• Localised impact - Small area of physical disturbance • Low contribution to overall atmospheric emissions
E36	Hydrotest of pipeline section on foreshore	• Discharge of chemically treated test water into Sangachal Bay	• Contamination potential	• Hydrotest water will be recycled • Troskill approved chemical recipe will be used (Caspian specific tox tested) • Partial emptying of hydrotest water to perform tie-in (not total) • Use of test water for	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4	4	-	-	-	-	-	• Chemical dosing will be calculated to match the volume of hydrotest (so no large volumes of active biocide remaining) • Partial discharge to enable use of hydrotest for subsequent tests of the same pipeline

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
				subsequent tests (only partial emptying of the pipeline)																									• Approval will be obtained prior to discharge of test water
E37	Removal of temporary berm	• Disturbance to seabed • Sedimentation	• As E32	• As E32 • Removal of all berm material to allow seabed to recover naturally to pre-installation condition	4	-	-	-	-	-	-	-	-	-	4	-	-	4	4	4	-	4	4	4	4	-	4	-	• As E25
Installation/commissioning (offshore)																													
E38	Prelay survey/post build survey	• As E34	• As E34	• As E34	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	-	4	4	4	4	-	4	-	• Survey will be progressive so will not prevent vessel activity over a large area • ROW is in an exclusion zone • Pipelay will occur over a short timescale • All wastes will be brought ashore for appropriate disposal
E39	Marine Works Installation of pipelines on the seabed (offshore)	• Physical disturbance (pipelay, trenching, anchoring) • Emissions • Wastes • Noise	• As E34	• As E34	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	-	4	4	4	4	-	4	-	• As E34

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																								Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds	Cumulative contribution ▲	
E40	Marine Works Pipeline crossings (11)	• Physical disturbance (of the seabed) • Atmospheric emissions • Waste	• As E34	• As E34 • CCPs/CIPPs/BP Marine Management Plan • Crossing Management Plan	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	-	4	4	4	4	-	4	-	• As E34
E41	NDT	• Radioactive sources	• Contamination potential	• No radiation sources used, ADT (automatic)	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	• No waste generation • No radioactive sources
E42	Hydrotest of pipeline	• Discharge of chemically treated test water into the Caspian	• As E36	• As E36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• As E36
Pipeline operation																													
E43	Start up and pigging	• Generation of hazardous wastes from pipeline cleaning. • Interim storage on platform of hazardous wastes.	• Contamination potential	• CCPs/CIPPs • Interim storage on platform of hazardous wastes • Closed system - waste will fall into the pig receiver and waste will be bagged for shipment onshore • Waste Management Procedure • Use of approved waste reception/disposal facilities (Hazardous waste landfill)														4	4			4	4						• No discharge of wastes (total containment and ship to shore to approved waste disposal facilities)

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																							Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine											
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E44	Vessel activity during surveying and monitoring	• As E34	• As E34	• As E34	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	-	4	4	4	4	-	4	-	• As E34
E45	Decommissioning plan to be produced	• As E24	• As E24	• As E24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• As E24
OFFSHORE FACILITIES																													
HUC and commissioning (offshore)																													
E46	NDT	• Radioactive sources	• Contamination potential	• No radiography offshore	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• No waste generation • No radioactive sources
Operation																													
E47	Pigging of line once every 2 weeks (28-30 days for travel at low rate of 0.1m/s)– drainage of water at pig trap offshore	• PW waste from pig trap when draining to hazardous open drains. • Hazardous chemicals to sea	• As E43	• As E43	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4			4	4						• As E43

ID	Activity	Aspects	Environmental Impacts	Existing Environmental Mitigation	Environmental receptors																						Cumulative contribution ▲	Residual Environmental Impact Justification
					Terrestrial/coastal													Marine										
					Physical								Biological					Physical				Biological						
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
E48	Filter maintenance-disposal of filters and residue	• Hazardous solid waste	• As E43	• As E43	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4			4	4						• As E43
E49	Pigging of line once every 2 weeks	• Hazardous solid waste (50 lb per run) to be disposed of onshore	• As E43	• As E43	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4			4	4	-	-	-	-	-	• As E43
E50	Decommissioning plan to be produced	• As E24	• As E24	• As E24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• As E24

Table AIV.2 Scoring of impact assessment for socio-economic impact significance

ID	Activity	Aspects	Social Impacts	Social mitigation	Socio-economic Receptors								Cumulative contribution ▲	Residual social impact justification
					Sea use	Population in vicinity	Infrastructure	Utilities	Transport	Employment base	Supply chain	Government revenue		
INTERNATIONAL PLANT/EQUIPMENT FABRICATION AND TRANSPORTATION TO AZERBAIJAN														
S1	Procurement of materials	• Employment, training	• Positive national income generation	• CCPs/CIPPs • Procurement and Supply Chain Management	-	-	-	-	-	-	+	-	▲	• Positive: Large quantities of goods and services will be purchased within Azerbaijan.
S2	Mobilisation of workforce	• Indirect employment	• As S1	• CCPs/CIPPs • Extension of existing contracts established for prior Phases of ACG FFD	-	-	-	-	-	+	-	-	▲	• Positive: An extension of construction activities leading to extended employment for existing employees
S3	Vessel transportation of pipe lengths (Japan, Brazil, Italy) to Varna (Mediterranean/ Black) and Sangachal Terminal equipment to Azerbaijan	• Physical presence • Noise • Emissions	• Interference/disturbance to other users	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Marine Management Plan • Bilge water, sewage water standards and control (MARPOL 73/78) • Waste implementation planning and procedures	4	-	-	-	4	-	-	-	▲	• Environmental mitigation will ensure air quality not affected detrimentally • Liaison with Port Authorities
S4	Rail transportation of pipe lengths and Sangachal Terminal equipment to Baku	• Rail usage	• Increased demand on overburdened infrastructure	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Liaison with Azerbaijan Rail Authority • Liaison with AzerTrans (cargo transportation authority)	-	-	4	-	4	-	-	-	-	• Use of existing rail network (with sufficient capacity)

ID	Activity	Aspects	Social Impacts	Social mitigation	Socio-economic Receptors: Sea use	Population in vicinity	Infrastructure	Utilities	Transport	Employment base	Supply chain	Government revenue	Cumulative contribution ▲	Residual social impact justification
S5	Vehicle transportation of pipe lengths and Sangachal Terminal equipment within Azerbaijan	• Vehicle use • Physical presence • Noise • Emissions	• Increased demand on road infrastructure • Interference/disturbance to other users • Deterioration of air quality	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Large/oversized loads will be scheduled to avoid periods of heavy congestion (Transportation Management Plan) • Liaison with Municipal Authorities	-	4	4	-	4	-	-	-	-	• Environmental mitigation will ensure air quality not affected detrimentally • Transportation routes are well established and the loads are not oversized.
S6	Supply support vessel refuelling, waste transfer (EUPEC)	• Vessel use • Physical presence • Noise • Emissions	• Interference/disturbance to other users • Deterioration of air quality	• CCPs/CIPPs/Marine Management Plan • Liaison with Baku Port authority • Existing vessel supply base and onshore waste reception facilities used	4	-	-	-	4	-	-	-	-	• As S3 • Use of existing vessel supply base
SANGACHAL TERMINAL														
facilities construction/commissioning														
S7	Metal works (grinding welding and hammering) and excavation may be carried out during night shifts (possible)	• Noise • Emissions • Dust	• Increased demand on infrastructure, depletion of resources • Deterioration of air quality	• CCPs/CIPPs • Shielding • Avoidance of nightime work where possible (subject to programme) • Schedule noisy operations during day shifts • Community Complaints Procedure	-	4	-	-	-	-	-	-	-	• Work will be intermittent and of short duration • Environmental mitigation will reduce social impacts from dust generation (E8) • Use of existing terminal facility (within boundaries previously established under ACG Phase 1) • Closest socio-economic receptor is Umid camp, 1.6 km from the terminal drainage boundary. • No disturbance complaints from previous Phases of ACG

ID	Activity	Aspects	Social Impacts	Social mitigation	Socio-economic Receptors								Cumulative contribution ▲	Residual social impact justification
					Sea use	Population in vicinity	Infrastructure	Utilities	Transport	Employment base	Supply chain	Government revenue		
S8	Flushing with water prior to hydrotest	• Water use from municipal supply	• Increased demand on infrastructure/resources • Potential interference/disturbance to other users	• Agreement to draw water from municipal supply (based on pre approval on predicted levels of water use under routine and no-routine conditions) • Re-use of water where possible (reduce demand from municipal supply)	-	4	4	-	-	-	-	-	-	• Water use quantified and does not present a problem considering the capacity of the municipal line • Reuse where possible to minimise water take
PRODUCED WATER PIPELINE														
installation/commissioning (onshore/coastal)														
S9	Third party line crossings (21 crossings, 23 lines). - excavation (by hand) to 3.5 to 4m	• Vehicle use • Dust • Noise	• As S5	• CCPs/CIPPs • Full construction Risk assessment • Crossing Management Plan • Liaison with Municipal Authorities • Survey of existing infrastructure	-	-	4	-	-	-	-	-	-	• Environmental mitigation will ensure air quality not affected detrimentally • Short term, localised activity (with prior experience from earlier Phases) • Directional drilling through manmade embankment • No problems experienced from previous Phases of ACG FFD
S10	Onshore works - rail crossing (directional drilling through embankment)	• Atmospheric emissions • Dust • Noise	• Possible interference with rail traffic • Deterioration of air quality	• As S9 • Rail crossing will be by directional drilling (no disturbance to rail track • Drilling will be undertaken in consultation with rail authority to avoid periods of high rail traffic	-	-	4	-	-	-	-	-	-	• As S9

ID	Activity	Aspects	Social Impacts	Social mitigation	Socio-economic Receptors: Sea use	Population in vicinity	Infrastructure	Utilities	Transport	Employment base	Supply chain	Government revenue	Cumulative contribution ▲	Residual social impact justification
S11	Onshore works - road crossing to a depth of 1.5 m	• Atmospheric emissions • Dust • Noise	• Interference with road traffic • Deterioration of air quality	• As S9 • Hand excavation of the highway • Partial closure of highway (not total) to maintain traffic flow. • Safety/security personnel for traffic watch • Cones/signs for notifying traffic • Only during daylight hours (lit construction area at night) • Equipment storage at landfall site	-	4	4	-	-	-	-	-	-	• Environmental mitigation will ensure air quality not affected detrimentally • Excavation will involve closure of one side of the highway only • Road will be reinstated to former condition • No problems experienced from previous Phases of ACG FFD
S12	Coastal landfall site preparation	• Interference with public access • Atmospheric emissions • Dust • Noise	• Disturbance to other users • Deterioration of air quality	• As S9 • Security control/fencing	-	4	-	-	-	-	-	-	-	• No coastal social receptors in vicinity of existing landfall site • Extension of existing work programme (impacts addressed under earlier Phases of ACG FFD) • Site will be restored and public access resumed
installation/commissioning (offshore)														
S13	Vessel activity during pre-lay/post build survey, during pipeline installation and commissioning	• As S6	• As S6	• As S6	4	-	-	-	4	-	-	-	-	• As S6 • Vessel activity will be progressive so will not prevent vessel activity over a large area
S14	Vessel transportation of pipe lengths	• As S6	• As S6	• As S6	4	-	-	-	4	-	-	-	-	• As S6

ID	Activity	Aspects	Social Impacts	Social mitigation	Socio-economic Receptors: Sea use	Population in vicinity	Infrastructure	Utilities	Transport	Employment base	Supply chain	Government revenue	Cumulative contribution ▲	Residual social impact justification
PIPELINE OPERATION														
S15	Physical presence of pipeline	• Physical presence of pipeline	• Obstacle to fishing activity • Safety exclusion zone for anchoring	• Pipeline route selection parallel to existing EOP, ACG FFD, and SD lines in an existing exclusion zone • Recording of pipeline position on Admiralty Charts • Liaison with Port Authority	4	-	-	-	4	-	-	-	-	• Existing fishing/anchoring exclusion zone • No known fishing grounds in the vicinity of the pipeline • No restriction on vessel movements over the live line once in place
S16	Vessel activity during surveys and monitoring	• As S6	• As S6	• As S6	4	-	-	-	4	-	-	-	-	• As S6

Table AIV.3 Scoring of impact assessment for accidental impact significance

ID	Activity	Aspects	Accidental impacts	Existing mitigation	Terrestrial/coastal													Marine										Cumulative contribution ▲	Residual impact justification
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
INTERNATIONAL PLANT/EQUIPMENT FABRICATION AND TRANSPORTATION TO AZERBAIJAN																													
A1	Vessel transportation of pipe lengths (Japan, Brazil, Italy) to Varna (Mediterranean/Black) and Sangachal Terminal equipment to Azerbaijan	• Vessel accident and: • Spill • Fire • Explosion	• Contamination potential	• CCPs/CIPPs • Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Marine Management Plan • OSCP	-	-	-	-	-	-	-	2	-	2	2	-	-	2	2	-	-	2	2	-	-	2	2	-	• Low probability and significance due to controls in place
A2	Rail transportation of pipe lengths and Sangachal Terminal equipment to Baku	• Rail accident and: • Spill • Fire • Explosion	• Contamination potential	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Liaison with Azerbaijan Rail Authority • Liaison with AzerTrans (cargo transportation authority)	3	3	3	3	-	-	-	-	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	• Low probability and significance due to controls in place
A3	Vehicle transportation of pipe lengths and Sangachal Terminal equipment within Azerbaijan	• Vehicle accident and: • Spill • Fire • Explosion	• Contamination potential	• Logistics and Supply Management Plan (from earlier ACG FFD Phases) • Transportation Management Plan • Liaison with Municipal Authorities • OSCP	3	3	3	3	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability and significance due to controls in place

ID	Activity	Aspects	Accidental impacts	Existing mitigation	Terrestrial/coastal													Marine											Cumulative contribution	Residual impact justification
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds	▲	
A4	Supply support vessel refuelling, waste transfer (EUPEC)	• As A1	• Contamination potential	• As A1 • Liaison with Baku Port authority	-	-	-	-	-	-	-	2	-	2	2	-	-	2	2	-	-	2	2	-	-	2	2	-	• As A1
SANGACHAL TERMINAL																													
FACILITIES CONSTRUCTION/COMMISSIONING																													
A5	Digging of foundations and trenching of lines	• Damage to existing 'Live' project facilities	• Contamination potential • Interference with other users	• CCps/CIPPs • Full construction Risk assessment carried out • Main facilities (Produced Water tank) located outside operational areas, minimising requirement for working within this area. • Pipework requires working in operation side - permitting system, HSE management	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place
A6	Welding works	• Risk of sparks causing fire, explosion in operational area (atmospheric emissions, spills)	• Contamination potential	• CCps/CIPPs • Fenced off work area • Designated weld station • Bridging document will be produced between operational site and adjacent area	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place
A7	Welding (Produced Water tank)	• Risk of relief valve lifting on adjacent Produced Water tank - release of hydrocarbons to the air causing	• Contamination potential • Deterioration of air quality	• CCps/CIPPs • Gas detectors • Meteorological monitoring	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• One time event (during construction). Low consequence of occurrence due to potential volume of gas released

ID	Activity	Aspects	Accidental impacts	Existing mitigation	Terrestrial/coastal													Marine										Cumulative contribution	Residual impact justification
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds		
		potential fire, explosion (atmospheric emissions, spills)																											
A8	Connection to live facilities	• Spill	• Contamination potential	• CCps/CIPPs • Partial shut down (Produced Water tank)	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place
A9	Chemical injection first fills	• Spill	• Contamination potential	• CCps/CIPPs • Bunding around plant • Closed drains	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place
TERMINAL OPERATION																													
A10	Storage of Produced Water in PWD tank 2	• Damage to tank/liner and potential spill of Produced Water	• Contamination potential	• Tank will be lined • Bunding will be provided	-	3	3	3	3	-	-	-	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place
A11	PW distribution around plant using carbon steel pipe	• Corrosion potential • Spill of Produced Water	• Contamination potential	• Integrity management system (frequency determined during inspection) • Corrosion Management Operations • Bunding around terminal operational areas • Drainage systems (not discharged) for any spills • Spill clean up equipment located at multiple points	-	3	3	3	3	-	-	-	3	-	3	3	3	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place
A12	Frequent chemical loading from either tankers or TOTE tanks to inject at	• Spill	• Contamination potential	• CCps/CIPPs • Bunding at delivery/storage locations (as per ACG	-	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place

ID	Activity	Aspects	Accidental impacts	Existing mitigation	Terrestrial/coastal													Marine											Cumulative contribution	Residual impact justification
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds	▲	
	least 5 chemicals for pipeline corrosion prevention and separation aid.			FFD Phase 1) • Good ventilation, 14 days storage																									
PRODUCED WATER PIPELINE																													
INSTALLATION/COMMISSIONING (ONSHORE)																													
A13	Onshore works Cross over of existing pipelines/subsea cables onshore (risk of spontaneous bursts)	• Damage to third party infrastructure and • Spill	• Interruption of third party services • Contamination Potential	• Full construction Risk assessment carried out • Hand excavation (3 to 4 m)	3	3	3	3	3	3	-	-	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place
A14	Onshore works Third party crossings (road)	• Road accident • Spill	• Contamination potential	• Partial closure of highway (not total) to maintain traffic flow. • Safety/security personnel for traffic watch • Cones/signs for notifying traffic • Only during daylight hours (lit construction area at night) • Equipment storage at landfall site (no road crossing)	2	2	2	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place
A15	Pipeline hydrotest (450 bar)	• Spill risk of inhibited water • Potential contamination of surface/ground water	• Contamination potential	• Use of hydrotest pond which is lined • Partial emptying of hydrotest water to perform tie-in (not total) • Use of treated test water for subsequent tests of same line	3	3	3	3	3	-	-	-	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	• Low probability of occurrence due to controls in place

ID	Activity	Aspects	Accidental impacts	Existing mitigation	Terrestrial/coastal													Marine										Cumulative contribution	Residual impact justification
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds	▲	
INSTALLATION/COMMISSIONING (OFFSHORE)																													
A16	Vessel collision	• As A1	• As A1	• As A1 • Liaison with Baku Port authority	-	-	-	-	-	-	-	2	-	2	2	-	-	2	2	-	-	2	2	-	-	2	2	-	• As A1
A17	Collision with live pipelines/Damage from vessel anchoring (laybarge) during installation	• Spill • Fire • Explosion	• Contamination potential	• Construction risk assessment • Minimum 20 m up to 200 m spacing. • Anchor handling plan	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	-	2	2	2	2	2	2	-	• Low probability of occurrence due to controls in place
A18	Marine works Installation and tie in to risers	• Spill • Potential loss to sea • Contamination	• Contamination potential	• Hydrotest water treated with approved chemicals only • Shut down on hook up to Central Azeri and DWG platforms	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	-	3	3	3	3	3	3	-	• Low probability of occurrence due to controls in place
PIPELINE OPERATION																													
A19	Presence of the pipeline on the seabed and spanning	• Damage by vessel grounding (nearshore) • Impact from vessel anchors/fishing gear (offshore) • Breach of pipeline and uncontrolled release of Produced Water	• Contamination potential	• Recording of pipelines on Admiralty Charts • Pipeline surveys • Concrete coating provides some protection for anchors (but not intended as mitigation for grounding) • Trenching of pipeline in water depths<11m	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	-	4	4	4	4	4	4	-	• Low probability of occurrence due to controls in place but would result in critical financial loss to the Company and media attention
A20	Corrosion and failure of pipeline	• Gross loss of product to environment.	• Contamination potential	• Sacrificial anodes/concrete coating • Chemical addition • Pigging • Pipeline survey	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6	6	-	6	6	6	6	6	6	-	• Would result in critical financial loss to the Company, fines and media attention

ID	Activity	Aspects	Accidental impacts	Existing mitigation	Terrestrial/coastal													Marine											Cumulative contribution	Residual impact justification
					Physical								Biological					Physical				Biological							
					Atmosphere	Soil	Groundwater	Surface water	Hydrological systems	Subsurface geology	Landscape/topography	Coastline	Terrestrial habitat/flora	Coastal habitat/flora	Terrestrial/coastal birds	Reptiles/amphibians	Mammals	Atmosphere	Seawater	Seabed	Subsurface geology	Plankton	Fish	Marine habitat/flora	Benthos	Mammals (seals)	Sea birds	▲	
				• Leak detection																									
A21	Vessel activity during surveys and monitoring	• As A1	• As A1	• As A1 • Liaison with Baku Port authority	-	-	-	-	-	-	-	3	-	3	3	-	-	3	3	-	-	3	3	3	-	3	3	-	• As A1
OFFSHORE FACILITIES																													
HUC AND COMMISSIONING (OFFSHORE)																													
A22	Lifts of equipment over live facilities	• Dropped object on facilities • Spill • Fire • Explosion	• Contamination potential	• CCPs/CIPPs • Lifting plans	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	-	2	2	2	2	2	2	-	• Low probability of occurrence due to controls in place • Low consequence due to shut down of facilities
OPERATION																													
A23	Pigging of line once every 2 weeks. – Potential blockage of filter	• Potential for surge being directed overboard to hazardous open drain caisson Hazardous chemicals to sea	• Contamination potential	• Fast acting shut down value will be installed to block the filter (and prevent hazardous discharge) Sparing provided by second online filter (if required)	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	3	3	3	-	3	3	-	• Medium probability of occurrence due to controls in place Operational procedures in place to reduce consequence of impacts to low
A24	Failure at riser, process pipework, filters.	• Loss of containment	• Contamination potential	• Sparing (two filter system) and bypass built in No failure at riser	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	2	2	2	-	2	2	-	• Low probability of occurrence due to controls in place
A25	Failure of injection system (pump)	• Disposal of Produced Water overboard	• Contamination potential	• No sparing but possible to inject less seawater (CWP) and discharge seawater overboard	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	1	1	-	1	1	-	• Low probability but low consequence of occurrence due to controls in place (seawater only discharged)

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APPENDIX V

Dispersion Modelling for Accidental Release Scenarios under the ACG FFD PWD Project

Contents

List of Figures

List of Tables

1 Introduction

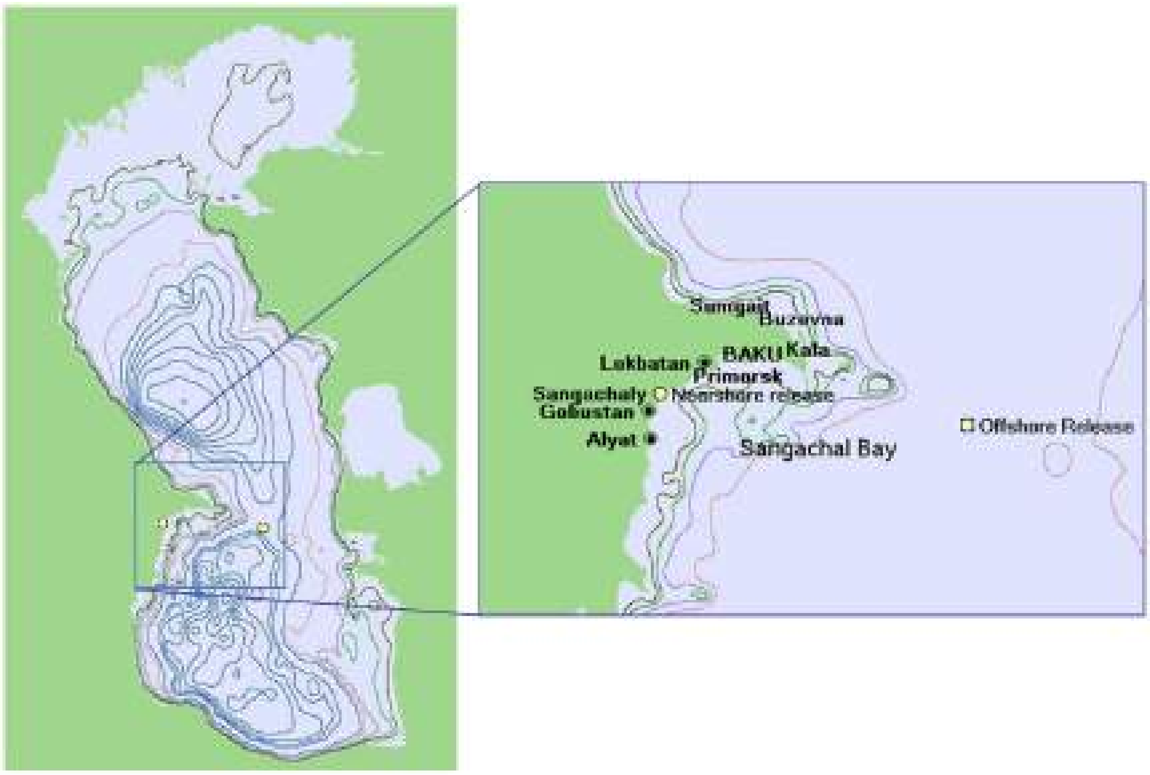
This report provides the results of modelling conducted to simulate the dispersion of an accidental release of Produced Water from the ACG FFD PWD pipeline. The ESIA identified two scenarios for the release of Produced Water, as follows:

- A breach of the pipeline and largescale single loss of containment e.g. from vessel or anchor impact (defined as Scenario 1); and
- Loss of pipeline integrity as a result of pipeline corrosion leading to a continuous uncontrolled release of untreated Produced Water (defined as Scenario 2).

Both scenarios were considered for a nearshore location along the pipeline route in Sangachal Bay and for the offshore location of the tie in to the Compression and Water-Injection Platform (CWP) at Central Azeri (Figure 1).

Dispersion modelling of the accidental release scenarios was conducted by Applied Science Associates, Inc. (ASA). ASA has developed a Caspian Sea hydrodynamic model and undertaken a variety of dispersion studies within the Caspian region, including mud and drill cuttings, platform effluent and oil spill simulations, many of these as part of the ESIA Process for the phased development of ACG.

Figure 1 The bathymetry of the Caspian Sea, showing the study area of Sangachal Bay and offshore CWP release locations



2 Produced Water Simulation Specifications

The simulation of dispersion characteristics of the Produced Water effluent plume under each scenario was modelled using Visual Plumes to predict the behaviour of the plume close to the release point (near-field) and CHEMMAP to predict the behaviour beyond the release point (far-field).

The results from the near-field simulations include the dilution, rise and diameter of the Produced Water plume after release. These results were used to initialise the far-field simulations and separate simulations were run under summer and winter conditions to identify any seasonal differences in the behaviour of the Produced Water after release. Table 1 summarises the Produced Water release specifications for the models.

Table 1 Produced water release specifications

Parameter	Scenario 1: Pipeline Breach	Scenario 2: Pipeline Leak
Location	(1) Sangachal Bay: 40° 11’ 43” N 49° 29’ 42” E (2) CWP Primary location: 40° 01’ 52” N 51° 21’ 04” E	
Release rate	80,000 barrels/day (i.e. 1,000 barrels lost over period of release)	3200 barrels/day
Period of release	18 minutes	Indefinite
Release hole diameter	0.36 m	0.05 m
Pipe diameter	0.36 m	
Pipe release modelled from	5 m above seabed	
Orientation	Horizontal	
Water depth	(1) 7.5 m Sangachal Bay (2) 242 m CWP location	
Produced Water release temperature	(1) 20°C: Sangachal Bay (2) 5°C: CWP location	
Produced Water Salinity	35 psu	
Assumed Caspian Sea Salinity	12 psu	

The current conditions for the near-field modelling of the accidental releases were assumed to be 1 cm/s for the deterministic near-field model. As the near-field model identified the dispersion and dilution of the Produced Water due to current conditions, this current velocity represents near-stagnant and therefore worst-case water conditions.

The current fields used for the far-field modelling were supplied by the ASA Caspian Sea Model. A complete description of the environmental data, validation and application of the ASA Caspian Sea Model can be found in the ASA report Hydrodynamic and Dispersion Modelling for the Azeri, Chirag, Gunashi Field Offshore Baku, Azerbaijan (ASA, 2001), presented as Appendix 4 to the Azeri, Chirag, Gunashi Phase I EIA (URS, 2002).

The predicted currents near the release sites, during summer and winter, are shown respectively in Figures 2 and 3. The currents in Sangachal Bay reach 20-40 cm/s with 1-2 cm/s weak currents near the offshore location of the CWP.

Figure 2 Current patterns near the release sites during summer

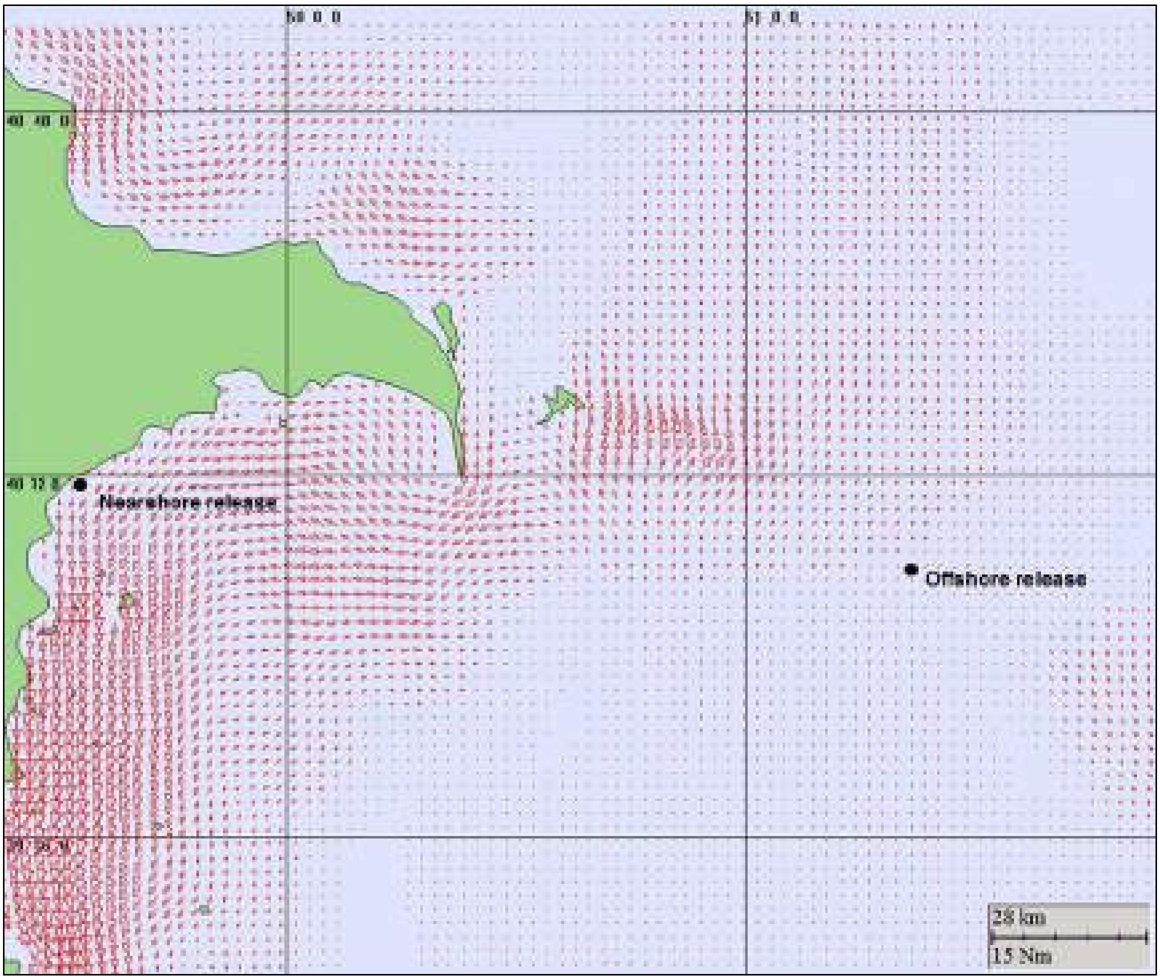
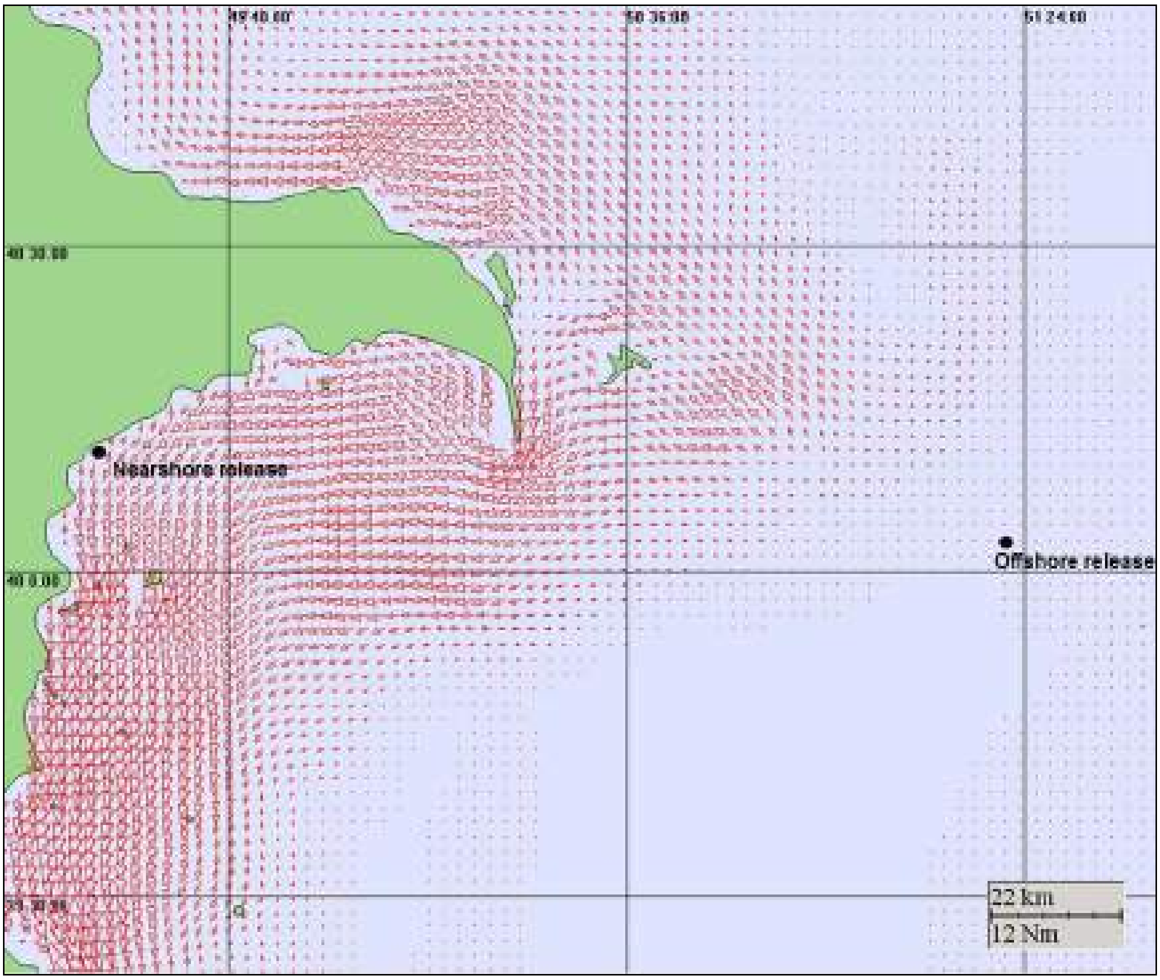


Figure 3 **Current patterns near the release sites during winter**



3 Modelling Results

This section presents the results of the near-field and far-field modelling results under Scenarios 1 and 2.

3.1 Near-field results

The near-field dispersion characteristics of a hypersaline (35 psu) release for both the pipeline breach (Scenario 1) and the pipeline leak (Scenario 2) at Sangachal Bay and the offshore CWP location were evaluated using the near-field VP model. The simulations follow the effluent plume from its release until it reaches the sea bed. The model records the distance for the plume to reach the seabed, the time taken to reach the seabed, the salinity and dilution of the Produced Water at the seabed. The near-field modelling results for Scenario 1 and 2 are provided in Table 2.

Table 2 Near-field dispersion modelling results

Flow (barrels/day)	Location	Duration of release (mins)	Distance for plume to reach the seabed (m)	Time to reach seabed (seconds)	Salinity at maximum extent of plume (psu)	Dilution factor
Scenario 1: Pipeline breach						
80,000	Sangachal Bay	18	5.9	20	13.99	10.6
80,000	Offshore CWP	18	5.8	19	14.00	10.5
Scenario 2: Pipeline leak						
3200	Sangachal Bay	Continual	5.6	50	12.30	78.0
3200	Offshore CWP	Continual	5.6	50	12.28	81.0

3.2 Far-field results

The far-field model simulates the behaviour and dilution of the Produced Water effluent over a period of 2 days after release. The results of the near-field modelling in Scenario 2 (pipeline leak) showed that due to the slow release rate (3,200 barrels/day), the Produced Water rapidly dilutes to near background levels 50 seconds after release and within 6 m of the release site (Table 2); therefore there was no value in further modelling the release and far-field modelling was only conducted for Scenario 1 Pipeline breach.

The predicted near-field modelling results for Scenario 1 were used to initiate the far-field simulations at the Sangachal Bay and the offshore CWP locations. Simulations were run under summer (July) and winter (March) winds/currents conditions. A total of 50 far-field simulations were performed at the given release site for each season, varying the time of release and thus the ambient current conditions within the specified period. Based on the results from the 50 simulations, the predicted plume with the farthest extent and least dilution was defined as the worst case scenario.

The results from the far-field model are presented as plots showing coloured contours representing dilution factors, based on an initial Produced Water salinity of 35 psu and average ambient salinity of 12 psu for the Caspian Sea. Salinities under the different dilution factors are shown in Table 3.

Table 3 Salinities for different dilution factors

Dilution factor	Salinity (psu)
10	14.30
100	12.23
400	12.058
1000	12.023
5000	12.0046
10,000	12.0023
50,000	12.0005
100000	12.0002

Under a pipeline breach (Scenario 1) in Sangachal Bay simulated under summer conditions, the Produced Water release was diluted by a factor of 100 (i.e. from 35 psu to 12.23 psu) within 0.5 km of the release location. Under winter conditions the model simulations show the dilution of the Produced Water release by a factor 100 within 0.4 km of the release location. The predicted area enclosed by the dilution contour of 100 was 0.146 km^2 for both seasons.

Whilst the simulations were conducted over a modelling time period of two days, only the temporal variation of the Produced Water dilution over the course of 4 and 8 hours are shown in Figures 4 and 5. This is due to the rapid dilution of the Produced Water indicated in the 50 model runs. In both summer and winter seasons the Produced Water was diluted to a factor of 100 only 3 hours after release. Looking at the No Effects Concentration (NEC) safety factor of 400 defined in the ESIA, the Produced Water is diluted to this level within 7.5 hours to 7.6 hours, in summer and winter respectively.

For the offshore Scenario 1 simulations the model shows the Produced Water spreading in a roughly circular pattern with little advective transport due to the predicted weak current field in the region compared to that of the nearshore release. In summer, the Produced Water release was diluted to a factor of 100 within 300 m of the release location, with dilution factors of less than 100 covering an area of 0.133 km^2. For the worst case winter simulations, a 100x dilution occurred within 300 m of the release location, with dilution factors of less than 100 covering an area of 0.111 km^2.

Offshore, dilution of the Produced Water to the NEC safety factor of 400 occurs 12.5 hours and 12.25 hours after release, in summer and winter respectively. This longer period for dilution of the Produced Water in the offshore environment is attributable to the weaker current regime compared to that in the nearshore location. Figures 6, 7 and 8 provide the temporally variation plots for the CWP offshore location for 4, 8 and 16 hours after the accidental release.

Figure 4 Sangachal Bay, 4 hours after a Scenario 1 release

a) Summer

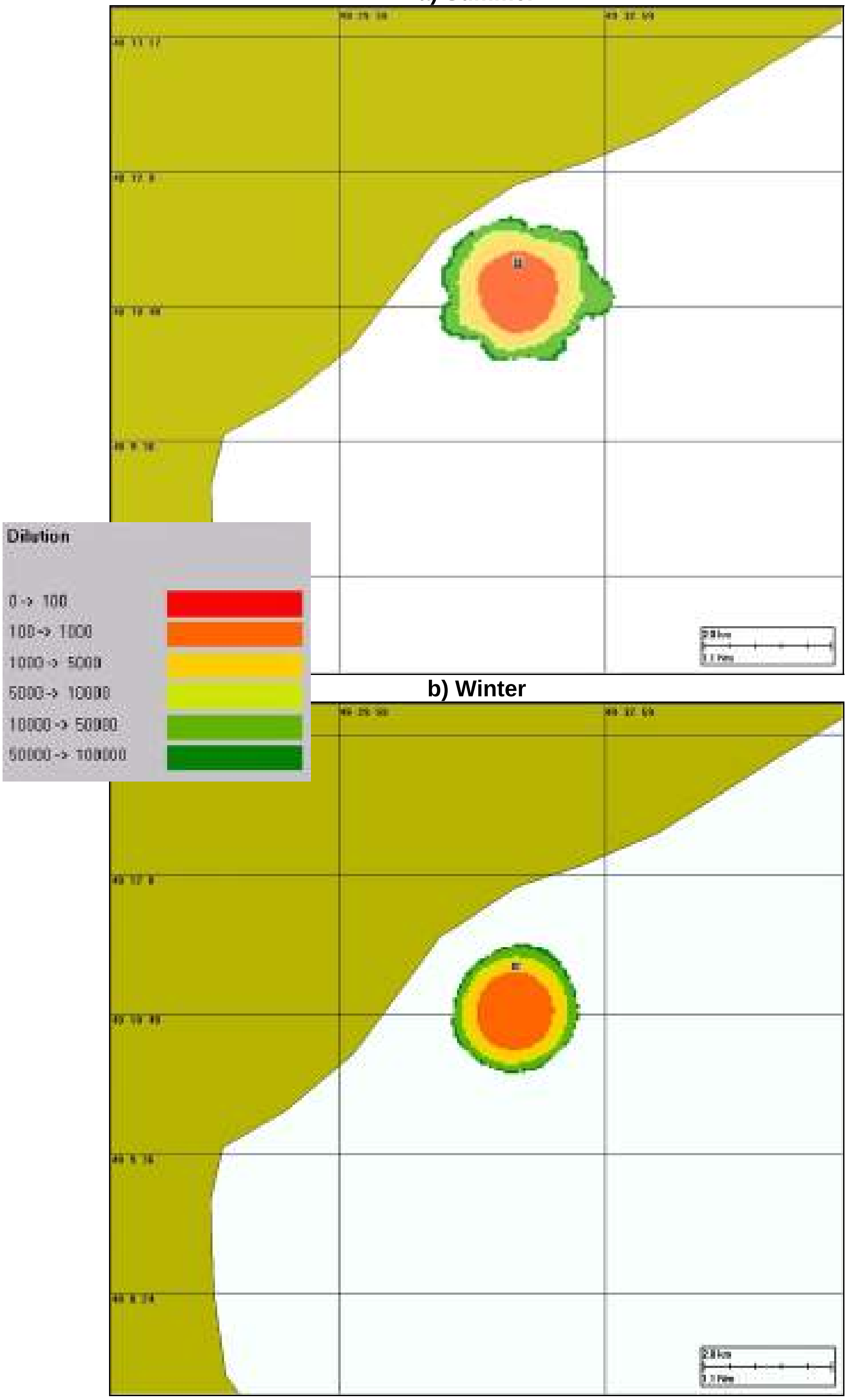


Figure 5 Sangachal Bay, 8 hours after a Scenario 1 release

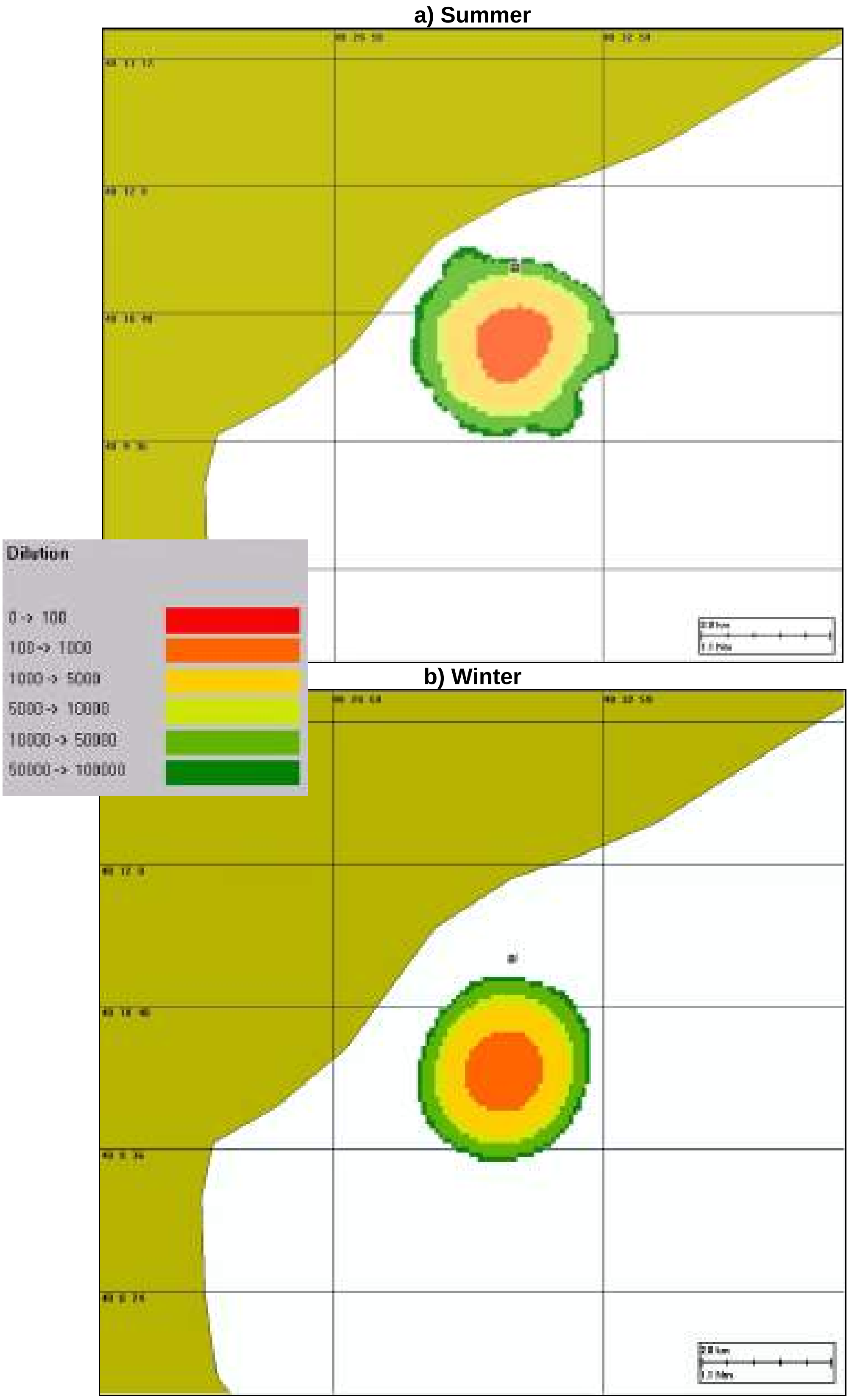
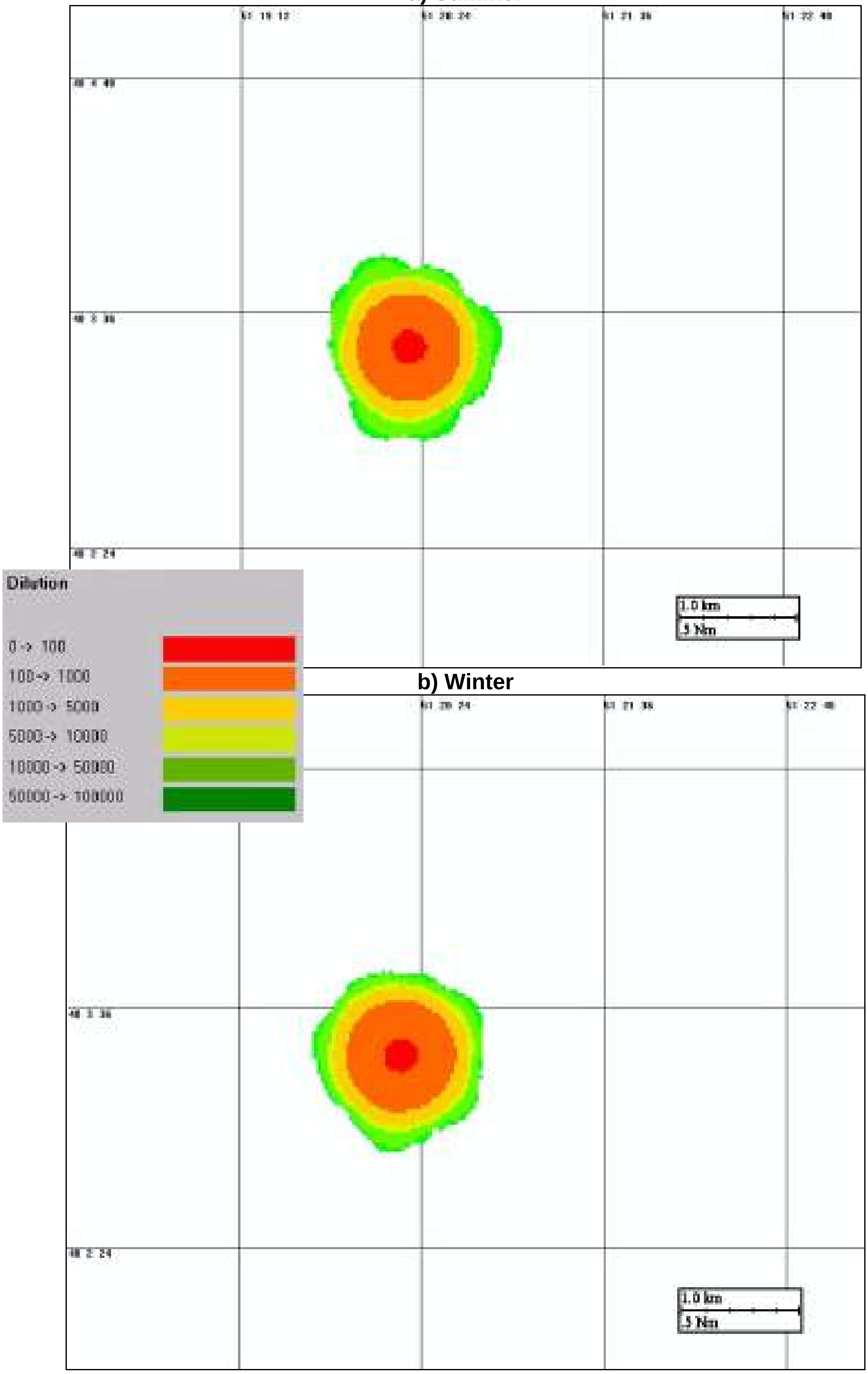


Figure 6 CWP location, 4 hours after a Scenario 1 release

a) Summer



b) Winter

Figure 7 CWP location, 8 hours after a Scenario 1 release

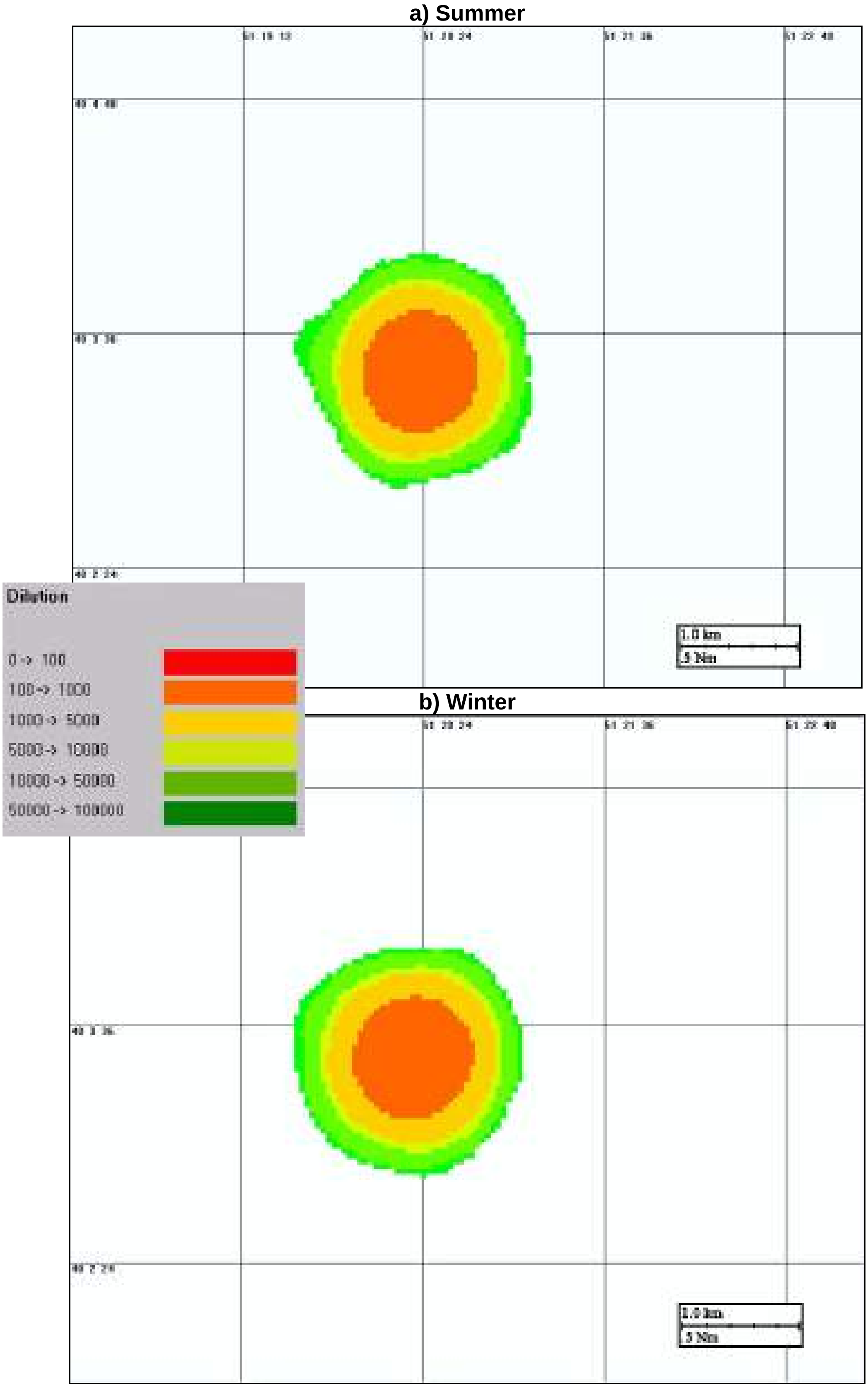
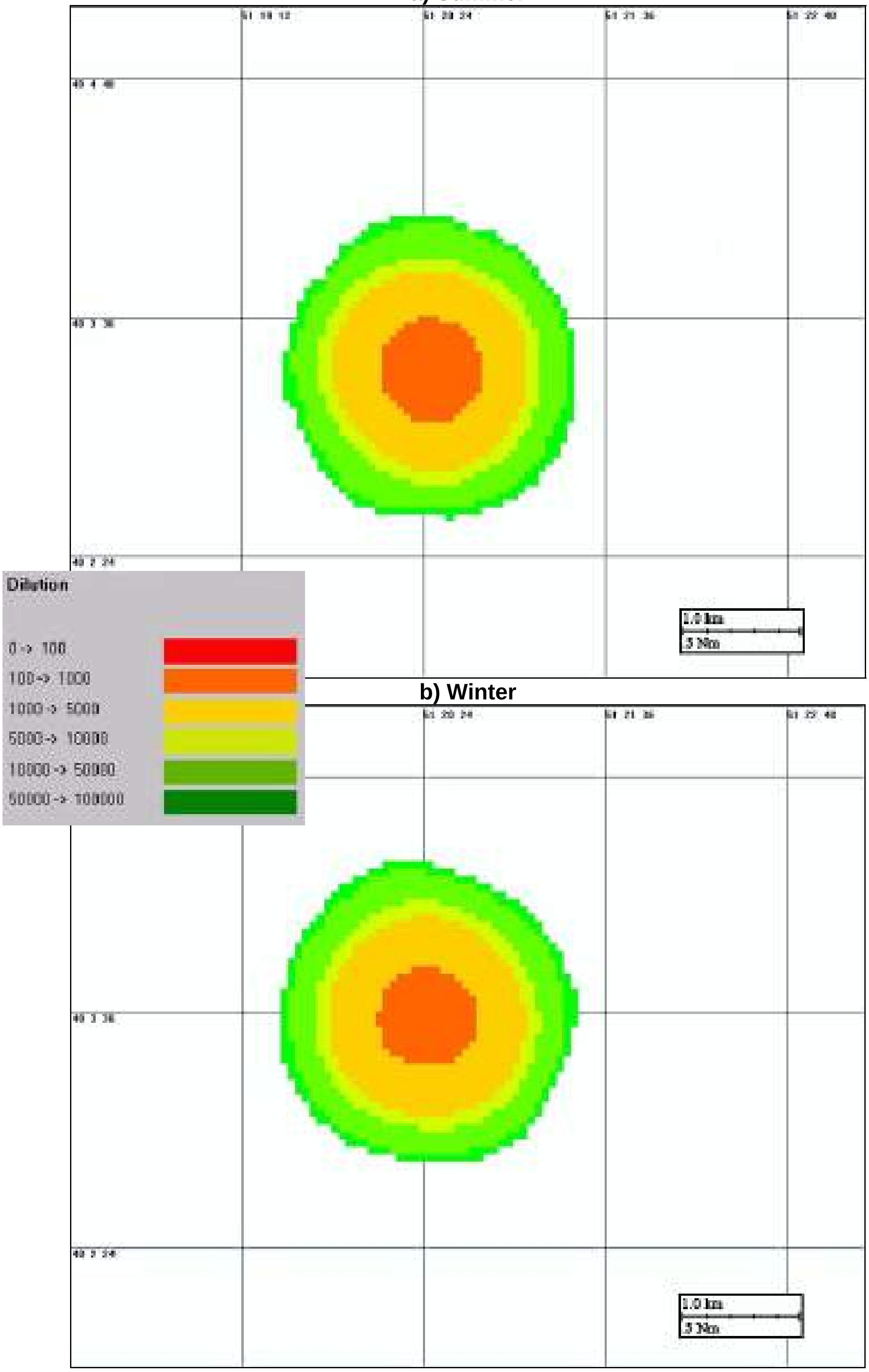


Figure 8 CWP location, 16 hours after a Scenario 1 release

a) Summer



4 References

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