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GUIDELINES FOR THE REVIEW OF ENVIRONMENTAL IMPACT ASSESSMENTS (EIAs) OF DEVELOPMENTS IMPACTING ON SEA TURTLES AND TURTLE HABITAT

(Prepared by an Advisory Committee Member)

Action requested:

- Review the guidelines and provide feedback
- Each Signatory State to consider how to address their own site specific industry-related impacts on sea turtles on a case-by-case basis

At SS7 during the regional discussion of the WIO working group, it was highlighted of there is a new and growing pressure in the region driven by the development of new energy reserves (particularly low pressure gas) as well as an expanding tourism industry. The Advisory Committee was asked to draft some guidelines on potential impacts on sea turtles and their habitats that should be included during the Environmental Impact Assessment (EIA) process. Given the specific legislation of Range States, the unique environmental and socioeconomic settings, and the diverse types of industries, only broad principles are highlighted here as they relate to sea turtles and their habitats. The intention is for each Signatory State to address their own site specific industry related impacts on sea turtles on a case-by-case basis.

Guidelines for the review EIAs of developments impacting on sea turtles and turtle habitat

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The **aim** of the paper is to guide and strengthen the capacity of IOSEA range states in their call for directing and evaluating Environmental Impact Assessments (EIA) for new developments or expansion of existing projects that can impact sea turtles or their habitats in the IOSEA region. The guidelines will assist in identifying potential impacts (i.e. severity, spatial extent and duration) of industry related pressures on sea turtles and their habitat, and where possible, identify potential mitigation measures to maximise environmental, social and economic benefits. It is important to recognise that many of the habitats used by sea turtle may directly or indirectly support alternative livelihoods of local people through tourism industries or conservation and management programs. Developments should therefore aim to maintain or improve the long-term quality of life of all people and the environment [1].

The **intention** is for signatory states to be made aware of potential issues and so develop and adopt their own best practice approaches mitigating industry related impacts on sea turtle populations and habitats. Each government should ensure that the EIA process for projects located in coastal and marine areas specifically evaluates the industry related impacts on these threatened species and their habitats. These Guidelines do not promote any point of view, development sector, policy or legislation, and should be adapted to the regulations and frameworks of each country.

Activities that require an EIA

Typical marine and coastal development or expansion projects likely to require an EIA include, but is not limited to;

- coastal industry including aquaculture, salt mining, wind farms, fisheries/trawling,
- ports, harbours and marinas, including load out facilities, solid wharves or Material Offloading Facilities (MOF),

- Hydrocarbon (oil and gas) exploration and production activities, including seismic, drilling, construction, production and decommissioning phases,
- coastal tourism or urban developments,
- nature-based tourism developments (including cabins/cabana, golf courses, beach developments, walking trails, docking facilities marinas etc.), or
- dredging for new developments (capital) or maintenance of existing navigation channels

All of these have the potential to have short- or long-term impact on sea turtles at the population level, or can cause permanent damage to critical marine turtle habitats, and therefore should be carefully considered.

Steps of a typical EIA process

Each EIA is a unique, yet iterative process, specific to each development project. However, there are some common steps in a basic EIA (Table 1). The project is normally initiated by a developer approaching the government with a comprehensive project proposal. After a review of the merits of the proposal, the relevant government department/s will guide and direct the content (including the scope and purpose) of an EIA process (summarised in a Terms of Reference, ToR document). The project developer will appoint an independent qualified consulting team to manage the EIA. This EIA team will comprise; qualified Subject Matter Experts (SMEs), environmental management practitioners and risk assessment experts and through the process the team will identify and consult with all stakeholders including interested and affected parties. Based on the information obtained, the results of the formal risk assessment together with the respective views and interests posed, alternative development options will be drafted and/or mitigation measures proposed. The EIA is then submitted to the appropriate government regulatory agency for review, assessment and approval for the project to proceed. The approval will be issued as a written Record of Decision (RoD, also known as a licence or permit) which will stipulate any specific conditions before, during, and after the development that the developers and contractors must comply with. The approval Conditions will also specify actions required to mitigate, manage and monitor any impact from the project and address land and or wildlife rehabilitation. The compliance with the RoD regulations is the responsibility of both the developer and government.

Table 1 *Summary steps of a typical EIA process.*

1.	Project Initiation: Purpose and need for a project is proposed and tested against EIA policies/requirements or exclusions. [*Responsibility – proponent*]
2.	Proceed with EIA: Outline the purpose and need [*Responsibility – proponent*]
	a. Scoping and alternatives, as well as identify and consult with Technical and Interested and Affected parties
	b. Describe **environmental setting** and carry out a **risk assessment**
	c. Identify **mitigation** measures and alternatives
3.	Review and comment on EIA [*Responsibility – regulatory agency*]
4.	Revise EIA [*Responsibility – proponent*]

5. Decision (Record of Decision + Mitigation + Conditions of approval)	[*Responsibility – regulatory agency*]
6. **Project Implementation**	[*Responsibility – proponent*]
7. **Monitor project to ensure compliance with Conditions of approval**	[*Responsibility – proponent*]
8. **Review** compliance with conditions	[*Responsibility – regulator*]

The most important contribution government departments can make to the ensure the sustainability of developments and minimising impacts to sea turtles and their habitats is to be very deliberate in a) compiling country specific guidelines for sea turtle monitoring and impact mitigation at proposed development sites b) directing the scope of the EIA to include sea turtles and their habitat and make pre-EIA monitoring results a compulsory inclusion of EIA reports, c) adequately review the EIA and the expert consultations provided and if deemed necessary require expert peer review of EIA outputs, d) ensure that the Environmental Management Plans (EMPs) specific to the proposed development sufficiently address the residual impacts on sea turtles through appropriate mitigation measures, and e) ensure that the RoD protect sea turtles and their habitat through all relevant life stages. This include making adequate provision in terms of resources and expertise to mitigate, monitor and, if necessary, recover and rehabilitate sea turtle rookeries, populations, and/or habitats. And finally, follow-up on the compliance of the RoD and mitigation measures at all stages of the project.

Environmental Setting: Sea turtle life history, habitat and management units

All sea turtle populations are **conservation dependent** and many populations are also threatened species [2, 3] as well as some of the habitats they frequent. Further, due to natal homing and nest fidelity, many rookeries support a **genetically-unique** stock, representing a specific population per species (or regional management unit, RMU). Further, the broad distribution of these species, result in turtles being linked in time/space to **protected areas**. Therefore, development impacts could impact on genetically unique, threatened species protected elsewhere at great cost and effort, and thus require special attention in EIA procedures.

Despite recognising the special value of sea turtles as important biodiversity components in EIAs, quantitative data and information on the abundance, distribution across the different life history phases, habitat use of different species or genetic uniqueness of a rookery, are frequently lacking. Most frequently EIA-initiated data collection focusses on qualitative (presence/absence), or "predictable and visible" components of a populations such as adult females and nests on breeding beaches. However, the turtles that use these beaches come from, and will return to other foraging habitats. The impact of a development on the **entire RMU should thus be considered** in the EIA processes. Not all (five) different life history phases and habitats (Table 2) will be affected by each project, but the potential impacts should at least be considered across the entire **lifetime of the project** – initiation, development, operation and decommissioning, across all life history phases of sea turtles, and the physical and habitat connectivity between/among them.

Table 2: *Life history phases and distribution to be considered* (modified from DWH NRDA [4] Module 2):

Life stage	Habitat	Description
Breeding males and females	Courtship areas in proximity to nesting beaches	Both male and female turtles may collect off nesting beaches in the months before nesting starts.
Nesting females, eggs and hatchlings	Sandy beaches and adjacent dune systems	Female turtles generally nest on unlit beaches, near or in vegetation, and embryos develop in the sand for ~55 – 75 days after which they emerge and crawl to the ocean.
Post-hatchlings and early juveniles	Surface waters of (fast-flowing) oceanic currents, as well as eddies and convergent zones where seaweed collect	This is the oceanic life phase where juveniles drift mostly at the ocean's surface, with limited diving capacity feeding on plankton.
Large juveniles and adults	Nearshore reefs, seagrass beds, mangroves and soft sediment habitats	Foraging habitat of large juvenile to adult stage; they tend to use the entire water column to ~ 200m depth year-round, with frequent resident behaviour.
Pre-breeding/migratory adults	Migration routes	Adult turtles move to and from the breeding grounds along somewhat predictable paths during predictable times of the year.

Project developers must assess the impact of their project on both a local and a regional scale. The risk assessment should identify all populations and sensitive habitat that could potentially be exposed to project related stressors both within the project footprint and in the adjacent area. The responsibility of the government to ensure that developers adequately review impacts and not limit the scope to footprint areas only. It is important to note that biophysical and ecological process in the marine environment are characterised by connectivity between and among different habitats and ecosystems [5]. Habitat modification and destruction due to any development is thus rarely localised.

The five main effects of impact on marine turtles are:

A) **Habitat is destroyed**, and **sea turtles are displaced** and forced to utilise alternative habitat (e.g., beach nourishment/erosion [6], or port developments [7]).
B) Turtles are **disturbed** (e.g., light [8, 9] or noise [10]) in their preferred habitat and therefore avoid these areas and thus utilise suboptimal environments.
C) **Turtles are killed** (e.g., sucked into a dredger [11], sucked into a cooling water or salt mining intake) in development/use activities.
D) The possible but less likely scenario is that sea turtles are differentially attracted to an **artificial habitat** which **alters their natural behaviour** (e.g. thermal outlets [12]).

E) **Reduction in the resilience** of the habitat or population through degradation or future conditions (resulting from climate change).

The potential impacts of all of these scenarios should be considered on all of the life history phases of the sea turtles, as well as forward-casting of probable conditions given the current rate of climate change. Site visits and footprint planning frequently consider normal routine operations or **modal environmental** conditions. However, impact forecasting should consider the risks induced by **extreme events** including high impact or tropical storms and hurricanes, storm surges, and sea level rise.

During any significant development project, key threats must be identified. These **activities** threaten sea turtle habitats and populations due to a range of different impacts, with some devastating effects (Table 3).

Table 3 *Listed scenarios and the associated activities and impacts they induce*.

Effects	**Impacts**	**e.g. Activity**
Habitat alteration and destruction or immune suppression and stress causing	e.g., water pollution, contaminants and discharges,	Explosives, oil spills, dredging, erosion, slope alteration, vegetation removal & wetland destruction, sediment accumulation and transport, environmental chemical or sewage contamination
Disturbance	e.g., light, noise, vibrations; human presence	City glow, lights, industrial/drilling rig/airport/port lighting Seismic surveys, heavy machinery, vehicles.
Injuring or killing turtles	e.g., drowning, crushing, damage	Ocean intakes, Vessel or vehicle strikes, altered predation pressures through domestic and wild predators.
Altering behaviour of turtles	e.g., creating artificial thermal & foraging habitat; failed chemoreception	Flow-through cooling (mostly power/electricity/nuclear) altering thermal profile of nearshore waters
Indirect effects	Reduced resilience e.g. coastal erosion or interruption of sediment supply;	Increased storms and sea level rise affecting coastal dynamics & cumulative impacts from serial developments and hinterland activities (e.g. estuarine sand mining, next to a developed coast prone to erosion)

Evaluations of the potential effects should consider **direct, indirect and cumulative impacts,** including the magnitude and frequency, and certainty (or data gaps and uncertainties) of the data/methods and assessments, and the proposed plans. Direct impacts (e.g. disturbance or killing of turtles) are generally easy to consider but indirect and cumulative impacts (not resulting

directly from any single development activity like coastal erosion or coastal squeeze) which could affect populations or habitats over time, are difficult to quantify and frequently overlooked. Conversely, these effects are also frequently exaggerated by conservation lobby against development, due to the inherent uncertainty, and “precautionary approaches” are invoked. Either approaches i.e. those in favour of or against developments, may have undesirable outcomes if biased. Stating uncertainty (e.g. expert opinion vs quantitative data or modelling approaches) is necessary to make informed decisions and could be incorporated in designing appropriate management/monitoring/mitigation plans for developments.

Spatial mapping of both the development footprint and some of the key impacts can facilitate more informed decision making. However, the spatial extent of impacts, specifically on turtles are not known. The known literature is summarised to provide guidelines on the spatial extent of the development impacts (for near, mid and far afield), in this case using mostly Hydrocarbon Exploration and Production (HEP) with their associated activities as guideline (Table 4). The activities that cause these different types of impacts are summarised in Table 5.

Table 4: *Six main impacts associated with developments particularly Hydrocarbon Exploration and Production plus the rationale for the spatial extent of the impact (adapted from Harris et al [13] and Pretorius [14]).*

Threat	Extent	Explanation
Water Pollution	Near: 0 – 20km; Mid: 20 – 100 km; Far: 100 – 200 km	The impact and extent of water pollution is dependent on oceanography, weather conditions, the volatility/density and volume of the pollutant, as well as the emergency response readiness to contain and mitigate spills. These spills can range from benign small events that disperses without noticeable impacts (like groundwater discharge, fertilizers and pesticides), to persistent chronic spills or large-scale catastrophic oil spill events (e.g., *Deepwater Horizon* Spill). Hence, the extent of pollution events is highly variable in time and space. However, here we suggest three different distances for near, mid and far impacts based on known effects associated mostly with the hydrocarbon industry (HEP or hydrocarbon exploration and production). It is recognised that the surface impact is most often directional, following currents, rather than being a circular plume. It should also be noted that the extent range is based on the anticipated immediate impact extent rather than "trickle" impacts that can last for years over great distances. For example, the coastal impacts following the *Deepwater Horizon* spill extended beyond 600 km for more than two years after the spill [15]. Near-field effects are generally those generated by development and maintenance activities such as dredging, pipelines or source point discharges that disperse within a few hundred meters. Clinical response of turtles varies but there is a clear immunological compromise when turtles come in direct contact with oil. See Shigenaka et al [16] for details.
Light Pollution	Near: 0 -10 km Mid: 10 – 20km Far: 20 -30km	Most development have a variety of sources of light that is visible at a great distance. These range from discrete low-level footpath lights to safety and warning lights from cruise and other ships, tourist developments, oil platforms and refineries, or gas flaring all emitting a city glow. Light type and intensity, duration (timers vs motion activated), and height placement all affect the distance of light detection. Further, sea turtles are positive, neutral or negatively phototactic at different life stages and therefore not predictably affected by light [17]. Studies that investigated turtle responses to light indicated disorientation of hatchlings from 500 m [18] to >1.5 km [9], with misorientation up to 10 km from bright light horizon due to LNG plants [8], with city lights noticeable at sea turtle rookeries up to 32 km away [19]. A 500 – 1500 m dark buffer must always be between the high tide mark on turtle rookeries and the nearest light glow, and the light should be shielded behind a dune or vegetation screen which creates a dark horizon on the beach. Guidelines specific to light and marine turtles should be used to design lighting on a case-by-case basis, but any development within 20 km of a turtle rookery should have special consideration in an EIA [20, 21].

Noise Pollution & vibration	Near: 0-1 km Mid: 1- 2 km Far: 3 – 4 km	Sea turtles in coastal waters are frequently exposed to anthropogenic noise generated from routine activities including port operations, shipping/boating/recreational craft noise, ranging between 26 – 110 dB [10], whereas development related sounds like drilling, dredging or dynamite/explosives or airguns from seismic surveys can exceed 220-240 dB [22]. Sea turtles tend to avoid areas of high noise, especially if it is sudden and prolonged, but the change in behaviour or reaction range is not well researched. Experiments conducted with (caged) green and loggerhead turtles indicated active swimming when sound exceed 166 dB and appeared in an agitated state at 175 dB. The distances reported ranged 2 km for altered behaviour at 1 km for avoidance behaviour (at 120 m depth). It is expected that this distance will be closer in neritic environments turtles typically frequent as sounds travel less in shallow water [23]. Appropriate noise buffers must be made available around development activities not to affect turtle behaviour specially where they tend to congregate in high densities, like rookeries or courtship areas. Activities such as seismic or pile driving must not take place in rookeries or courtship areas during the breeding season.
Air Pollution	Near: 0 – 1 km Buffer: 10 km	Sea turtles are air breathers and will be affected by poor air quality similarly to mammals. Poor air can originate from chemical/oil fires or vapour producing particulate organic carbon and noxious vapours. However, no quantitative information is currently available on the effects of air pollution on sea turtles. Air quality metrics from the *Deepwater Horizon* disaster indicated high concentrations of gasses at 1 km upwind, to 10 km downwind from the event [24]. All air-breathing organisms would be affected within this radius.
Vessel Strikes	Near: 0 – 10 km	These are physical injury caused to turtles due to collision. Even though there needs to be a direct interaction between a turtle and a vessel to cause such damage, there are areas/zones where these interactions are more likely to take place. Shipping lanes for bidirectional traffic is ~5 nm to direct with a 2-3 nm separation zone between the two lanes. This approximates to an impact zone of ~ 10 km. Smaller power crafts operating from ports and launch sites also pose a threat; so, all ports and launch sites, as well as their operational distances pose a threat to injure or kill turtles.
Habitat Degradation & Destruction	Near: footprint of development + connectivity to nearest other habitat of same type.	The extent of habitat destruction is difficult to quantify as it depends on the sensitivity and ecological function of a specific habitats (which differs among coral reefs, seagrass beds, mangroves etc. [5]), and the extent of damage (way equipment is used) size and type of projects. However, the minimum size is the footprint of activity and infrastructure, although the impact is invariably larger due to habitat fragmentation and loss of connectivity [5]. Connectivity among habitats may include movement of individuals (turtles and other organisms), nutrients and materials within and among habitat patches and ecosystem types [5]. For example, a new jetty

		may destroy a seagrass bed, which was also the stepping-stone for invertebrates (like cucumbers or molluscs i.e. prey organisms of sea turtles) between other seagrass beds. The impacts thus extend beyond the footprint of the jetty. However, to generalise for each scenario is impossible as it is habitat and condition specific and it may trigger thresholds or tipping points. Other impacts can occur when a solid jetty is built on a sandy coast leading to changes in long shore sand movement which can cause erosion of nesting habitat. The main objective of the EIA should be to ensure that habitat and ecosystem connectivity is maintained, especially for critical and sensitive sea turtle habitat.

Table 5 *Summary of likely activities during different phases of different development projects and the likely impact to be present. (From Kellie Pendoley, Pendoley Environmental)*

	Harbour/ Port		Onshore Industrial		Coastal Development (Tourism & Urban)		Hydrocarbon Exploration and Production					Dredging
	Construc-tion	Opera-tions	Construc-tion	Opera-tions	Construc-tion	Opera-tions	Seismic	Drilling	Produc-tion Platforms and LNG	Dredging	Decom mission	Dredging – mainte-nance
Light	X	X	X	X	X	X		X	X	X		X
Marine habitat modifications	X			X	X					X		X
Sound (noise) vibration	X	X			X (nearshore)	X (nearshore)	X		X	X		X
Shoreline modifications	X		X	Dust layer on sand – albedo, beach erosion	X							
Boat strike or entrainment	X	X			X	X	X	Work boats	Work boats	Entrain-ment		Entrain-ment
Ocean intake			Cooling water	Cooling water, salt mining intake					X			
Oil spill	X	X			X		X	X	X	X		X
Contaminant discharge			Hydrotest water			Sewage and road drainage		Drill mud, hydrotest	Produced water			
Disease					Sewage	Sewage						
Heavy metals and organochlorine	X		X		X					X		X
Predation (& pest control)			X	X	X	X						
Explosives	X		X		X						X	
Disturbance	X	X	X	X	X	X				X		X

Management, mitigation & monitoring

All EIAs should contain the following:

- Preferred sites and potential alternative sites (with their associated advantages and disadvantages);
- Alternative procedures for construction and operations (e.g. noise reduction technologies suppression equipment, sound-absorbing structures and barriers, warm-up times for air guns, blasting plans, time-of-day/night limitations) to minimise impacts to sea turtles;
- Justification for the scale of operations;
- Justification for the season and duration of activities across all phases – construction to decommissioning; and
- Consideration and justification of cumulative impacts from multiple development sources
- A comprehensive life-cycle Environmental Management Plan clearly stating construction, operation and decommissioning requirements, protocols and specific roles and responsibilities of those responsible for implementing monitoring, mitigation measures.

The ToR and RoD issued by the relevant government department/s should also include adaptive management/mitigation measures, contingency plans and penalties for i) in case of failure to comply with environmental standards, ii) if new information is obtained or impacts appear to be greater than the predicted impacts from the EIA e.g., turtles nest in an area that was not expected, and iii) in case of accidents or natural catastrophes disrupt the project. For example, a project may fall behind schedule due to storms, and development activities are then postponed, to continue during the turtle breeding season, which is restricted. It should also be clear upfront, if sea turtle (presence) is enough to disrupt development activities or what the acceptable limit of loss (if any) is for turtles. Sea turtles can have a (bag) limit, equivalent to a *choke species* in fisheries that forces a vessel to stop fishing if the catch exceed a set limit on a restricted species.

Suggested minimum data sets that should be available for any decision making, including the drafting of an Environmental Management Plan, recommendations, or **monitoring** and auditing plans are:

- Pre-construction baseline data on turtle and habitat dynamics, ideally a minimum of one (2 week) internesting cycle at the peak of the nesting season for each species and 2 weeks at the peak of the hatchling emergence period, over 5 seasons/years (if possible)
- Turtle population size, health, geographic distribution
- Longshore stranding trends
- Nesting, incubation and hatching success
- Identify the location and existing threats to critical habitats (including the migration routes, nesting and internesting sites, and foraging habitats per species)
- Collect demographic data from turtles on foraging grounds
- Monitor light/noise (pre-construction) and hatchling orientation onshore and offshore

These data sets do not need to be made publicly available specially concerning locations of threatened species in high densities or during sensitive life stages that may make them more vulnerable, but they should be available for expert consultation.

Restoration

The effect of any development project will be measured during both routine/modal conditions and major catastrophes (e.g. *Deepwater Horizon* spill). The restoration actions required will differ among projects but the principles for **restoration** are common:

- Adequate restoration funds and resources should be set aside as a contingency.
- **Restoration projects** should consider **all parts** of the life history (breeding, incubating, hatchlings, post-hatchling dispersal, juvenile and adult feeding/migration routes).
- Have the expertise to treat and rehabilitate injured turtles, or have arrangements with facilities, expertise and response teams to rehabilitate turtles in case of a disaster.
- Support existing **conservation and monitoring programs** that are aiming to recover populations and protect habitat where wild populations can flourish – these include:
    - "Reduce artificial lighting visible from nesting beaches
    - Enhance protection of nests by addressing anthropogenic threats
    - Reduce nesting beach barriers
    - Acquire lands for conservation of nesting beach habitat
    - Beach user outreach and education
    - Reduce sea turtle bycatch in fisheries" [4].

Education, Awareness & Public Information Sharing

All development projects should have a suitable awareness campaign (to take place at the initiation of the project after stakeholder engagements are completed). The purpose of this campaign is to make the public aware of turtle-related issues, and suitable response plans and contact numbers. Where there is a higher density of people and their associated activities, impacts on sea turtles are more likely. However, many of the impacts may be reduced with proactive management of light, noise, pollution, disturbance onto, and around nesting beaches, and appropriate patrols and stranding/response networks.

Most of this document, similar to most development projects, has a strong bias to the economic or ecological consideration. It is acknowledged that there is a very poor consideration here of people's livelihoods and their fundamental social and cultural relationship to turtles. It is recommended that the social evaluation also form an integral part of EIA process. Most proposed developments are presented with great socioeconomic expectations and opportunities. However, most local communities have a strong historic, cultural-traditional, recreational, and/or socio-economic relationship with sea turtles that should also be specifically considered along with sea turtles and their habitats.

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