Managing oil and gas activities in coastal areas

An awareness briefing

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Purpose and use

This document introduces considerations and recommendations for oil and gas development in coastal environments. It highlights key issues for decision-makers and their advisors, project managers and HSE professionals in planning, designing, impact-assessing and managing oil and gas activities in these areas.

Any form of oil and gas development in coastal areas poses complex challenges from the very early stages. This document provides an overview of key actions for meeting these challenges by addressing the incumbent risks and opportunities. It adopts a broad perspective for gathering and assimilating administrative, environmental, economic and socio-cultural information to effectively identify and address key factors that could influence the planning, design and execution of an oil and gas development. This approach necessitates an appreciation of the wider ecological, administrative, economic and socio-cultural context of oil and gas activities and operations, as well as the sensitivities of operating in different types of coastal ecosystems.

This document builds upon basic concepts for minimizing impacts to biodiversity and ecosystem services and provides some additional resources for further reading in the 'Further advice and information' section. The document, *Managing biodiversity impacts: 10 tips for success in the oil and gas industry* may be of specific interest; it can be found on the IPIECA website.

Summary

There are important constraints to successful oil and gas development in coastal areas, including climate change, population pressures, natural threats and over-exploitation of land/sea areas and resources. It is vital for energy companies to think strategically about the business risks, as well as the opportunities, of operating in coastal areas. The following global developments are of particular importance to the oil and gas industry:

- The existing and increasing concentration of human populations and infrastructure in coastal areas, leading to growing competition for access to resources. This creates a need for the oil and gas industry to distinguish its role in driving positive change and avoiding potential adverse cumulative impacts;
- The increasing establishment of marine protected areas (MPAs), where access and use conditions often severely restrict or exclude resource extraction activities. Additionally, there is a drive towards integrated coastal zone management (ICZM) and the practice of marine spatial planning (MSP);
- The likely increases in costs and technical difficulties for the siting and protection of oil and gas assets in coastal areas, as a result of changing climate.

The protection and maintenance of healthy coastal ecosystems through good environmental management practices can help to address these challenges, and mitigate a range of environmental, social, and economic risks for business. The basic concepts of responsible risk-based biodiversity and ecosystem services (BES) impact management, applied as early as possible (preferably before site selection), and tailored to the unique challenges of dynamic coastal areas, can achieve a myriad of business benefits.

These concepts include:

- Early engagement with coastal stakeholders;
- Appreciation of the broad-scale complexities and sensitivities of coastal systems;
- Integrated environmental and socio-economic analysis focusing on the human-ecosystem interdependencies of coastlines;
- Alignment with landscape-scale considerations of interconnected inland and marine systems;
- An adaptive approach that can readily respond to the changes in knowledge, conditions, and governance that characterize coastal areas.

Defining coastal areas

Coastal areas include a wide range of environments that contain complex, frequently highly biologically productive and valuable ecosystems. The bio-geochemical and physical linkages among coastal ecosystems are critical to their sustainable use and are key factors when selecting sites and formulating development strategies and management plans for projects (see Table 1).

Coastal areas are here defined to include the inter-tidal and sub-tidal areas on and above the continental shelf to a depth of 200 metres and adjacent lands up to the 50-metre contour. The continental slope below 200 metres or deep-sea habitats is not normally included[1].

Table 1 – Examples of coastal environments

Near-shore terrestrial	Dunes, cliffs, rocky and sandy shores, coastal xeromorphic habitats, urban, industrial and agricultural landscapes
Inter-tidal	Estuaries, deltas, lagoons, mangrove forests, mudflats, salt marshes, salt pans, other coastal wetlands, aquaculture beds ports and marinas.
Benthic	Kelp forests, sea grass beds, artificial reefs and structures coral reefs and soft bottom environments above the continental shelf.
Pelagic	Open waters above the continental shelf, free-standing fish farms: e.g. plankton blooms, neuston zone, sea ice herring schools

Source: WRI (2001)

1 World Resources Institute (2001). Pilot Analysis of Global Ecosystems – Coastal Ecosystems, Washington D.C., p.11.

Risks of coastal areas

Coastal areas attract people and commerce. Although coastal areas constitute less than 15% of the Earth's surface, they contain more than 60% of the world's population. It is estimated that by 2025 up to 75% of the global population could be living in coastal areas. Coastlines serve as key links between the commerce of the seas, and both populations and infrastructure on land. Coastlines therefore form a focal point for many businesses, including near-shore and offshore oil and gas development. Much of the world's major energy infrastructure lies in coastal areas.

Nevertheless, there are many risks associated with coastal areas. These risks translate into higher costs for siting, construction, maintenance, repair/retrofit, insurance, compensation, offsets, and reclamation. Environment-related disruptions to energy facilities are being reported with increasing frequency[2].

Examples of these risks include:

- Natural threats, such as tsunamis and earthquakes, that can cause massive changes to coastal landforms;
- Flooding caused by oceanic storms, poorly-controlled storm-water runoff, and/or coastal subsidence;
- Pollution from domestic and industrial sources – coastal, marine, and inland;
- Loss of fresh surface water and groundwater sources due to excess withdrawals and/or seawater intrusion;
- Conflicts over access to and use of coastal areas and associated natural resources;
- Erosion, whether natural or caused by poorly-engineered and sited structures, such as docks and sea walls, or from dredging offshore;
- Siltation of navigation channels and rapid advances of shorelines resulting from increased soil erosion in river catchments further inshore;
- Potential acid sulphate soil/sediments (PASS) that can cause rapid deterioration of equipment, and pose a risk to the health and safety of workers.

A number of these risks relate to inland and upland activities outside the control of coastal populations and businesses; this emphasizes the large-scale perspective needed to understand and manage coastal risks. The impacts of climate change coupled with increasing coastal populations will also place greater demands on coastal resources and infrastructure further emphasising the potential of these risks.

Additionally, there are associated risks to coastal ecosystems and their species and functions. These risks in turn represent environmental, reputational, and financial risks for business, including the oil and gas industry. These risks are likely to rise as changes and accumulation of damage and loss increase the rarity and vulnerability of undamaged coastal areas.

The benefits of healthy coastlines

Healthy coastlines can limit or mitigate the above risks in numerous ways. For example, naturally-vegetated shorelines and coastal wetlands regulate flooding and erosion, stabilize soil chemistry, and play a role in assimilating pollutant loads. Natural undeveloped coastal areas can serve as buffers between inshore development and the sea, increasing the supply of coastal resources and reducing unmet demand (competition) for them. In addition, healthy coastlines can provide these functions

2 Paskal, Cleo (2009). The Vulnerability of Energy Infrastructure to Environmental Change, Chatham House Briefing Paper, July 2009.

more cost-effectively than their engineered alternatives such as sea walls, fortified beaches, levees, dredging, and filling. Maintaining the health of coastal ecosystems offers risk reduction and cost-saving opportunities for many businesses, including oil and gas.

Healthy coastlines provide key support systems for coastal and marine biodiversity. They filter water, mediate nutrient cycling, and provide substrate, shelter, nurseries, and food for a broad array of plant and animal species.

Healthy coastlines also offer economic benefits through fishing (recreational and commercial), recreation, and tourism. A broad and healthy coastal economy offers benefits for all businesses.

By contrast, adverse impacts on ecosystems can increase coastal risks to business by reducing ecologically-based mitigations and protections, undermining livelihoods, and threatening habitats, food webs, and iconic species.

Threats to coastal environments

Many coastal environments are under stress, resulting in reductions in the spatial extent, health and productivity of ecosystems. Short-sighted or ill-informed development planning and management have led to worldwide loss of coastal wetlands. Moreover, coastline-dependent fisheries are in decline, many formerly abundant species are becoming rare, food webs are being altered, and invasive species and diseases are proliferating[3]. Climate changes are bringing additional pressures, such as increasing ocean temperatures, sea level rise and ocean acidification.

Competing demands for coastal land and resources, created by population growth, commercial fishing, tourism, water withdrawals, agricultural runoff, waste discharges, and urban development, among others, are exceeding their sustainable supply in some locations, resulting in negative effects on coastal ecosystems and the human livelihoods that depend on them.

Threats resulting from oil and gas activities

Oil and gas development can increase existing demand for, and pose significant risks to, coastal ecosystems and their services. Conflict with other uses of coastal and marine resources, such as fishing, recreation, other forms of energy generation (such as offshore wind farms), or aesthetic enjoyment can arise. Through careful planning early in the life of an oil and gas asset, integrated impact and risk assessments (such as ESIAs or ESHIAs) and the application of good practices, the oil and gas industry can act as a catalyst for improved coastal governance and contribute to more sustainable coastal development patterns, thus increasing business sustainability and benefiting a variety of coastline users.

Examples of potential oil and gas-related impacts include:

- Subsidence of the seabed resulting from oil and gas extraction, which can lead to changes in bathymetry and shoreline retreat;
- Disturbance to the seabed and damage to coral reefs due to dredging for pipeline construction. This can alter sediment flows and create siltation that can smother benthic communities and damage sea grass beds, corals and other shallow-water ecosystems;
- Changes in tidal currents and sediment flows resulting from the construction and presence of bulkheads, docks, jetties, slipways and other structures where the engineering design does not account for natural coastal processes;
- Direct destruction of mangroves through clearing, dredging and filling. This results in potentially adverse impacts on fisheries (nurseries), shoreline stability, and water quality, due to the loss of natural water cleansing functions and the potential liberation of

3 L. B. Crowder, G. Osherenko, O. R. Young, et al, Resolving Mismatches in U.S. Ocean Governance, Science, Vol. 313, 4 August 2006, pp. 617-618.

sulphurous acids when acid sulphate sediments (PASS) are present[4];

- Damage to, or fragmentation of key coastal areas for nesting, feeding, breeding, and other critical life functions of iconic or other important species;
- Introduction of alien invasive species that can transform habitat, alter function, and undermine native biodiversity;
- Lowered water quality and altered nutrient and oxygen balances - especially where poor waste and discharge management practices have led to poor ambient water quality;
- Oil pollution from accidental oil spills leading to local and/or regional environmental, social and economic impacts;
- Conflicts with local or indigenous people whose culture and livelihoods depend on areas/resources that are used or displaced by oil and gas activities.

Sensitivity to potential threats from oil and gas activities varies depending on the nature of the activity, coastline features, environmental health (existing stress level), location and time of year. Sensitivity also varies from one ecosystem type, habitat or species to another. Demands on and damage to coastal areas from all sources increase sensitivity and risk to coastal ecosystems, as well as financial risk to business, by undermining or eliminating the benefits they provide.

Many overlapping threats and impacts to coastal areas may not be easily attributed to any individual cause or source. Oil and gas operations in areas of on-going threat and/or damage are vulnerable both to the effects on their own direct impacts, as well as to the indirect risk of impacts being erroneously perceived to be related to oil and gas operations.

Socio-economic considerations

Social and economic conditions can pose significant risks to oil and gas development. Concerns may range from disputes over property values and conflicts over livelihoods, land, and natural resources, to social injustice, corruption, social unrest, unstable governments, poverty, disease, poor sanitation, food and water scarcity, and lack of infrastructure (health, education, power, sewer, transportation). These conditions can both impair the safe and timely conduct of development and operations, as well as create unrealistic expectations of oil and gas companies as being the primary solution to a host of socio-economic woes. This is especially the case in remote and frontier regions, where the arrival of a global industry such as oil and gas presents a combination of threats and opportunities to nearby populations, especially for indigenous, subsistence-based, or otherwise vulnerable communities.

Coastal areas serve as a convergence point for marine, coastal, and upland ecosystems, and the people, activities, and businesses that both depend on them and may adversely affect them. Thus a holistic approach to BES impact management that considers social, economic and environmental interdependencies at a landscape scale is appropriate. The document *Ecosystem services guidance: Biodiversity and ecosystem services guide and checklists* is designed to help companies implement this approach, and is available from the IPIECA website. This will be the most effective way to identify, avoid, and

4 See E&P Forum/IUCN (1993). Guidelines on Oil and Gas Exploration in Mangrove Areas, 1993.

mitigate risks to business, people, and the environment, and to limit the adverse trade-offs that can occur when social, economic, and environmental changes are considered and managed separately. It is becoming clear that environmental, social, and economic issues can be tightly interconnected, and that their combined influence can be decisive in determining whether and at what pace coastal projects can proceed[5]. Naturally, consultation and engagement with stakeholders, including individual and business users of coastal land and resources, play a key role in understanding issues and responding effectively.

Coastal governance

Coastal areas are the interface between what have been historically distinct marine and land-based planning systems. Traditionally, decision-making regarding coastal areas has been ad hoc, with no single government body having clear authority to resolve conflicts across sectors, or to address cumulative effects[6]. In the United States, for example, at least 20 federal agencies implement over 140 federal ocean-related statutes. An entirely different set of agencies address onshore activities, some of which (agriculture and municipal river discharges, for example) have important influences on coastlines that are virtually not addressed within their respective frameworks. Additionally, separate regimes for fisheries, aquaculture, marine mammal conservation, oil and gas, shipping and mining are designed to resolve conflicts within sectors, but not across sectors.

This approach often translates into:

- Spatial and temporal overlap of human activities causing 'user vs. user' and 'user vs. environment' conflicts;
- Lack of connection between the various authorities responsible for individual activities or the protection and management of the marine environment as a whole;
- Lack of connection between offshore activities and resource use and onshore communities that are dependent on them;
- Misalignment between protected areas, restrictions within them, and ecological sensitivities;
- Lack of investment certainty for developers and users of coastal and marine resources[7].

There are a variety of initiatives at the international and national level aiming to establish more integrated policies governing development in the coastal and marine environment. Of particular interest to the oil and gas industry is the drive towards integrated coastal zone management (ICZM) and the related (though subsidiary) practice of marine spatial planning (MSP).

Of particular relevance to the oil and gas industry are the new 2020 targets adopted under the Convention on

5 Jones, Murray and Wagner, Jay (2004), Strategic Assessment of Oil and Gas Activities: Looking Beyond EIA/SIA, Paper presented at the Seventh SPE International Conference on HSE in Oil and Gas E&P, Calgary, Alberta, Canada, 29–31 March 2004.

6 Crowder, L.B, Osherenko, G, Young, O, et al (2006). Resolving Mismatches in U.S. Ocean Governance, Science, Vol. 313, 4 August 2006.

7 Douvere, Fanny and Ehler, Charles (2009). Ecosystem-Based Marine Spatial Management: An Evolving Paradigm for the Management of Coastal and Marine Places, Ocean Yearbook 23: p.6.

Biological Diversity (CBD)[8] to ensure that at least 17% of the world's terrestrial and 10% of the marine ecological regions are effectively conserved, and the already ongoing move to establish marine protected areas (MPAs) (see Box 1), where access and use conditions often severely restrict or exclude resource extraction activities ("no-go" areas).

Box 1 – Marine Protected Areas

As of 2010, 5880 Marine Protected Areas (MPAs) exist worldwide, covering over 4.2 million km^2 of ocean, and constituting an estimated 4.3% of continental shelf areas globally. However, this equates to just over 1% of the marine area of the world, far short of the Convention on Biological Diversity goal of 10% coverage by 2012. There is a growing trend to establish very large MPAs, such as the recently-established British Indian Ocean Territory MPA, currently the largest in the world[9].

Assessing risks for coastal oil and gas development

General actions for risk assessment include: early collection of relevant environmental and socio-economic data (at an appropriate scale), stakeholder engagement, understanding of design and operational alternatives/options, delineation of ecosystem dependencies and impacts, development of impact scenarios for various design and operational alternatives, and risk evaluation (likelihood and impact severity) for those scenarios, enabling concept selection, routing/siting, and operational decision-making. In coastal areas, the following specific considerations may apply:

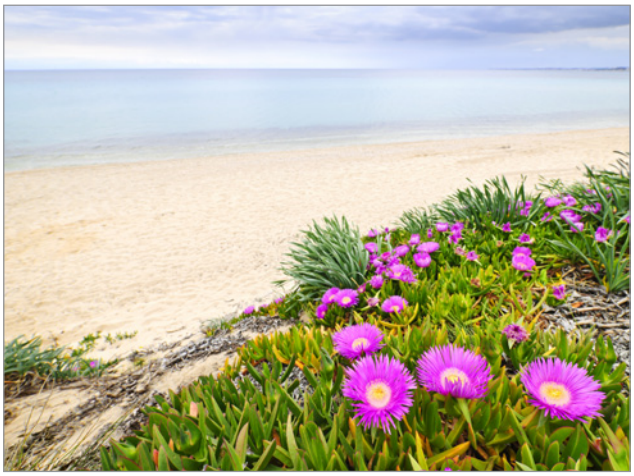
- Address overlapping or incomplete jurisdictional requirements common in coastal areas. This can be done by mapping access constraints, the location and significance of legally protected areas, other areas of biodiversity importance, the presence of threatened species, sensitive habitats and key natural resources. This is particularly important given the growing convergence between oil and gas activities and the expansion of terrestrial and marine protected and designated areas. Two resources may be of interest: The *Integrated Biodiversity Assessment Tool* (IBAT) and the *A-Z areas of biodiversity importance* (www.biodiversitya-z.org).
- Capture community and commercial uses/users of coastal areas and resources, recognizing that these may extend significantly onshore and/or offshore. Understand where and how these uses and users overlap or conflict, and the resulting ecosystem and oil and gas development risks[10].
- Identify dependencies of the project or operation on coastal services and resources, realizing that these dependencies may need to be broadly interpreted in coastal areas. For example, shoreline stability, water quantity and quality needs, discharge and waste assimilation, integrity of facilities and infrastructure, access to goods and services, worker quality of life, stable governance, and good will of adjacent communities and businesses (including tourism, recreation, and fishing) may all be at higher risk in coastal areas.

8 See http://www.cbd.org.

9 Toropova, C., et al (eds) (2010). Global Ocean Protection: Present Status and Future Possibilities. Brest, France: Agence des aires marines protégées, IUCN WCPA, UNEP-WCMC

10 Austin, Duncan and Sauer, Amanda, (2002). Changing Oil, pp.25-32.

- Understand the socio-economic role of the coastal area relative to other areas in the region. Account for coastal, marine, and terrestrial implications for both beneficial and adverse environmental and socio-economic effects.



Considerations for specific key coastal habitats

Near-shore terrestrial environments

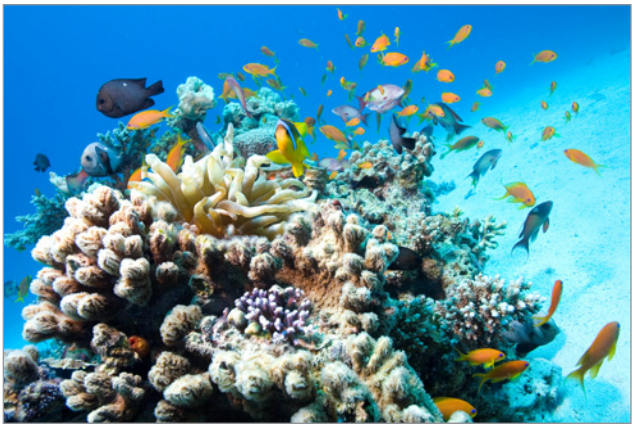
Key considerations for oil and gas companies in near-shore terrestrial environments include the following:

- *Beaches:* Projects in or close to beach environments should avoid changes in the sediment budget and tidal currents which could lead to problematic erosion and/or deposition. They must also consider the timing of the development to avoid conflicts with other uses, such as turtle nesting, seasonal fisheries and tourism.
- *Dunes:* Projects in the vicinity of dune systems must understand the geo-morphological links between beaches and dunes in order to avoid damage to or reestablish those linkages following any development.
- *Agriculture and aquaculture systems:* Agriculture and aquaculture (both development and management) can create competition for water resources and sea-space, respectively. They can pose risks to nearby oil and gas projects in terms of conflict, pollution, impact on BES and attribution of oil and gas responsibility for those impacts.

Inter-tidal coastal environments

Key considerations for operating in inter-tidal coastal environments include the following:

- *Mangroves:* Adverse environmental, social and economic impacts on mangroves resulting from oil and gas operations can include dredging, seismic surveys using explosives, and the creation of access routes. Measures such as the use of minimally-sized drilling barges and directional drilling can reduce direct damage to mangroves and other intertidal ecosystems. Further measures are set out in the OGP "Guidelines on E&P Activities in Mangroves[4]".
- *Non-mangrove wetlands:* Key issues to consider include maintenance of freshwater and salt water flows to wetlands, the difficulty of rehabilitating areas where dredging or drilling have occurred, subsidence due to the extraction of gas or oil and consequent changes in sedimentation and water flows, and the effect of accidental spills and releases.
- *Coral reefs:* Oil and gas development can impose physical, chemical, and temperature stresses on corals. Rehabilitation of coral ecosystems and compensation for damage has proven to be difficult in practice, underlining the importance of impact prevention. This is especially the case where corals are already damaged or under threat from other coastal activities and development. In cold water environments, it is important to consider areas of soft and hard cold-water corals and other less common benthic ecosystems. Disturbance of corals can be limited by locating activities and platforms away from coral reefs, avoiding dredging access channels and trenches for pipelines through corals, limiting nearby waste discharges, managing turbidity during



civil works (use of silt curtains) and preventing spills. Coastal and marine current circulation and solute/sediment transport modelling can be used to predict and avoid temperature, chemical, and sedimentation impacts on corals.

Appendix 1 provides a summary of the major components of the coastal environments where oil and gas development takes place and highlights key management issues when carrying out oil and gas activities.

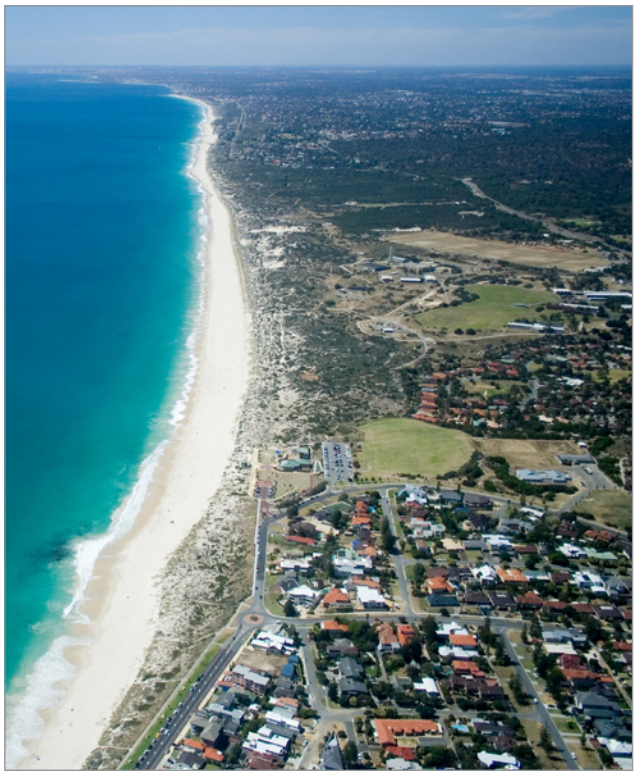
Key recommendations

Do

- Obtain senior management support to ensure that a broad, strategic environmental, social and economic perspective is adopted as early as possible in the life of the asset;
- Carry out landscape-scale baseline studies of environmental, economic, social and political conditions prior to the start-up of activities;
- Engage and consult relevant stakeholders to understand how they use and value natural resources, address perceived impacts and avoid potential resource conflicts to the extent practicable;
- Map exposure to access constraints, carefully examine alternative routing and siting options, and take timely measures to avoid areas that pose elevated economic, ecological or social risks;
- Limit exposure to natural and human-induced threats by careful assessment of links with natural processes and human activities in interconnected inland watersheds, and marine areas;
- Think strategically about the risks and opportunities of operating in coastal areas. Ensure key staff and planners appreciate the wider ecological and socio-economic context of coastal operations;
- Frame forward-looking and integrated environmental and social impact assessments that take account of the accelerating pace of global change and the complex nature of coastal areas, and put in place targeted action plans to effectively prevent or mitigate potential impacts (primary, secondary, cumulative and perceived). Ensure plans are aligned with known larger-scale ecosystem conservation/management plans and priorities;
- Design or retrofit equipment and facilities for changing environmental conditions and requirements;
- Consider opportunities to contribute to more sustainable coastal development patterns through careful planning and the application of design, development, and operating practices adapted to the specific characteristics of coastal areas.

Do not

- Proceed with development without the engagement and support of government and affected communities;
- Overlook key stakeholders, especially at the local level, or delay consultation beyond the time when changes can be made;
- Encroach on areas of government responsibility. Identify early-on the limits of company planning and responsibility in the coastal environment;
- Proceed without considering the wider environmental and social picture, long-term processes such as climate change and other natural and anthropogenic stresses on the environment.



Further advice and information

Considerable information is available on ecosystems and different forms of economic activity in coastal areas. Useful websites to consult include:

- Australian Petroleum Production and Exploration Association - APPEA (www.appea.com.au)
- Energy and Biodiversity Initiative – EBI (www.theebi.org)
- Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection - GESAMP (www.gesamp.org)
- IPIECA - the global oil and gas industry association for environmental and social issues (www.ipieca.org)
- International Association of Oil and Gas Producers - OGP (www.ogp.org.uk)
- European Environment Agency - EEA (www.eea.europa.eu)
- International Finance Corporation – IFC (www.ifc.org/enviro/EnvSoc/index.html)
- National Oceanic and Atmospheric Administration - NOAA (www.noaa.gov)
- UK Oil and gas (www.oilandgasuk.co.uk)
- United Nations Environment Programme - UNEP (www.unep.org)
- UNEP World Conservation Monitoring Centre - UNEP-WCMC (www.unep-wcmc.org)
- World Resources Institute – WRI (www.wri.org)

Appendix 1 – Major coastal environment types and potential interactions with oil and gas development

Coastal environment type	Common human uses	Adverse effects of poor management	Natural and man-induced threats to oil and gas development	Selected considerations for planning and impact assessment
Estuaries Inter-tidal estuaries, deltas, lagoons, mangrove forests, mudflats, salt marshes, salt pans, other coastal wetlands including freshwater marshes and forests, and brackish water marshes.	Ports and harbours; Residential development (urban, rural, traditional or subsistence); Aquaculture; Capture fisheries; Agriculture; Industry; Ecotourism; Oil and gas terminals and processing facilities, refineries, LNG Plants.	Pollution from domestic and industrial wastes; Conflicts among uses/users; Declining capture fishery and aquaculture yields; Loss of biodiversity; Habitat degradation and fragmentation; Introduction of alien invasive species; Increased flooding, salt intrusion, and changes in drainage patterns; Restricted access by wildlife; Reduced ecosystem services; Visual impact.	Flooding; Subsidence; Reduction in water quality; Competition for freshwater.	Availability and quality of freshwater; Vulnerability to flooding and subsidence; Potential conflicts with other activities such as tourism, capture fisheries, marine aquaculture, biodiversity conservation, and navigation; Disruption of bio-chemical and physical processes that maintain the health and productivity of coastal ecosystems; Conservation easements; Coastal setbacks with vegetated buffer zones; Ballast water management (invasive species).
Semi-enclosed coasts with large scale bays Tidal wetlands including freshwater marshes and forests, and brackish water marshes and mangroves, mudflats, sea grass.	As above, plus Tourism and recreation; Oil and gas pipeline terminals; Oil and gas exploration, extraction and primary processing.	Conflicts among uses/users; Declining capture fishery and aquaculture yields; Loss of biodiversity; Habitat degradation and fragmentation; Reduced/degraded ecosystem services; Visual impact.	Tsunamis; Storm surges; Pollution from land and sea based activities.	Availability and quality of freshwater; Vulnerability to flooding, storm surges and tsunamis. Erosion and shoreline loss; Siltation due to increased erosion inland; Potential conflicts with other activities such as tourism capture fisheries, aquaculture, biodiversity conservation and navigation.
Open coasts Beaches, rock cliffs, soft and highly erodible cliffs, reefs.	Tourism, recreation and related construction; Navigation; Aggregate dredging; Commercial and artisanal fisheries; Wind farms; Oil and gas pipeline terminals, primary processing; transfer of oil and gas to vessels.	Pollution from domestic and industrial waste discharges and agricultural runoff; Conflicts among uses/users; Erosion; Alteration of natural drainage patterns; Loss of biodiversity; Habitat degradation; Degraded ecosystem services; Visual impact.	As above, plus Erosion; Navigation channel siltation, shoreline accretion due to changes in coastal processes.	Vulnerability to flooding (storm surges, runoff); Tsunamis; Erosion and siltation; Potential conflicts with other activities such as tourism, capture fisheries, aquaculture, biodiversity conservation, and navigation.

Coastal environment type	Common human uses	Adverse effects of poor management	Natural and man-induced threats to oil and gas development	Selected considerations for planning and impact assessment
Benthic (sea-bed systems) Kelp forests, sea grass beds, coral reefs, soft bottom environments above the continental shelf, artificial reefs and structures.	Fisheries (esp. trawling); Recreation; Aggregate and navigational dredging; Marine aquaculture; Oil and gas platforms and pipelines.	Pollution from inland, coastal and marine sources; Conflicts among uses/users; Siltation from poor on-shore land management; Damage from dredging; Damage from bottom trawling; Loss of biodiversity; Habitat degradation; Reduced/ degraded ecosystem services.	Competition for access; Erosion; Navigation channel siltation, shoreline accretion due to changes in coastal processes.	Vulnerability to erosion and siltation; Potential conflicts with other activities, such as fisheries, biodiversity conservation and navigation; Temperature of discharges (possible impact on coral reefs); Accumulation of discharged solids.
Pelagic Open waters above the continental shelf, sea ice, zone for migratory fish stocks and marine mammals such as whales.	Commercial and artisanal fisheries; Freestanding fish farms; Navigation routes, shipping and discharge of ballast water; Oil and gas pipelines, platforms, exploration, extraction and primary processing.	Pollution from inland, coastal, and marine sources; Conflicts among uses/users; effects of seismic activities on marine mammals, fish and turtles; impact of platform lighting on migratory birds; Siltation from poor on-shore land management; Alien invasive species; Overfishing; Reduced/degraded ecosystem services.	Competition for access; perceived effects on fisheries.	Potential conflicts with other activities such as fisheries and navigation; Potential adverse effects on marine life (light, discharges, sound, vessel traffic, etc.).

Source: Burbridge, P.R. and Maragos, J.E. (1985). Analysis of Environmental Assessment and Coastal Resources Management Needs for a Possible U.S. Agency for International Development Project in Indonesian Aquatic Resources Development - joint report on a consultancy prepared for the International Institute for Environment and Development, Washington, D.C.; World Resources Institute.

IPIECA

IPIECA is the global oil and gas industry association for environmental and social issues. It develops, shares and promotes good practices and knowledge to help the industry improve its environmental and social performance; and is the industry's principal channel of communication with the United Nations. Through its member led working groups and executive leadership, IPIECA brings together the collective expertise of oil and gas companies and associations. Its unique position within the industry enables its members to respond effectively to key environmental and social issues.

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OGP

OGP represents the upstream oil and gas industry before international organizations including the International Maritime Organization, the United Nations Environment Programme (UNEP) Regional Seas Conventions and other groups under the UN umbrella. At the regional level, OGP is the industry representative to the European Commission and Parliament and the OSPAR Commission for the North East Atlantic. Equally important is OGP's role in promulgating best practices, particularly in the areas of health, safety, the environment and social responsibility.

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