# Good Practice in the Prevention and Mitigation of Primary and Secondary Biodiversity Impacts

The Energy & Biodiversity Initiative

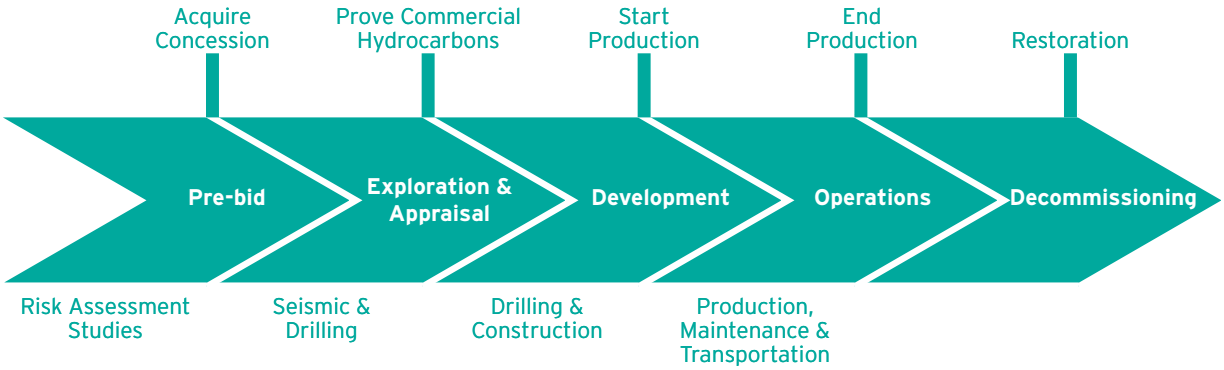
## INTRODUCTION

The practices noted in this document represent a mixture of "good," and, in some cases, "best" practice drawn from those that are well known and that have been shown to be effective when used appropriately. However, it should be recognized that "best practice" is constantly evolving and must also be adapted to each specific site and its environment. This document therefore represents a "menu" of sound biodiversity conservation practices from which can be chosen the most appropriate measures that fit the operational and geographic setting.

The impacts and related preventative and mitigative measures discussed cover the entire project lifecycle, with the exception of the pre-bid phase, where there are no physical impacts. This document is primarily aimed at corporate officers, site managers and other relevant personnel responsible for the management, monitoring and conservation of biodiversity throughout the lifecycle of upstream oil and gas operations (see Figure 1).

It is often difficult to definitively label environmental degradation as a result of either primary or secondary impacts. Most primary impacts can be relatively easily predicted with a standard Environmental and Social Impact Assessment (ESIA) process, based on the proposed activity and an understanding of the surrounding ecosystem. However, although secondary impacts may be predicted with a thorough ESIA process that includes biodiversity issues and explicitly links environmental and social issues, in some cases, the potential for such impacts may not be identified or realized until much later in the project cycle, or even after the project has been decommissioned. The potential range of biodiversity impacts that might be faced by a company are summarized in Box 1.

## FIGURE 1. THE LIFECYCLE OF UPSTREAM OIL AND GAS OPERATIONS[1]




[1] At the pre-bid stage, a company may choose not to proceed with investment and exit the project lifecycle, because of biodiversity or other concerns. For technical, economic or other reasons, a company may not continue activity after completion of exploration and appraisal. In addition, at any point in the project lifecycle after the pre-bid stage, a company may choose (or be required by the host government) to "exit" a project by divesting and transferring its legal interest to another operator. This possibility may raise a number of issues about the continuity of biodiversity-related philosophy, commitment and practice from one company to another, potentially jeopardizing sustainable biodiversity conservation and a company's ability to maintain the reputational value of its activities related to biodiversity conservation (see *Integrating Biodiversity into Environmental and Social Impact Assessment Processes*, Section 3.11, and *Framework for Integrating Biodiversity into the Site Selection Process* for further discussion of this issue).

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| BOX 1. SUMMARIZED BIODIVERSITY IMPACTS[2] | | |
|---|---|---|
| **PROJECT STAGE** | **PROJECT ACTIVITY** | **POTENTIAL BIODIVERSITY IMPACTS** |
| **Exploration: seismic, drilling, etc.** | **Onshore**:<br>• Provision of access (airstrips, temporary roads)<br>• Set up and operation of camps and fly camps<br>• Use of resources (water, aggregate)<br>• Storage of fuel<br>• Clearing of lines and layout geophones<br>• Shot hole drilling<br>• Use of explosives<br>• Closure of shot holes, mud pits, camps and access infrastructure<br>• Mobilization of drill rig<br>• Drilling operations<br>• Well testing/flaring | • Footprint impacts to habitats/flora<br>• Disturbance of fauna<br>• Noise impacts on animal populations<br>• Physical disturbance of soils and watercourses<br>• Contamination of soils, surface and groundwater<br>• Landscape modification, visual impact |
| | **Marine**<br>• Vessel mobilization and movement<br>• Vessel emissions and discharges<br>• Seismic operation<br>• Anchor rig/lower legs<br>• Use of chemicals<br>• Mud and cuttings discharge<br>• Fuelling and fuel handling<br>• Blow-out risk | • Impact on fish<br>• Disturbance of marine mammals<br>• Disturbance of sediment and benthic populations<br>• Contamination of sediment<br>• Impact on seabirds, coastal habitats, etc. in event of oil spill |
| **Construction** | **Onshore**<br>• Set-up and operation of construction camps<br>• Provision of construction access<br>• Resource use (water, timber, aggregate)<br>• Import of heavy plant and machinery<br>• Vehicle movements<br>• Earthmoving, foundations, excavation<br>• Storage/use of fuel and construction materials<br>• Generation of construction wastes | • Temporary and permanent loss of habitat and component ecological populations due to temporary and permanent footprint<br>• Soil erosion and reduction in productivity<br>• Contamination of soils, surface and groundwater<br>• Damage to cultural heritage |
| | **Marine**<br>• Mobilization and movement of vessels<br>• Vessel emissions and discharges<br>• Anchoring, piling | • Disturbance to sediment, benthic fauna and other seabed flora and fauna<br>• Loss of seabed habitat<br>• Disturbance to marine mammals |
| **Operation/ Production** | **Onshore**<br>• Footprint<br>• Visible presence<br>• Import and export of materials and products<br>• Product handling, storage, use of chemicals and fuel<br>• Solid wastes arising<br>• Liquid effluent<br>• Emissions to atmosphere<br>• Noise<br>• Light | • Long-term landtake effects on ecology<br>• Effects on landscape and visual amenity<br>• Soil and groundwater contamination<br>• Effects on water quality, aquatic ecology and resource users<br>• Effects on air quality, ecology and human health<br>• Global warming |
| | **Marine**<br>• Direct footprint<br>• Chemicals storage, handling and use<br>• Emissions to atmosphere<br>• Operational noise, helicopter supply and standby vessel movement<br>• Discharges to sea<br>• Oil spill risk<br>• Light | • Loss of seabed habitat<br>• Interruption of fishing effort<br>• Disturbance to seabirds and marine mammals<br>• Effects on water quality and marine ecology<br>• Effects on air quality and global warming<br>• Risk to marine and coastal resources in event of spill |

[2]Adapted from Shell's draft *Integrated Impact Assessment: Environmental Impact Assessment Module*, EP 95-0370, May 2002.

In general terms, preventative measures should take priority over those that are mitigative in nature; prevention may be more efficient and cost-effective than mitigation, in addition to the reputational benefits of avoiding impacts rather than addressing them once they have already occurred. However, prevention may not always be technically feasible or economically viable, and therefore, a mixture of preventative and mitigative measures typically represents the optimum solution.

In the tables that follow, it is important to recognize that not all impacts will occur in every case, nor will all good practices identified be appropriate for implementation in all cases. Equally, as the practices identified in the tables have been largely drawn from the literature, they are not all-inclusive. As best practice continues to develop so new approaches and technology will become available. In all cases, full and complete compliance with all applicable laws and regulations must be the starting point for all phases of oil and gas activities. When and where appropriate, company environmental policies and standards may mandate more stringent controls on operations. Good and best practice will ultimately be determined by collective experience as applied to a unique set of conditions that comprise the local operating environment.

Although this document is designed for use as a standalone document, other Energy and Biodiversity Initiative products offer detailed guidance on key elements contained within it. In particular, *Integrating Biodiversity Conservation into Oil and Gas Development* contains a summary of the analysis and recommendations of the EBI, which form the overall context for this document, and contains a number of examples and case studies of good practice in dealing with primary and secondary impacts. Other significant EBI documents include *Integrating Biodiversity into Environmental and Social Impact Assessment Processes*, *Opportunities for Benefiting Biodiversity Conservation*, and *Negative Secondary Impacts from Oil and Gas Development* (which includes an analysis of major factors that may lead to secondary impacts). While the Energy and Biodiversity Initiative has identified a large number of good practices from the available literature, the continued improvement of this document is dependent on the active participation of end-users. Therefore, we welcome any comments and suggestions relating to revisions and additions that will improve the usability, content and breadth and depth of application in the oil and gas sector and highlight new and existing good or best practice methods of impact prevention and mitigation. We are also actively seeking case studies that exemplify good and best practice in the oil and gas industry for inclusion in future updates of this document.

## PLEASE SEND COMMENTS, SUGGESTIONS AND QUESTIONS TO:

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## STRUCTURE OF THE DOCUMENT

The analysis of potential impacts and preventative/mitigative measures is presented in four parts:

### PART A – Primary Impacts: Onshore Operations

- Table 1. Seismic activity
- Table 2. Exploration and appraisal drilling
- Table 3. Field development
- Table 4. Production
- Table 5. Transmission
- Table 6. Decommissioning

### PART B - Primary Impacts: Offshore Operations

- Table 7. Seismic activity
- Table 8. Exploration
- Table 9. Field development
- Table 10. Production
- Table 11. Transmission
- Table 12. Decommissioning

### PART C – Secondary Impacts: Onshore Operations

- Table 13. Seismic activity
- Table 14. Exploration and appraisal drilling
- Table 15. Field development
- Table 16. Production
- Table 17. Transmission
- Table 18. Decommissioning

## PART D – Secondary Impacts: Offshore Operations

- Table 19. Seismic activity
- Table 20. Exploration
- Table 21. Field development
- Table 22. Production

Each issue within Tables 1-22 has been numbered and cross-referenced where appropriate to other related issues to show the major links between primary and secondary impacts. References supporting the statements of good practice are compiled at the end of the document. Table 23 summarizes and cross-references the principal issues (primary impacts are shown in normal font, and secondary impacts in italics), the location (onshore/offshore), lifecycle stage and spatial dimension where these may occur (shown as shading).

## PART A. PRIMARY IMPACTS – ONSHORE OPERATIONS

### TABLE 1. ONSHORE SEISMIC ACTIVITY

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE SEISMIC | **ISSUE 1A:** Seismic lines & grids<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Vibroseis machinery may cause damage to vegetation and surface hydrology<br>• Short-term disturbance to wildlife and human populations from vibrations and shot-hole drilling activities (explosions)<br>• Erosion and changes in surface hydrology from unplugged or improperly plugged shot holes and seismic lines (cleared vegetation) | • Schedule operations during least sensitive periods, avoiding migration, nesting and mating seasons.<br>• Shot-hole methods should be considered in the place of vibroseis machinery where vegetation cover is required and where access is a concern. Ensure that the charge is small enough and deep enough to avoid cratering. Consider aquifer protection and suitable plugging. Use offsets to avoid specific sensitivities. Ensure that misfired charges are disabled and removed. Mobilize clean-up crews after operations.<br>• If using vibroseis machinery on soft ground, avoid excessive compaction from vehicles and baseplate.<br>• Ensure appropriate handling and storage of fuels and hazardous materials (e.g., explosives).<br>• Cut seismic lines by hand to minimize disturbance.<br>• Minimize the width of corridors to ensure compatibility with operational, health and safety requirements.<br>• Do not cut trees that are larger in diameter than local regulations permit, or in the absence of regulations, greater than 20 centimeters (8 inches) in diameter.<br>• Minimize clearing of vegetation. Leave in place smaller vegetation, topsoil, root stock, seeds and endangered or protected species and species used by local communities for commercial or subsistence use (identified in the environmental assessment).<br>• Treat all onshore operations as if "offshore" to maintain isolation from access routes and communities. |
| | **ISSUE 1B:** Helipads/airfields<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Short-term disturbance of habitats from helipad clearings; disturbance of wildlife populations from noise (impacts usually local and short-term) | • Use helicopters within safety limits where minimization of ground transport is required (e.g., access, clearing).<br>• Construct helipads to reduce disturbance consistent with operational, health and safety requirements.<br>• Assess lowest impact location for helipads and flight paths.<br>• Schedule operations during least sensitive periods, avoiding migration, nesting and mating seasons. |
| | **ISSUE 1C:** Other infrastructure<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing local habitats | • "Minimize the footprint." Use existing infrastructure to the extent possible to avoid or reduce road construction and clearing.<br>• In clearing vegetation, use hand-cutting techniques to the extent possible, thereby avoiding the use of heavy machinery. |

## TABLE 1. ONSHORE SEISMIC ACTIVITY (cont'd)

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE SEISMIC | **ISSUE 1D:** Drainage<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology, causing short- and possible long-term changes in local habitats | • Take topography, natural drainage and site runoff patterns into account. Ensure adequate drainage away from streams, rivers and other waterways. |
| | **ISSUE 1E:** Erosion (topsoil loss)<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Impedes ability of habitats to revegetate, causing possible long-term damage to affected area<br>• Siltation of waterways, with negative impacts on aquatic and marine environments | • Take topography, natural drainage and site runoff patterns into account. Ensure adequate drainage.<br>• Stabilize all slopes, revegetating with native species to reduce/avoid erosion.<br>• Break-up compacted surfaces and replace topsoil, brash, seed source, leaf litter, etc. |
| | **ISSUE 1F:** Site clearance<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing and fragmenting local habitats | • Select site to reduce effects on environmental and local communities and to minimize the need for clearing, using existing infrastructure.<br>• Choose site to encourage natural revegetation by indigenous flora and fauna and to avoid the removal of vegetation, topsoil and seed source for decommissioning. |
| | **ISSUE 1G:** Base camp construction<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Wastes, fires and discharges (sewage) impact local habitats<br>• Destruction of habitats through creation of access routes to base camps and creation of base camp sites (potentially long term)<br>• Short-term disturbance of local habitats from base camp light, noise and other activities | • Minimize the size of camps and facilities consistent with operational, health and safety requirements.<br>• Reduce waste and control waste disposal (solids, sewage).<br>• Prepare contingency plans for spillages, fire risks, etc.<br>• Keep the workforce within defined boundary and to the agreed access routes.<br>• Light sources should be properly shaded and directed onto site areas.<br>• Educate workforce on environmental concerns and design and implement policies to protect biodiversity. |
| | **ISSUE 1H:** Traffic<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Short-term disturbance of habitats from traffic; short-term disturbance of wildlife populations from noise<br>• Compaction of soils and changes in surface hydrology<br>• Killing or maiming of local wildlife | • Use existing infrastructure to the extent possible to avoid or reduce road construction and clearing.<br>• Keep traffic to the absolute minimum requirements for operations.<br>• Impose and enforce speed limits and provide driving guidelines for vehicle operators.<br>• Treat (water) road surfaces to manage dust.<br>• Allow only authorized employees access to site(s) transportation. |
| | **ISSUE 1I:** NOx emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from ground-level NOx gas | • Ensure requirements from the planning phase are met to minimize effects from exhausts and to address any NOx problems. |
| | **ISSUE 1J:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area, local zone, country, transboundary<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions<br>• Local damage to flora and fauna<br>• Contribution to impacts arising from acid rain | • Ensure requirements from the planning phase are met to minimize effects from exhausts and to address any $SO_2$ problems. |
| | **ISSUE 1K:** VOC emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • Ensure requirements from the planning phase are met to minimize effects from exhaust and to address any VOC problems. |
| | **ISSUE 1L:** Noise<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions | • Minimize extraneous noise sources and use adequate noise attenuation on engines. |

## TABLE 2. ONSHORE EXPLORATION AND APPRAISAL DRILLING

ONSHORE EXPLORATION AND APPRAISAL DRILLING

| ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|
| **ISSUE 2A:** Helipads/airfields<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Local, short-term disturbance of habitats and wildlife populations | • All practices identified for seismic should be applied to other infrastructure during exploration and appraisal. |
| **ISSUE 2B:** Other infrastructure<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing local habitats | • Use existing infrastructure to the greatest extent possible to avoid or reduce road construction and clearing.<br>• In clearing vegetation, use hand-cutting techniques to the extent possible, thereby avoiding the use of heavy machinery. |
| **ISSUE 2C:** Drainage<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Changes in surface hydrology, causing short- and possibly long-term changes in local habitats and possible contamination from run-off | • Take topography, natural drainage and site run-off into account. Avoid areas prone to flooding.<br>• Incorporate drainage and minimize disturbance to natural drainage patterns. Engineer slopes and drainage to reduce erosion. Design for storm conditions, ensure off-site natural runoff does not wash over site, and use perimeter drainage ditches.<br>• Seal bund and ensure suitable drainage of machinery areas, fuel and chemical storage and mud-mixing areas.<br>• Provide base material compatible with local ground conditions. Hard core should be laid on geotextile membrane. Avoid concrete at sites.<br>• Limit leveling activity.<br>• Protect groundwater from drill stem penetration and shallow aquifers from possible site contamination.<br>• Where watercourses and aquifers are deemed sensitive, consider a fully sealed site; avoid use of mud pits, use lined steel tanks.<br>• Mud and burn pits, if used, must have adequate contingency capacity, especially in areas of high rainfall, and must be fully lined and bunded.<br>• Treat surface drainage water in an interceptor with hay filter or similar material. |
| **ISSUE 2D:** Erosion (topsoil loss)<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Impedes ability of habitats to revegetate, causing possible long-term damage to affected areas<br>• Aquatic and marine environments adversely impacted by siltation from erosion | • Protect watercourses from contamination and siltation.<br>• Avoid clearing steep slopes and creating well-defined paths, and when unavoidable, use biodegradable material (jute, straw, etc.) and native species to stabilize slopes. |
| **ISSUE 2E:** Site clearance<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing and fragmenting local habitats | • Site to minimize impacts on water resources, conservation interests, settlement, agriculture, sites of historical and archaeological interest and landscapes. Consider using sites that are already cleared or disturbed, are of low ecological value or that may be easily restored (e.g., agricultural land).<br>• Schedule operations during least sensitive periods, avoiding migration, nesting and mating seasons.<br>• Select the least sensitive locations within the confines of the bottom target/drilling envelope. Consider directional drilling to access targets beneath sensitive areas.<br>• Plan subsequent restoration requirements prior to and during operations.<br>• Use cluster drilling to minimize the "footprint."<br>• Minimize cleared area and size of site; maximize the perimeter to area ratio to aid natural revegetation.<br>• Use hand cutting to clear vegetation. If machinery is necessary, be selective in using it.<br>• Do not burn brush and uprooted materials.<br>• Where vegetation and soil are removed, ensure proper separation and storage. Collect seed, rootstocks and brash for subsequent revegetation. |

## TABLE 2. ONSHORE EXPLORATION AND APPRAISAL DRILLING

| ONSHORE EXPLORATION AND APPRAISAL DRILLING | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| | **ISSUE 2F:** Base camp construction<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Adverse impacts on local habitats from wastes, fires and discharges (sewage)<br>• Destruction of habitats through creation of base camps and access routes to base camps (possibly long-term)<br>• Short-term disturbance of local habitats from light, noise and other human activity at base camps<br>• Erosion and changes in surface hydrology | • All practices identified for seismic lines should be applied to other infrastructure during exploration and appraisal. |
| | **ISSUE 2G:** Traffic<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Short-term disturbance of habitats and wildlife populations from traffic and traffic noise<br>• Compaction of soils and changes in surface hydrology<br>• Killing and maiming of local wildlife by vehicles | • All practices identified for seismic lines should be applied to other infrastructure during exploration and appraisal. |
| | **ISSUE 2H:** NOx emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impact:**<br>• Short-term disturbance to wildlife from emissions | • Ensure that requirements from planning phase are met to minimize the effects of exhausts.<br>• Ensure that well test procedures are followed.<br>• Minimize flaring of gas.<br>• Knockout drums should be used on flares to prevent condensate emissions.<br>• Use flaring instead of venting.<br>• Never use continuous venting, and minimize emergency venting.<br>• Use low-NOx burners in process heaters. |
| | **ISSUE 2I:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area, local zone, country, transboundary<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions<br>• Local damage to flora and fauna<br>• Contribution to impacts arising from the generation of acid rain | • Ensure that requirements from planning phase are met to minimize the effects of exhausts.<br>• Ensure that well test procedures are followed.<br>• Minimize flaring of gas.<br>• Knockout drums should be used on flares to prevent condensate emissions.<br>• Use flaring instead of venting.<br>• Never use continuous venting, and minimize emergency venting.<br>• Remove hydrogen sulfide and mercaptans from sour gases before flaring. |
| | **ISSUE 2J:** VOC emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • Ensure that requirements from planning phase are met to minimize the effects of exhausts.<br>• Ensure that well test procedures are followed.<br>• Minimize flaring of gas.<br>• Knockout drums should be used on flares to prevent condensate emissions.<br>• Use flaring instead of venting.<br>• Never use continuous venting, and minimize emergency venting. |
| | **ISSUE 2K:** Noise<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions | • All practices identified for seismic lines should be applied during exploration and appraisal. |
| | **ISSUE 2L:** Produced water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local waterways, water table and ground surface with subsequent impacts on flora and fauna | • Any produced water from well test operations must be properly disposed of. Disposal options must be addressed in planning phase, and subsequent requirements must be met. Reinject untreated produced water. |

## TABLE 2. ONSHORE EXPLORATION AND APPRAISAL DRILLING (cont'd)

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE EXPLORATION AND APPRAISAL DRILLING | **ISSUE 2M:** Effluent/sewage water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local waterways, water table and ground surface with subsequent impacts on flora and fauna | • Carefully consider water receptors and supply sources (groundwater, surface or marine). In areas of water shortage, use water separation/recycling mud system. If marine sources are used, care must be taken with regard to disposal.<br>• Treat contaminated water and affluent as liquid waste.<br>• Use local sewage disposal facilities where available. For small, isolated sites, soak away/septic field systems can be used, biodegradable solids may be buried, and liquid discharges should be controlled to ensure that local water resources, both surface and groundwater, are not contaminated.<br>• Use package treatment plants for the rig camp. |
| | **ISSUE 2N:** Drill cuttings/mud<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of site collection pits, local waterways, water table and ground surface with subsequent impacts on flora and fauna | • Use non-toxic water-based muds. Minimize use of oil-based mud (OBM) and synthetics to that required by operational reasons and use down-hole disposal of OBM wastes; otherwise, treat as hazardous waste.<br>• Reuse invert (diesel-based) muds and drilling-mud pond decant water. |
| | **ISSUE 2O:** Oil spills<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local habitats, especially waterways, water table and ground surface with subsequent impacts on flora and fauna | • Requirements of oil spill and emergency plans must be met before operations commence. |
| | **ISSUE 2P:** Waste deposition<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Adverse impacts on site ecosystems from waste discharges | • Containerize spent oils and lubes for appropriate disposal or recycling.<br>• Where approved disposal sites are available and suitable, use them for all off-site waste disposal. On-site disposal may be considered for inert materials. Ensure detailed documentation and manifesting. Ensure adequate consultation with local authorities regarding nature, type and volumes of wastes arising and capability and capacity of local resources.<br>• Do not discard litter or debris around sites. All wastes to be containerized on-site.<br>• In isolated and remote areas, with no local disposal facilities, non-toxic dry and liquid wastes may be burned, giving due consideration to atmospheric effects. If necessary, portable incinerators can be used to provide a cleaner burn.<br>• Containerize contaminated soils that cannot be treated *in situ* and remove off-site for treatment.<br>• Consider bulk supply of materials to minimize packaging wastes. Return unused materials to suppliers when possible.<br>• Hazardous materials usage, storage and disposal requirements must meet planning requirements. |

## TABLE 3. ONSHORE FIELD DEVELOPMENT

| ONSHORE FIELD DEVELOPMENT | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| | **ISSUE 3A:** Helipads/airfields<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Disturbance of habitats from clearing for helipads and disturbance of wildlife from noise (usually limited to the project site, but long-term use of the same flight patterns may disturb wildlife over a larger area) | • All practices identified for exploration and appraisal should be applied to helipads/airfields during field development. |
| | **ISSUE 3B:** Other infrastructure<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing local habitats | • All practices identified for exploration and appraisal should be applied to other infrastructure during exploration. |
| | **ISSUE 3C:** Drainage<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology, causing short- and possibly long-term changes in local habitats | • All practices identified for exploration drilling should be applied to drainage during field development.<br>• Use consolidated, impermeable base at all facilities with permanent in-built drainage systems.<br>• Segregate drainage systems for offsite and non-contaminated clean site areas and oily drainage system for process areas. |
| | **ISSUE 3D:** Erosion (topsoil loss)<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Impede revegetation of habitats (possibly long term)<br>• Damage to aquatic and marine environments from erosion-caused siltation | • All practices identified for exploration drilling should be applied to erosion during field development. |
| | **ISSUE 3E:** Site clearance<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing local habitats | • All practices identified for site clearance in exploration should be applied to field development.<br>• Consult with local authorities and communities before sites are selected and cleared.<br>• Consider construction and drilling activities and impacts separately from operational activities. Construction and drilling will use intensive methods and will be longer term compared to exploration construction and drilling requirements.<br>• Sites should only be cleared where long-term disturbances and impacts on the local environment and infrastructure can be avoided.<br>• Locate all facilities at single site to minimize the "footprint."<br>• Maximize use of satellite/cluster drilling sites, horizontal wells and extended-reach drilling in sensitive areas.<br>• Planning for site selection and preparation should include consideration of eventual decommissioning and restoration. |
| | **ISSUE 3F:** Base camp construction<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Damage to local habitats from wastes, fires and discharges (sewage)<br>• Destruction of habitats through creation of base camps and access routes to base camps (possibly long-term)<br>• Short-term disturbance of local habitats from light at base camps<br>• Erosion and changes in surface hydrology | • All practices identified for exploration drilling should be applied to base camps during field development. |

## TABLE 3. ONSHORE FIELD DEVELOPMENT (cont'd)

| ONSHORE FIELD DEVELOPMENT | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| | **ISSUE 3G:** Traffic<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Short-term disturbance of habitats and wildlife populations from traffic and noise<br>• Compaction of soils and changes in surface hydrology; blockage of streams and other waterways<br>• Killing and maiming of local wildlife by vehicles | • All practices identified for exploration should be applied to traffic during field development.<br>• Requirements for permanent long-term access routes include appropriate design and engineering, especially regarding the impacts of long-term disturbances from vehicle traffic volume and density in relation to environmental infrastructure and local communities. |
| | **ISSUE 3H:** Pipeline corridors (ROW)<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Destruction and fragmentation of habitat from the clearing of vegetation<br>• Introduction of invasive species during revegetation activities<br>• Interference with wildlife movements | • Flowlines and pipeline routing will require consideration in relation to disturbances and effects (bury, surface). Avoid sensitive habitats and build along existing access routes, using spatial planning exercises with relevant stakeholders to design route.<br>• Minimize width of corridors during construction and operation, and plan for closure of ROW to the greatest extent possible after completion.<br>• Allow trees and shrubs to re-establish through minimized cutting and clearing.<br>• Time clearing activities to avoid nesting/migration periods.<br>• Use selective removal of trees and shrubs through cutting.<br>• Limit amount of pipeline trench open at any one time, especially in sensitive habitats, with escape ramps at a maximum every 1 km (0.62 miles). |
| | **ISSUE 3I:** Soil deposition<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Burial/blanketing of sensitive habitats<br>• Increased erosion, leading to water turbidity, and impacts on benthic organisms and habitats | • Avoid sensitive habitats for deposition areas.<br>• Do not deposit material on slopes – use flat areas.<br>• Maximize distance between disposal areas and surface waters.<br>• Minimize dump heights/slopes to prevent excessive erosion.<br>• If deposition is temporary, consider bunding or other measures to control erosion of solids.<br>• If deposition is permanent, revegatate as quickly as possible with appropriate local species to stabilize area. |
| | **ISSUE 3J:** Revegetation<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Revegetation with non-native or invasive species can disrupt ecosystems and crowd out native species. | • Revegetate only with native species appropriate to the areas cleared. |
| | **ISSUE 3K:** NOx emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions | • All practices identified for exploration should be applied to NOx emissions during field development. |
| | **ISSUE 3L:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area, local zone, country, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna<br>• Associated impacts from acid rain generation | • All practices identified for exploration should be applied to $SO_2$ emissions during field development. |
| | **ISSUE 3M:** VOC emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for exploration should be applied to VOC emissions during field development. |

## TABLE 3. ONSHORE FIELD DEVELOPMENT (cont'd)

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE FIELD DEVELOPMENT | **ISSUE 3N:** Noise<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Disturbance to wildlife from noise | • All practices identified for exploration should be applied to noise emissions during field development. |
| | **ISSUE 3O:** Produced water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local waterways, water table and ground surface with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to produced water during field development. |
| | **ISSUE 3P:** Effluent/sewage water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local waterways, water table and ground surface with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to effluent/sewage water during field development. |
| | **ISSUE 3Q:** Drill cuttings/mud<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of site collection pits, local waterways, water table and ground surface with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to drill cuttings/mud during field development. |
| | **ISSUE 3R:** Oil spills<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local habitats, especially waterways, water table and ground surface with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to oil spills during field development. |
| | **ISSUE 3S:** Waste deposition<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Damage to site ecosystems through waste discharges from operations | • All practices identified for exploration should be applied to waste desposition during field development. |

## TABLE 4. ONSHORE PRODUCTION

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE PRODUCTION | **ISSUE 4A:** Helipads/airfields<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Disturbance of habitats from clearing for helipads and disturbance of wildlife populations from noise (usually local, but could be more widespread if same flight patterns are used over the long term) | • All practices identified for exploration should be applied to helipads and airfields during production. |
| | **ISSUE 4B:** Other infrastructure<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing local habitats | • All practices identified for exploration should be applied to other infrastructure during production.<br>• Evaluate construction and drilling activities and impacts separately from operational activities.<br>• Assess full implications of well treatment and processing, storage, power generation and other support and accommodation facilities in relation to long-term disturbances and impacts.<br>• Evaluate the implications for biodiversity of development of local infrastructure, especially infrastructure related to onshore service functions (port and harbor operations, resource use conflicts, waste treatment and disposal, socio-economic impacts, employment, local services and supply, support infrastructure for employee and family accommodations, etc.). |
| | **ISSUE 4C:** Drainage<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology, causing short- and possible long-term changes in local habitats | • All practices identified for exploration should be applied to drainage during production. |
| | **ISSUE 4D:** Erosion (topsoil loss)<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Impedes revegetation (possibly long-term damage to affected area)<br>• Damage to aquatic and marine environments from erosion-caused siltation | • All practices identified for exploration should be applied to erosion during production. |
| | **ISSUE 4E:** Traffic<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Disturbance of habitats from traffic and disturbance of wildlife populations from noise<br>• Compaction of soils and changes in surface hydrology<br>• Killing and maiming of local wildlife by vehicles | • All practices identified for exploration should be applied to traffic during production. |
| | **ISSUE 4F:** Pipeline corridors (ROW)<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country<br>**Potential impacts:**<br>• Destruction and fragmentation of habitat from clearing of vegetation<br>• Introduction of invasive species during revegetation activities | • All practices identified for field development should be applied to pipeline corridors during production. |
| | **ISSUE 4G:** Revegetation<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Revegetation with non-native or invasive species can disrupt ecosystems and crowd out native species | • All practices identified for field development should be applied to revegetation during production. |

## TABLE 4. ONSHORE PRODUCTION (cont'd)

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE PRODUCTION | **ISSUE 4H:** NOx emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions | • All practices identified for exploration should be applied to NOx emissions during field production. |
| | **ISSUE 4I:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area, local zone, country, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna<br>• Impacts arising from the generation of acid rain | • All practices identified for exploration should be applied to $SO_2$ emissions during production. |
| | **ISSUE 4J:** VOC emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for exploration should be applied to VOC emissions during production. |
| | **ISSUE 4K:** Noise<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions | • All practices identified for exploration should be applied to noise emissions during production. |
| | **ISSUE 4L:** Produced water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local waterways, water table and ground surface with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to produced water during production.<br>• Install produced water treatment facilities, particularly if local infrastructure cannot support requirements.<br>• Re-inject any untreated produced water down hole.<br>• Evaluate beneficial reuse of treated produced water, especially in areas of water stress. |
| | **ISSUE 4M:** Effluent/sewage water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local waterways, water table and ground surface with subsequent impacts on flora and fauna | • Install waste treatment facilities, particularly if local infrastructure cannot support requirements. Do not discharge untreated water into local waterways. |
| | **ISSUE 4N:** Drill cuttings/mud<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of site collection pits, local waterways, water table and ground surface with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to drill cuttings/mud during production.<br>• Provide contained storage areas for drill cuttings and muds.<br>• Fully assess terms of treatment and disposal options for drill cuttings and muds. Reinject cuttings and muds. |
| | **ISSUE 4O:** Oil spills<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local habitats, especially waterways, water table and ground surface with subsequent impacts on flora and fauna | • Prepare detailed contingency plans and conduct personnel training and regular spill response exercises.<br>• Establish consultation and liaison activities with local authorities and communities to make them aware of the possibility of spills and potential mitigation measures. |
| | **ISSUE 4P:** Waste deposition<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Damage to site ecosystems from waste discharges | • Install waste treatment facilities, particularly if local infrastructure cannot support requirements.<br>• Solid wastes, particularly toxic and hazardous substances, will require full assessment in relation to treatment and disposal options. If local facilities are unavailable, incineration facilities may be required, and a full assessment of implications will be necessary.<br>• Prepare and implement a detailed waste management plan.<br>• Provide contained storage areas for produced oil, chemicals and hazardous materials, including treatment of tank sludges.<br>• Monitor waste streams and fulfill compliance requirements. |

## TABLE 5. ONSHORE TRANSMISSION

| ONSHORE TRANSMISSION | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| | **ISSUE 5A:** Helipads/airfields<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Disturbance of habitats from clearing for helipads, disturbance of wildlife populations from noise (usually local, but could be more widespread if same flight patterns are used over the long term) | • All practices identified for exploration should be applied to helipads and airfields during transmission. |
| | **ISSUE 5B:** Other infrastructure<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing and fragmenting local habitats | • All practices identified for field development should be applied to other infrastructure during transmission. |
| | **ISSUE 5C:** Drainage<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology, causing short- and possibly long-term changes in local habitats | • All practices identified for field development should be applied to drainage during transmission. |
| | **ISSUE 5D:** Erosion (topsoil loss)<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Impedes revegetation (possibly long-term damage)<br>• Damage to aquatic and marine environments from erosion-caused siltation | • All practices identified for field development should be applied to erosion during transmission. |
| | **ISSUE 5E:** Site clearance<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing and fragmenting habitats | • All practices identified for exploration should be applied to site clearance during transmission. |
| | **ISSUE 5F:** Traffic<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Disturbance of habitats from traffic and disturbance of wildlife populations from noise<br>• Compaction of soils and changes in surface hydrology<br>• Killing and maiming of local wildlife by vehicles | • All practices identified for exploration should be applied to traffic during transmission. |
| | **ISSUE 5G:** Pipeline corridors (ROW)<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Vegetation clearing, destroying and fragmenting habitat<br>• Introduction of invasive species during revegetation | • All practices identified for field development should be applied to pipeline corridors during transmission. |
| | **ISSUE 5H:** Soil deposition<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Burial/blanketing of sensitive habitats<br>• Increased erosion, leading to water turbidity, and impacts on benthic organisms and habitats | • All practices identified for field development should be applied to soil deposition during transmission. |
| | **ISSUE 5I:** Revegetation<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Revegetation with non-native or invasive species can disrupt ecosystems and crowd out native species | • All practices identified for field development should be applied to revegetation during transmission. |

## TABLE 5. ONSHORE TRANSMISSION (cont'd)

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE TRANSMISSION | **ISSUE 5J:** NOx emissions<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions | • All practices identified for exploration should be applied to NOx emissions during transmission. |
| | **ISSUE 5K:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area, local zone, country, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for exploration should be applied to $SO_2$ emissions during transmission. |
| | **ISSUE 5L:** VOC emissions<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for exploration should be applied to VOC emissions during transmission. |
| | **ISSUE 5M:** Noise<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from noise | • All practices identified for exploration should be applied to noise emissions during transmission. |
| | **ISSUE 5N:** Oil spills<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Contamination of local habitats, especially waterways, water table and ground surface with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to oil spills during transmission. |

## TABLE 6. ONSHORE DECOMMISSIONING

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE DECOMMISSIONING | **ISSUE 6A:** Helipads/airfields<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Disturbance to habitats from clearing for helipads and disturbance to wildlife populations from noise (usually local, but could be more widespread if same flight patterns are used over the long term) | • Early in the project lifecycle, develop full decommissioning, restoration and aftercare plan in consultation with local authorities.<br>• Break up compacted surfaces and replace topsoil, brash, seed source, leaf litter, etc.<br>• Remove all non-native materials.<br>• Stabilize all slopes.<br>• If necessary, revegetate with native species to avoid erosion.<br>• Review success of restoration at later date and take remediation measures if site has not been returned to intended condition. |
| | **ISSUE 6B:** Other infrastructure<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing and fragmenting local habitats | • Develop full decommissioning, restoration and aftercare plan in consultation with local authorities.<br>• Consult with local authorities and other stakeholders concerning which infrastructure should remain, taking into account the short- and long-term impacts on biodiversity.<br>• Break up compacted surfaces and replace topsoil, brash, seed source, leaf litter, etc.<br>• Remove all non-native materials.<br>• Stabilize all slopes.<br>• If necessary, revegetate with native species to avoid erosion.<br>• Review success of restoration at later date and take remediation measures if site has not been returned to intended condition. |
| | **ISSUE 6C:** Land filling<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Loss of land-use options<br>• Long-term dispersion of contaminants from unrestored areas<br>• Long-term impacts on drainage patterns<br>• Invasion by non-native species in unrestored areas<br>• Health and safety issues for subsequent users of the area | • Successful reinstatement will require planning and implementation and should not be viewed as an afterthought or a short-term commitment.<br>• Develop full decommissioning, restoration and aftercare plans in consultation with local authorities and communities.<br>• Remove all debris and contaminated soils.<br>• Reform contours to match natural surroundings.<br>• Restore natural drainage patterns.<br>• Mud pits, where used, should be closed out according to local regulatory requirements.<br>• Infill burn and waste pits to meet local regulatory requirements.<br>• Re-spread original topsoil and brash, vegetation, leaf litter and organic material.<br>• Revegetate if necessary, using only native species compatible with the surrounding habitat.<br>• Document and monitor site recovery, taking remediation measures where necessary. |

## TABLE 6. ONSHORE DECOMMISSIONING (cont'd)

| ONSHORE DECOMMISSIONING | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| | **ISSUE 6D:** Base camp removal<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Wastes, fires and discharges (sewage); damage to local habitats from wastes, fires and discharges (sewage)<br>• Destruction of habitats through creation of base camps and access routes to base camps (possibly long-term)<br>• Disturbance to local habitats from light, noise and other human activities at base camps<br>• Erosion and changes in surface hydrology | • Develop full decommissioning, restoration and aftercare plans in consultation with local authorities and communities.<br>• Remove all debris and contaminated soils.<br>• Reform contours to match the natural surroundings.<br>• Restore natural drainage patterns.<br>• Mud pits, where used, should be closed out according to local regulatory requirements.<br>• Infill burn and waste pits to meet local regulatory requirements.<br>• Respread original topsoil and brash, vegetation, leaf litter and organic material.<br>• Revegetate if necessary, using only native species compatible with the surrounding habitat.<br>• Review success of restoration at later date and take remediation measures if site has not been returned to intended condition. |
| | **ISSUE 6E:** Traffic<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Disturbance of habitats from traffic and disturbance of wildlife populations from noise (usually local and short-term)<br>• Compaction of soils and changes in surface hydrology<br>• Killing and maiming of local wildlife | • All practices identified for exploration should be applied to traffic during decommissioning. |
| | **ISSUE 6F:** Pipeline corridors (ROW)<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of habitat | • Remove, if appropriate, all permanent structures, foundations, bases, roads, etc.<br>• Remove all debris and contaminated soils.<br>• Render access routes around pipeline corridors inaccessible or to conform with local requirments.<br>• Break up compacted surfaces and replace topsoil, brash, seed source, leaf litter, etc.<br>• Reform contours to match the natural surroundings.<br>• Restore natural drainage patterns.<br>• Respread original topsoil and brash, vegetation, leaf litter and organic material.<br>• Revegetate if necessary, using only native species compatible with the surrounding habitat.<br>• Review success of restoration at later date and take remediation measures if site has not been returned to intended condition. |

## PART B. PRIMARY IMPACTS - OFFSHORE OPERATIONS

### TABLE 7. OFFSHORE SEISMIC ACTIVITY

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE SEISMIC | **ISSUE 7A:** Seismic lines/grids<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Short-term acoustic disturbances to marine organisms | • Use environmental assessment to identify protected and locally sensitive areas. Schedule operations during least sensitive periods.<br>• Consult local authorities and other stakeholders regarding survey program, permitting and notifications.<br>• Remain on planned survey track to avoid unwanted interaction.<br>• Use local expertise to support operations (e.g., to spot marine mammals, wildlife, etc.).<br>• Implement airgun soft-start (ramp-up) procedure to minimize disturbance to marine mammals.<br>• Establish safety zones for shutdown in event of close approach of marine mammals |
| | **ISSUE 7B:** Traffic<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Damage to habitats (corals, mangroves) from anchoring and maneuvering vessels<br>• Short-term, local disturbances to marine organisms from noise and vibrations | • Identify and avoid protected and locally sensitive areas. Schedule operations during least sensitive periods.<br>• Make adequate allowance for deviation of towed equipment when turning.<br>• Keep speed of vessels to absolute minimums, particularly around identified sensitive habitats. |
| | **ISSUE 7C:** NOx emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions | • Ensure requirements from planning phase are met to reduce the effects from exhausts. |
| | **ISSUE 7D:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area, local zone, transboundary<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • Ensure requirements from planning phase are met to reduce the effects from exhausts. |
| | **ISSUE 7E:** VOC emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • Ensure requirements from planning phase are met to reduce the effects from exhausts. |
| | **ISSUE 7F:** Noise<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from noise | • Identify and avoid protected and locally sensitive areas and avoid most sensitive habitats. Schedule operations during least sensitive periods.<br>• Reduce noise to lowest levels possible. |
| | **ISSUE 7G:** Waste deposition<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Discharges can damage site-level ecosystems | • Dispose of all waste materials to meet international regulations.<br>• Apply procedures for handling and maintenance equipment.<br>• Prepare contingency plans for lost equipment.<br>• Attach active acoustic location devices to auxiliary equipment to aid location and recovery.<br>• Label all towed equipment. |
| | **ISSUE 7H:** Ballast water release<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Introduction of non-native species<br>• Contamination of ecosystems from chemicals and wastes in ballast water | • Sterilize water through filtration, heat treatments or deoxygenation with nitrogen prior to discharge. |

## TABLE 8. OFFSHORE EXPLORATION

| OFFSHORE EXPLORATION | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| | **ISSUE 8A:** Traffic<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Damage to habitats (corals, mangroves) from anchoring and maneuvering vessels<br>• Short-term, local disturbances to marine organisms from noise and vibrations | • Use environmental assessments to identify protected and sensitive areas. Schedule operations during least sensitive periods.<br>• Consult with local authorities regarding site selection and support infrastructure (ports and vessel and air traffic).<br>• Local conditions (waves, winds and currents) must be fully assessed.<br>• In coastal areas, select site and equipment to minimize disturbance, noise, light and visual intrusion.<br>• Exercise strict control on access and all vessel and rig activity.<br>• Prohibit transport of unauthorized passengers. |
| | **ISSUE 8B:** Trenching/dredging<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Damage to habitats and local flora and fauna<br>• Adverse impacts on habitats outside of project area from siltation caused by operations | • Select least sensitive location within confines of the bottom target/drilling envelope to avoid trenching and dredging of intertidal areas. |
| | **ISSUE 8C:** Anchoring<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Local damage to sensitive habitats, particularly corals | • Select least sensitive locations to anchor offshore exploration facilities. |
| | **ISSUE 8D:** NOx emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions | • Ensure that requirements from planning phase are met to minimize effects from exhausts. Ensure that any NOx problems are addressed and effectively controlled. |
| | **ISSUE 8E:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • Ensure that requirements from planning phase are met to minimize effects from exhausts. |
| | **ISSUE 8F:** VOC emissions<br>**Spatial dimension:** Project site, concession area, local zone, transboundary<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • Ensure that requirements from planning phase are met to minimize effects from exhausts. |
| | **ISSUE 8G:** Noise<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Short-term disturbance to wildlife from emissions | • All practices identified for seismic should be applied to noise during exploration and appraisal.<br>• Consult local authorities and other stakeholders regarding survey programs, permitting and notification.<br>• Remain on planned survey track to avoid unwanted interaction with sensitive areas.<br>• Use local expertise to support operations (e.g., spotting marine mammals, wildlife, etc.). |
| | **ISSUE 8H:** Produced water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • Treat and dispose on-shore, or use down-hole separation of oil and water.<br>• Minimize the quantity of water and reduce the toxicity of discharged produced water.<br>• Reuse produced water and recover oil from process wastewater prior to disposal.<br>• Use produced water for steam generation when steam is used to stimulate reservoir production. |
| | **ISSUE 8I:** Effluent/sewage water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • Sewage must be treated as necessary prior to discharge to meet international standards. Treatment must be adequate to prevent discoloration and visible floating matter. |

## TABLE 8. OFFSHORE EXPLORATION (cont'd)

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE EXPLORATION | **ISSUE 8J**: Cooling water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • Effluent should result in a temperature increase of no more than 3°C (5.4°F) at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters (109 yards) from the point of discharge. |
| | **ISSUE 8K:** Drill cuttings/mud<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • Use low toxicity water-based drilling muds. Minimize use of oil-based mud (OBM).<br>• Mud make-up and mud and cutting disposal requirements that are addressed in the planning process must be met.<br>• Do not dispose of whole OBM to sea. Any oily cuttings discharged should meet international standards.<br>• OBMs should be disposed of down hole. |
| | **ISSUE 8L:** Oil spills<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • Most spills and leakage occur during transfer operations. Ensure that adequate preventative measures are taken and that spill contingency plan requirements are in place. |
| | **ISSUE 8M:** Waste deposition<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • Oily water from deck washing, drainage systems, bilges, etc. should be treated prior to discharge to meet international standards.<br>• Ensure that requirements specified in the planning process are met with regard to waste treatment and disposal.<br>• Biodegradable kitchen wastes require grinding prior to discharge, if permitted under local regulations.<br>• Store oils and chemicals in suitably contained, drained areas. Limit quantities stored to a minimum level required for operational purposes. Ensure detailed control documentation and manifesting for disposal. Do not dispose of waste chemicals overboard.<br>• Separate and store oil from well-test operations. If burned, ensure burner efficiency is adequate to prevent oil fallout onto sea surface.<br>• Collect and compact all domestic waste for onshore disposal. Ensure detailed documentation and manifesting. Ensure that onshore receiving and disposal meet local and international requirements.<br>• Use waste segregation at source for different types (organic, inorganic industrial wastes, etc.).<br>• Do not discard any debris or waste overboard from rig or supply vessels.<br>• Waste containers must be closed to prevent loss overboard.<br>• Spent oils and lubes should be containerized and returned to shore.<br>• Purchase bulk supplies of materials to minimize packaging wastes. |
| | **ISSUE 8N:** Ballast water release<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Introduction of non-native species<br>• Contamination of ecosystems from chemicals and wastes in ballast water | • All practices identified for seismic lines should be applied to ballast water release spills exploration. |

## TABLE 9. OFFSHORE FIELD DEVELOPMENT

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE FIELD DEVELOPMENT | **ISSUE 9A:** Traffic<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Damage to habitats (corals, mangroves) from anchoring and maneuvering vessels<br>• Local disturbances to marine organisms from noise and vibrations | • Long-term occupation of sites and traffic channels, including supply and support bases, require detailed assessments of environmental implications, particularly where resource use conflicts arise and commercially important and protected habitats may be affected.<br>• Consult with local authorities on where traffic channels will have the least impact on biodiversity. |
| | **ISSUE 9B:** Gravel dumping<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Smothering of bottom living creatures and habitats | • Develop a full decommissioning and rehabilitation plan in consultation with local authorities and communities.<br>• Conduct assessment of potential impacts of gravel placement; evaluate alternatives.<br>• Identify source for gravel; evaluate impacts of procuring gravel for offshore placement. |
| | **ISSUE 9C:** Trenching/dredging<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Damage to habitats from operations with subsequent impacts on local flora and fauna<br>• Damage to habitats outside of project area from siltation caused by operations | • All practices identified for exploration should be applied to trenching and dredging during field development.<br>• Assess impacts of trenching and dredging on local flora and fauna; evaluate alternatives. |
| | **ISSUE 9D:** Anchoring<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Local damage to sensitive habitats, particularly corals | • All practices identified for exploration should be applied to anchoring during field development. |
| | **ISSUE 9E:** Pipeline corridors (ROW)<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Destruction and fragmentation of habitat | • Flowlines and pipeline routing will require consideration in relation to disturbances and effects (bury, surface). Avoid sensitive habitats and build along existing access routes.<br>• Minimize width of corridors during construction. |
| | **ISSUE 9F:** NOx emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions | • All practices identified for exploration should be applied to NOx emissions during field development. |
| | **ISSUE 9G:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area, local zone, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for exploration should be applied to $SO_2$ emissions during field development. |
| | **ISSUE 9H:** VOC emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for exploration should be applied to VOC emissions during field development. |
| | **ISSUE 9I:** Noise<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Short-term disturbance to wildlife | • All practices identified for exploration should be applied to noise emissions during field development. |
| | **ISSUE 9J:** Produced water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to produced water during field development. |
| | **ISSUE 9K:** Effluent/sewage/cooling water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to effluent/sewage/cooling water during field development. |

## TABLE 9. OFFSHORE FIELD DEVELOPMENT (cont'd)

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE EXPLORATION | **ISSUE 9L:** Drill cuttings/mud<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to drill cuttings and mud during field development. |
| | **ISSUE 9M:** Oil spills<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to oil spills during field development. |
| | **ISSUE 9N:** Waste deposition<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to waste deposition during field development. |

## TABLE 10. OFFSHORE PRODUCTION

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE PRODUCTION | **ISSUE 10A:** Traffic<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Damage to habitats (corals, mangroves) from anchoring and maneuvering vessels<br>• Local disturbances to marine organisms from noise and vibrations | • All practices identified for exploration should be applied to traffic during production. |
| | **ISSUE 10B:** Anchoring<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Local damage to sensitive habitats, particularly corals | • All practices identified for exploration should be applied to anchoring during production. |
| | **ISSUE 10C:** Pipeline corridors (ROW)<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Destruction and fragmentation of habitat | • Evaluate implications of development on local infrastructure, especially infrastructure related to onshore service functions (port and harbor operations, resource use conflicts, waste treatment and disposal, socio-economic impacts, employment, local services and supply, support infrastructure for employee and family accommodations, etc.). |
| | **ISSUE 10D:** Ballast water release<br>**Spatial dimension:** Project site, concession area, local zone, country, transboundary<br>**Potential impacts:**<br>• Introduction of non-native species<br>• Contamination of ecosystems from chemicals and wastes in ballast water | • All practices identified for seismic lines should be applied to ballast water release during production. |
| | **ISSUE 10E:** NOx emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions | • All practices identified for field development should be applied to NOx emissions during production. |
| | **ISSUE 10F:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area, local zone, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for field development should be applied to $SO_2$ emissions during production. |
| | **ISSUE 10G:** VOC emissions<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for field development should be applied to VOC emissions during production. |
| | **ISSUE 10H:** Noise<br>**Spatial dimension:** Project site<br>**Potential impacts:**<br>• Disturbance to wildlife from noise | • All practices identified for exploration should be applied to noise emissions during production. |
| | **ISSUE 10I:** Produced water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to produced water during production. |
| | **ISSUE 10J:** Effluent/sewage/cooling water<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to cooling water during production.<br>• Include effluent/sewage treatment systems in operations, to meet international standards. |

## TABLE 10. OFFSHORE PRODUCTION (cont'd)

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE PRODUCTION | **ISSUE 10K:** Drill cuttings/mud<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • All practices identified for exploration should be applied to drill cuttings and mud during production. |
| | **ISSUE 10L:** Oil spills<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • Prepare detailed contingency plans and conduct personnel training and regular exercises in response to spills, taking into consideration storage and export systems.<br>• Establish consultation and local liaison activities to ensure proper notification and response of communities and other stakeholders.<br>• Require all tankers to be double-hulled to avoid spills that could impact local habitats. |
| | **ISSUE 10M:** Waste deposition<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Contamination of local and possibly concession-area habitats with subsequent impacts on flora and fauna | • Treatment and disposal of solid, toxic and hazardous wastes onshore will require planning, particularly if local infrastructure is limited in capacity and capability. A detailed waste management plan is required.<br>• Monitor waste streams to meet compliance requirements. |

## TABLE 11. OFFSHORE TRANSMISSION

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE TRANSMISSION | **ISSUE 11A:** Traffic<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Damage to habitats (corals, mangroves) from maneuvering vessels<br>• Disturbances to marine organisms from noise and vibrations | • All practices identified for exploration should be applied to traffic during transmission. |
| | **ISSUE 11B:** Gravel dumping<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Smothering of seabed organisms and habitats | • All practices identified for exploration should be applied to gravel dumping during transmission. |
| | **ISSUE 11C:** Trenching/dredging<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Damage to habitats from operations, adversely impacting local flora and fauna<br>• Damage to habitats outside of project area from operation from secondary siltation | • All practices identified for exploration should be applied to trenching and dredging during transmission. |
| | **ISSUE 11D:** Anchoring<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Local damage to sensitive habitats, particularly corals | • All practices identified for exploration should be applied to anchoring during transmission. |
| | **ISSUE 11E:** Pipeline corridors (ROW)<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of habitat | • All practices identified for production should be applied to pipeline corridors during transmission. |
| | **ISSUE 11F:** NOx emissions<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions | • All practices identified for exploration should be applied to NOx emissions during transmission. |
| | **ISSUE 11G:** $SO_2$ emissions<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for exploration should be applied to $SO_2$ emissions during transmission. |
| | **ISSUE 11H:** VOC emissions<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Disturbance to wildlife from emissions<br>• Local damage to flora and fauna | • All practices identified for exploration should be applied to VOC emissions during transmission. |
| | **ISSUE 11I:** Noise<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Disturbance to wildlife from noise | • All practices identified for exploration should be applied to noise emissions during transmission. |
| | **ISSUE 11J:** Oil spills<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Contamination of habitats with subsequent impacts on flora and fauna | • All practices identified for production should be applied to oil spills during transmission. |

## TABLE 12. OFFSHORE DECOMMISSIONING

| | ISSUES AND POTENTIAL PRIMARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE DECOMMISSIONING | **ISSUE 12A:** Gravel dumping<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Smothering of seabed organisms and habitats | • Develop a full decommissioning and rehabilitation plan in consultation with local authorities and communities. |
| | **ISSUE 12B:** Trenching/dredging<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Damage to habitats from operations, with subsequent impacts on local flora and fauna<br>• Damage to habitats outside of project area from operation from secondary siltation | • Develop a full decommissioning and rehabilitation plan in consultation with local authorities and communities.<br>• Sites must be restored to condition prescribed by local and international law through filling of trenches and replanting of appropriate species (corals, mangroves, etc.). |
| | **ISSUE 12C:** Anchoring<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Local damage to sensitive habitats, particularly corals | • All practices identified for exploration should be applied to anchoring during decommissioning. |
| | **ISSUE 12D:** Pipeline corridors (ROW)<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of habitat | • Decommissioning of onshore support facilities must meet planning requirements.<br>• Record and monitor sites as required after appropriate decommissioning activities and take remediation measures if affected habitats cannot be restored. |
| | **ISSUE 12E:** Waste deposition<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Contamination of habitats with subsequent impacts on flora and fauna | • Record and monitor sites as required after appropriate decommissioning activities and take remediation measures if affected habitats cannot be restored. |

## PART C. SECONDARY IMPACTS - ONSHORE OPERATIONS

### TABLE 13. ONSHORE SEISMIC

ONSHORE SEISMIC

| ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|
| **ISSUE 13A:** Access roads<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing local habitats | • Treat all onshore operations as if "offshore" to maintain isolation from access routes and communities.<br>• Consult local authorities and other stakeholders regarding preferred locations, using spatial analysis and regional planning to ensure activities do not lead to secondary impacts.<br>• Block and control all access to the project site and concession areas.<br>• Choose the site to encourage natural rehabilitation by indigenous flora and fauna; avoid removing vegetation and topsoil; preserve topsoil and seed source for decommissioning.<br>• Select site to minimize effects on environmental and local communities; minimize clearing.<br>• Use existing access, if available.<br>• Avoid loops in roads, which can isolate and fragment habitat.<br>• Use "dog-legs" to discourage access.<br>• Prohibit transport of unauthorized/third party passengers. |
| **ISSUE 13B:** Non-native species introduction<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Displacement or elimination of native flora and fauna | • Prohibit the workforce from introducing pets, livestock and other animals.<br>• Because vehicles and machinery may carry exotic seeds and animals, clean vehicles and machinery that have been used in areas outside of project sites prior to commencement of work.<br>• Develop a quarantine system that inspects and cleans all incoming supplies prior to their use. |
| **ISSUE 13C:** Opening new areas<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Immediate destruction of local habitats, with wider destruction possible unless access is prohibited (possibly long term)<br>• Increased pressure on flora and fauna populations | • Through spatial analysis or regional planning with local stakeholders, select the site to minimize effects on environment and local communities and to reduce the need for clearing.<br>• Use existing infrastructure to the extent possible to avoid or reduce road construction and clearing.<br>• Create offsets for any habitat that cannot be restored. |
| **ISSUE 13D:** Immigration<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Immediate destruction and fragmentation of local habitats, with wider destruction possible unless the number of immigrants decreases over time (possibly long-term and widespread)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology/water quality from increased human activities | • Strictly control all access to project site and concession areas.<br>• Through spatial analysis or regional planning with local stakeholders, select the site to minimize effects on environment and local communities and to reduce the need for clearing.<br>• Create offsets such as new protected areas or additions to community land to mitigate any destroyed or damaged habitat. |

## TABLE 13. ONSHORE SEISMIC (cont'd)

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE SEISMIC | **ISSUE 13E:** New settlements<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats, with wider destruction possible unless the number of immigrants decreases over time (possibly long term and widespread)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology/water quality from increased human activities | • Through spatial analysis or regional planning with local stakeholders, select the site to minimize potential for the formation of new settlements.<br>• Work with local communities and authorities to prevent new settlements and relocate immigrant communities away from sensitive habitats.<br>• In protected areas or sensitive habitats that have experienced new settlements, conduct voluntary resettlement activities, modeling process on existing cultural resettlement practices common among groups in project area.<br>• Create offsets such as new protected areas or additions to community land to mitigate any destroyed or damaged habitat.<br>• Follow World Bank resettlement procedures to relocate settlements. |
| | **ISSUE 13F:** Cultivation<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats, with wider destruction possible unless the number of immigrants decreases over time (possibly long-term and widespread)<br>• Introduction of invasive/non-native species into local ecosystems<br>• Erosion and changes in surface hydrology/water quality | • Prohibit workers, local communities and migrant populations from cultivating areas cleared for company operations.<br>• Reclaim cultivated areas through reforestation and planting of native species. |
| | **ISSUE 13G:** Hunting/poaching<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Elimination or decreased populations of local species, possibly leading to extinction of the species<br>• Ecological alterations through removal of keystone species such as predators | • Control workforce activities (e.g., hunting, poaching and interaction with local populations).<br>• Prohibit the workforce from uncontrolled purchasing and trading of bushmeat and local wildlife (pets, souvenirs) in conjunction with local communities.<br>• Work with local authorities and communities to monitor and control hunting and poaching arising from new access in operations areas. |
| | **ISSUE 13H:** Gathering non-timber forest products (NTFPs)<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Ecological alterations through removal of keystone species | • Prohibit workforce from gathering NTFPs.<br>• Work with local authorities and local populations to monitor and control collection of NTFPs that stems from new access to operation areas. |
| | **ISSUE 13I:** Local commerce with communities<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Elimination or decreased populations of local species, possibly leading to extinction of the species | • Prohibit unregulated commerce with local communities.<br>• All commerce should be defined prior to commencement of operations, ensuring that endangered or rare flora and fauna or flora and fauna used by local communities for subsistence are not traded or sold to workforce at unsustainable levels. |

## TABLE 14. ONSHORE EXPLORATION AND APPRAISAL DRILLING

ONSHORE EXPLORATION AND APPRAISAL DRILLING

| ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|
| **ISSUE 14A:** Access roads<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing local habitats | • All practices identified for seismic should be applied to access roads during exploration and appraisal.<br>• Limit erosion potential by avoiding steep slopes and drainage courses and cut and fill techniques. Incorporate appropriate drainage, culverting and bridging techniques.<br>• Road construction should use local material, but minimize the cutting of timber. |
| **ISSUE 14B:** Non-native species introduction<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Displacement or elimination of native flora and fauna | • All practices identified for seismic should be applied to non-native species introduction during exploration and appraisal. |
| **ISSUE 14C:** Opening new areas<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Immediate destruction of local habitats with wider destruction possible unless access is prohibited (possibly long-term)<br>• Increased pressure on flora and fauna populations | • All practices identified for seismic should be applied to opening new areas during exploration and appraisal. |
| **ISSUE 14D:** Immigration<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Immediate destruction and fragmentation of local habitats with wider destruction possible unless access is prohibited (possibly long term and widespread)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • All practices identified for seismic should be applied to immigration during exploration and appraisal. |
| **ISSUE 14E:** New settlements<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats with wider destruction possible unless access is prohibited (possibly long-term and widespread). Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • All practices identified for seismic should be applied to new settlements during exploration and appraisal. |

## TABLE 14. ONSHORE EXPLORATION AND APPRAISAL DRILLING (cont'd)

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE EXPLORATION AND APPRAISAL DRILLING | **ISSUE 14F:** Cultivation<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats with wider destruction possible unless access is prohibited (possibly long-term and widespread)<br>• Invasive/non-native species introduced into local ecosystems<br>• Erosion and changes in surface hydrology and water quality | • All practices identified for seismic should be applied to cultivation during exploration and appraisal. |
| | **ISSUE 14G:** Hunting/poaching<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Decrease or elimination of specific local species (possibly leading to extinction)<br>• Alterations in ecology through removal of keystone species such as predators | • All practices identified for seismic should be applied to hunting/poaching during exploration and appraisal.<br>• Provide resources (e.g., scientific data, funding) for local and regional protection efforts of threatened species. |
| | **ISSUE 14H:** Gathering non-timber forest products (NTFPs)<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Alterations in ecology through removal of keystone species | • All practices identified for seismic should be applied to gathering NTFPs during exploration and appraisal.<br>• Provide resources (e.g., scientific data, funding) for local and regional protection efforts. |
| | **ISSUE 14I:** Local commerce with communities<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Decrease or elimination of specific local species (possibly leading to extinction) | • All practices identified for seismic should be applied to local commerce with communities during exploration and appraisal. |

## TABLE 15. ONSHORE FIELD DEVELOPMENT

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE FIELD DEVELOPMENT | **ISSUE15A:** Access roads<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing local habitats | • All practices identified for seismic should be applied to access roads during field development. |
| | **ISSUE 15B:** Non-native species introduction<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Displacement or elimination of native flora and fauna | • All practices identified for seismic should be applied to the introduction of non-native species during field development. |
| | **ISSUE 15C:** Opening new areas<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Immediate destruction of local habitats with wider destruction possible unless access is prohibited (possibly long term)<br>• Increased pressure on flora and fauna populations | • All practices identified for seismic should be applied to opening new areas during field development. |
| | **ISSUE 15D:** Immigration<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Immediate destruction and fragmentation of local habitats with wider destruction possible unless the number of immigrants decreases over time (possibly long-term and widespread)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • All practices identified for seismic should be applied to immigration during field development. |
| | **ISSUE 15E:** New settlements<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats, with wider destruction possible unless the number of immigrants decreases over time (possibly long-term and widespread).<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • All practices identified for seismic should be applied to new settlements during field development. |
| | **ISSUE 15F:** Cultivation<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats, with wider destruction possible unless the number of immigrants decreases over time (possibly long-term and widespread).<br>• Introduction of invasive/non-native species into local ecosystems<br>• Erosion and changes in surface hydrology and water quality | • All practices identified for seismic should be applied to cultivation during field development. |

## TABLE 15. ONSHORE FIELD DEVELOPMENT (cont'd)

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE FIELD DEVELOPMENT | **ISSUE 15G:** Hunting/poaching<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Decrease or elimination of specific local species (possibly leading to extinction)<br>• Alterations in ecology through removal of keystone species such as predators | • All practices identified for exploration should be applied to hunting and poaching during field development. |
| | **ISSUE 15H:** Gathering non-timber forest products (NTFPs)<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Alterations in ecology through removal of keystone species | • All practices identified for exploration should be applied to gathering NTFPs during field development. |
| | **ISSUE 15I:** Local commerce with communities<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Decrease or elimination of specific local species (possibly leading to extinctions) | • All practices identified for seismic should be applied to local commerce with communities during field development. |

## TABLE 16. ONSHORE PRODUCTION

| ONSHORE PRODUCTION | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| | **ISSUE 16A:** Access roads<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing and fragmenting local habitats | • All practices identified for exploration drilling should be applied to access roads during production. |
| | **ISSUE 16B:** Non-native species introduction<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Displacement or elimination of native flora and fauna | • All practices identified for exploration drilling should be applied to non-native species introduction during production. |
| | **ISSUE 16C:** Opening new areas<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Immediate destruction of local habitats with wider destruction possible unless access is prohibited (possibly long-term)<br>• Increased pressure on flora and fauna populations | • All practices identified for exploration should be applied to opening new areas during production. |
| | **ISSUE 16D:** Immigration<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Immediate destruction and fragmentation of local habitats with wider destruction possible unless the number of immigrants decreases over time (possibly long term and widespread)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • All practices identified for exploration should be applied to immigration during production. |
| | **ISSUE 16E:** New settlements<br>**Spatial dimension:** Project site, concession area, local zone, corridor<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats with wider destruction possible unless the number of immigrants decreases over time (possibly long term and widespread)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • All practices identified for exploration should be applied to new settlements during production. |
| | **ISSUE 16F:** Cultivation<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats with wider destruction possible unless the number of immigrants decreases over time (possibly long term and widespread)<br>• Invasive/non-native species introduced into local ecosystems<br>• Erosion and changes in surface hydrology and water quality | • All practices identified for exploration should be applied to cultivation during production. |

## TABLE 16. ONSHORE PRODUCTION (cont'd)

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE PRODUCTION | **ISSUE 16G:** Hunting/Poaching<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Decrease or elimination of specific local species (possibly leading to extinctions)<br>• Alterations in ecology through removal of keystone species such as predators | • All practices identified for exploration should be applied to hunting/poaching during production. |
| | **ISSUE 16H:** Gathering non-timber forest products (NTFPs)<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Alterations in ecology through removal of keystone species | • All practices identified for exploration should be applied to gathering NTFPs during production. |
| | **ISSUE 16I:** Local commerce with communities<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Decrease or elimination of specific local species (possibly leading to extinctions) | • All practices identified for exploration should be applied to local commerce with communities during production. |

## TABLE 17. ONSHORE TRANSMISSION

| ONSHORE TRANSMISSION | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| | **ISSUE 17A:** Access roads<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing and fragmenting local habitats | • All practices identified for production should be applied to access roads during transmission. |
| | **ISSUE 17B:** Non-native species introduction<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Displacement or elimination of native flora and fauna | • All practices identified for exploration should be applied to the introduction of non-native species during transmission. |
| | **ISSUE 17C:** Opening new areas<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Immediate destruction of local habitats with wider destruction possible unless access is prohibited (possibly long-term)<br>• Increased pressure on flora and fauna populations | • All practices identified for exploration should be applied to opening new areas during transmission. |
| | **ISSUE 17D:** Immigration<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats with wider destruction possible unless the number of immigrants decreases over time (possibly long-term)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • All practices identified for exploration should be applied to immigration during transmission. |
| | **ISSUE 17E:** New settlements<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats with wider destruction possible unless the number of immigrants decreases over time (possibly long-term)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • All practices identified for exploration should be applied to new settlements during transmission. |
| | **ISSUE 17F:** Cultivation<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of habitats with wider destruction possible unless the number of immigrants decreases over time (possibly long-term)<br>• Invasive/non-native species introduced into ecosystems<br>• Erosion and changes in surface hydrology and water quality | • All practices identified for exploration should be applied to cultivation during transmission. |
| | **ISSUE 17G:** Hunting/poaching<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Decrease or elimination of specific species (possibly leading to extinctions)<br>• Alterations in ecology through removal of keystone species such as predators. | • All practices identified for exploration should be applied to hunting and poaching during transmission. |

## TABLE 17. ONSHORE TRANSMISSION (cont'd)

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE TRANSMISSION | **ISSUE 17H:** Gathering non-timber forest products (NTFPs)<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Alterations in ecology through removal of keystone species | • All practices identified for exploration should be applied to gathering NTFPs during transmission. |
| | **ISSUE 17I:** Local commerce with communities<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Decrease or elimination of specific species (possibly leading to extinctions) | • All practices identified for exploration should be applied to local commerce with communities during transmission. |

## TABLE 18. ONSHORE DECOMMISSIONING

| ONSHORE DECOMMISSIONING | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| | **ISSUE 18A:** Access roads<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Erosion and changes in surface hydrology<br>• Vegetation cleared, disturbing and fragmenting local habitats | • Successful reinstatement will require planning and implementation and should not be viewed as an afterthought or a short-term commitment.<br>• Consult with local authorities and other stakeholders concerning which access roads should remain. Retention of access routes in or around protected areas and sensitive habitats should be discouraged and alternatives created.<br>• Render access routes inaccessible.<br>• Break up compacted surfaces and replace topsoil, brash, seed source, leaf litter, etc.<br>• Remove all non-native materials.<br>• Stabilize all slopes.<br>• If necessary, revegetate with native species to avoid erosion.<br>• Review success of restoration at later date and take remediation measures such as offsets if access has not been completely sealed off. |
| | **ISSUE 18B:** Non-native species introduction<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Displacement or elimination of native flora and fauna | • Identify and remove introduced species. Long-term eradication programs may be necessary and should be done in consultation and cooperation with local authorities, non-governmental organizations and communities.<br>• Document and monitor site recovery. |
| | **ISSUE 18C:** Opening new areas<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats with wider destruction possible unless access is prohibited (possibly long-term)<br>• Increased pressure on flora and fauna populations | • Develop full restoration and aftercare plans in consultation with local authorities and communities.<br>• Restoration plan must be followed and the site restored to original condition.<br>• Break up compacted surfaces and replace topsoil, brash, seed source, leaf litter, etc.<br>• Remove all debris and contaminated soils.<br>• Reform contours to match the natural surroundings.<br>• Restore natural drainage patterns.<br>• Respread original topsoil and brash, vegetation, leaf litter and organic material.<br>• Revegetate if necessary, using only native species compatible with the surrounding habitat.<br>• Document and monitor site recovery and take measures such as offsets if affected habitats cannot be fully restored. |
| | **ISSUE 18D:** Immigration<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats with wider destruction possible unless the number of immigrants decreases over time (possibly long-term)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • Work with local authorities and communities to redirect migratory flows away from important habitats.<br>• Render access routes inaccessible and establish control mechanisms to prevent re-entry.<br>• If affected habitats cannot be fully restored, take measures such as offsets. |

## TABLE 18. ONSHORE DECOMMISSIONING (cont'd)

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| ONSHORE DECOMMISSIONING | **ISSUE 18E:** New settlements<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of local habitats, with wider destruction possible unless the number of immigrants decreases over time (possibly long-term)<br>• Increased pressure on flora and fauna populations<br>• Erosion and changes in surface hydrology and water quality from increased human activities | • Work with local authorities and communities to voluntarily relocate migrant communities away from settled areas, sensitive ecosystems and protected areas. Follow World Bank resettlement procedures at a minimum.<br>• Develop full restoration and aftercare plans in consultation with local authorities and communities.<br>• Restoration plan must be followed and the site restored to original condition.<br>• Document and monitor site recovery and take measures such as offsets if affected habitats cannot be restored. |
| | **ISSUE 18F:** Cultivation<br>**Spatial dimension:** Project site, concession area, local zone, corridor, country, transboundary<br>**Potential impacts:**<br>• Destruction and fragmentation of habitats, with wider destruction possible unless the number of immigrants decreases over time (possibly long term)<br>• Invasive/non-native species introduced into ecosystems<br>• Erosion and changes in surface hydrology and water quality | • All practices identified for exploration should be applied to cultivation during decommissioning. |

## PART D. SECONDARY IMPACTS - OFFSHORE OPERATIONS

### TABLE 19. OFFSHORE SEISMIC

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE SEISMIC | **ISSUE 19A:** Fishing, marine product (corals) collection<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Depletion of local fishing stocks<br>• Damage to coral habitats | • Control workforce activities (e.g. fishing, coral collection, interaction with local populations).<br>• Report all unplanned interactions with other resource users or marine life to the authorities. |

### TABLE 20. OFFSHORE EXPLORATION

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE EXPLORATION | **ISSUE 20A:** Fishing, marine product (corals) collection<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Depletion of local fishing stocks<br>• Damage to coral habitats | • Prohibit the workforce from fishing, coral collection and interaction with sensitive habitats. |
| | **ISSUE 20B:** Local commerce with communities<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Decrease or elimination of specific local species | • Prohibit unregulated commerce with local communities. All commerce should be defined prior to commencement of operations, ensuring that endangered or rare flora and fauna and flora and fauna used by local communities for subsistence are not traded or sold to the workforce at unsustainable levels. |

### TABLE 21. OFFSHORE FIELD DEVELOPMENT

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE FIELD DEVELOPMENT | **ISSUE 21A:** Fishing, marine product (corals) collection<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Depletion of local fishing stocks<br>• Damage to coral habitats | • All practices identified for exploration should be applied to fishing and the gathering of marine products during field development. |
| | **ISSUE 21B:** Local commerce with communities<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Decrease or elimination of specific local species | • All practices identified for exploration should be applied to commerce with communities during field development. |

## TABLE 22. OFFSHORE PRODUCTION

| | ISSUES AND POTENTIAL SECONDARY IMPACTS | GOOD PRACTICE |
|---|---|---|
| OFFSHORE PRODUCTION | **ISSUE 22A:** Fishing, marine product (corals) collection<br>**Spatial dimension:** Project site, concession area<br>**Potential impacts:**<br>• Depletion of local fishing stocks<br>• Damage to coral habitats | • All practices identified for exploration should be applied to fishing and collection of marine products (e.g., corals) during production. |
| | **ISSUE 22B:** Local commerce with communities<br>**Spatial dimension:** Project site, concession area, local zone<br>**Potential impacts:**<br>• Increased pressure on flora and fauna populations<br>• Decrease or elimination of specific local species | • All practices identified for exploration should be applied to local commerce with communities during production. |

## TABLE 23. SUMMARY AND CROSS-REFERENCES BETWEEN ISSUES[3]

| | Location | | Lifecycle Stage | | | | | | Spatial Dimension | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Principal Issue** | Onshore | Offshore | Seismic | Expolration | Field development | Production | Transmission | Decommissioning | Proeject site | Concession area | Local zone | Corridor | Country | Transboundary | **Issue Numbers** |
| *Access Roads*[4] | Y | N | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 13A, 14A, 14A, 15A, 16A, 17A, 18A |
| Anchoring | N | Y | | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | | | | 8C, 9D, 10B, 11D, 12C |
| Ballast water release | N | Y | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | ■ | ■ | 7H, 8N, 10D |
| Base camp construction | Y | N | ■ | ■ | ■ | | | ■ | ■ | | | | | | 1G, 2F, 3F, 6D |
| Cooling water | N | Y | | ■ | ■ | ■ | | | ■ | ■ | | | | | 8J, 9K, 10J |
| *Cultivation* | Y | N | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 13G, 14H, 15H, 16H, 17H, 18G |
| Drainage | Y | N | ■ | ■ | ■ | ■ | ■ | | ■ | | | | | | 1D, 2C, 3C, 4C, 5C |
| Drill cutting/mud | Y | Y | | ■ | ■ | ■ | | | ■ | ■ | | | | | 2N, 2Q, 4N, 8K, 9L, 10K |
| Effluent/sewage water | Y | Y | | ■ | ■ | ■ | | | ■ | ■ | | | | | 2M, 3P, 4M, 8I, 9K, 10J |
| Erosion (topsoil loss) | Y | N | ■ | ■ | ■ | ■ | ■ | | ■ | ■ | | | | | 1E, 2D, 3D, 4D, 5D, 16B |
| *Fishing, marine production collection* | N | Y | ■ | ■ | ■ | ■ | | | ■ | ■ | | | | | 19A, 20A, 21A, 22A |
| *Gathering non-timber forest products* | Y | N | ■ | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | | | | 13I, 14J, 15J, 16J, 17J |
| Gravel dumping | N | Y | | | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 9B, 11B, 12A |
| Helipads/airfields | Y | N | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | 1B, 2A, 3A, 4A, 5A, 6A |
| *Hunting/poaching* | Y | N | ■ | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | 13H, 14I, 15I, 16I, 17I |
| *Immigration* | Y | N | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 13D, 14E, 15E, 16E, 17E, 18D |
| Infrastructure | Y | N | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 1C, 2B, 3B, 4B, 5B, 6B |
| Land filling | Y | N | | | | | | ■ | ■ | ■ | ■ | | | | 6C |

[3]Blue shading indicates where impacts may occur.

[4]Issues leading to primary impacts are shown in normal font, while those leading to secondary impacts are shown in italics.

## TABLE 23. SUMMARY AND CROSS-REFERENCES BETWEEN ISSUES (cont'd)

| | Location | | Lifecycle Stage | | | | | | Spatial Dimension | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Principal Issue** | Onshore | Offshore | Seismic | Expolration | Field development | Production | Transmission | Decommissioning | Proeject site | Concession area | Local zone | Corridor | Country | Transboundary | **Issue Numbers** |
| *Local commerce with communities* | Y | Y | | | | | | | | | | | | | 13J, 14K, 15K, 16K, 17K, 20A, 21A, 22A |
| *New settlements* | Y | N | | | | | | | | | | | | | 13F, 14G, 15G, 16G, 17G, 18F |
| Noise | Y | Y | | | | | | | | | | | | | 1L, 2K, 3N, 4K, 5M, 7E, 8G, 9I, 10H, 11I |
| *Non-native species introduction* | Y | N | | | | | | | | | | | | | 13B, 14D, 15C, 16C, 17C, 18B |
| NOx emissions | Y | Y | | | | | | | | | | | | | 1I, 2H, 3K, 4H, 5J, 7C, 8D, 9F, 10E, 11F |
| Oil spills | Y | Y | | | | | | | | | | | | | 2O, 3R, 4O, 5N, 8L, 9M, 10L, 11J |
| *Opening new areas* | Y | N | | | | | | | | | | | | | 13C, 14D, 15D, 16D, 17D, 18C |
| Pipeline corridors (ROW) | Y | Y | | | | | | | | | | | | | 3H, 4F, 5G, 6E, 9E, 10C, 11E, 12D |
| Produced water | Y | Y | | | | | | | | | | | | | 2L, 3O, 4L, 8H, 9J, 10I |
| Revegetation | Y | N | | | | | | | | | | | | | 3J, 4G, 5I |
| Seismic lines & grids | Y | Y | | | | | | | | | | | | | 1A, 7A |
| Site clearance | Y | N | | | | | | | | | | | | | 1F, 2E, 3E, 5E, 14B, 15B, 17B |
| $SO_2$ emissions | Y | Y | | | | | | | | | | | | | 1J, 2I, 3L, 4I, 5K, 7D, 8E, 9G, 10F, 11G |
| Soil deposition | Y | N | | | | | | | | | | | | | 3I, 5H |
| Traffic | Y | Y | | | | | | | | | | | | | 1H, 2G, 3G, 4E, 5F, 6E, 7B, 8A, 9A, 10A, 11A |
| Trenching/dredging | N | Y | | | | | | | | | | | | | 8B, 9C, 11C, 12B |
| VOC emissions | Y | Y | | | | | | | | | | | | | 1K, 2J, 3M, 4J, 5L, 7E, 8F, 9H, 10G, 11H |
| Waste deposition | Y | Y | | | | | | | | | | | | | 2P, 3S, 4P, 7G, 8M, 9N, 10M, 12E |

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