EEPGL Oil Spill Response Plan

ERM Coastal Sensitivity Maps

Liza Phase 1 Development Project

Esso Exploration and Production Guyana, Limited

May 2017

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ERM Partner

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ESMP VOLUME IV

Esso Exploration and Production Guyana Limited (EEPGL) Oil Spill Response Plan

Liza Phase 1 Floating, Production, Storage and Offloading (FPSO) Development Project

AMENDMENT

May 2017

Review and Approval

Approved by:

EEPGL Country Manager _____ 1 JUN 2017
Date

Contents

Tables

Figures

Amendment Record

For each revision of EEPGL's Oil Spill Response Plan (OSRP), EEPGL will insert approval signatures and details in Table below. Include details on the revision number, description and indication of the revised pages or paragraphs and amendment approval date.

Revision Number	Date	Summary of Amendment	Page Number	Approved by (Signature)
Rev 0	February 8, 2016	EEPGL Oil Spill Reponse Plan (OSRP)		J. Simons
Rev 1	February 27, 2017	EEPGL OSRP Amendment (Amended to reflect further spill scenarios associated with Liza Phase 1 FPSO Development Project and addition of Wildlife Response Plan)	Multiple	J. Simons
Rev 2	May 10, 2017	Final edits/revisions based on comments received to Liza Phase 1 FPSO Development Project EIA and OSRP	Multiple	R. Henson

1 INTRODUCTION

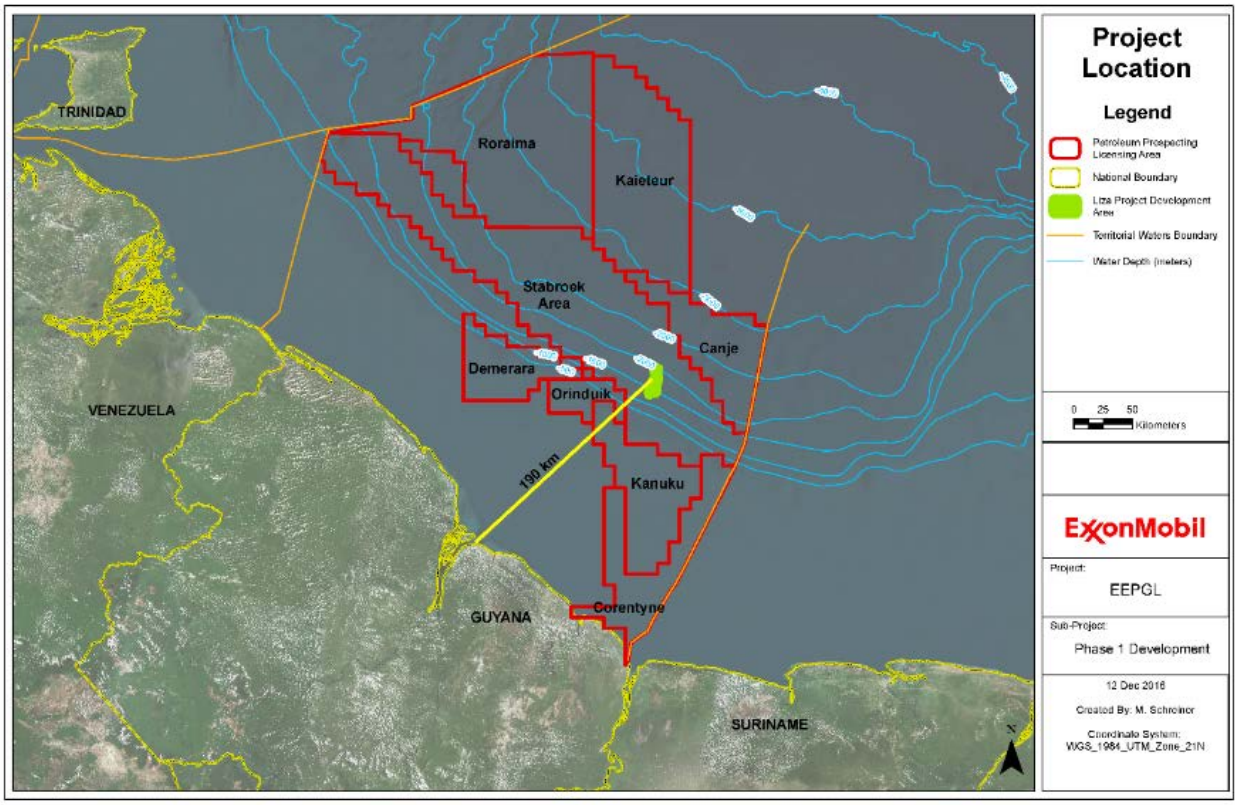
This Oil Spill Response Plan (OSRP) outlines plans and procedures, in the event of an oil spill incident, for engagement between the site operator (Esso Exploration and Production Guyana Limited (EEPGL)), the Guyana Authorities (Environmental Protection Agency (EPA), Civil Defense Commission (CDC), and Guyana Coast Guard (GCG)), ExxonMobil Corporate support teams, and third party support organizations.

This document has been amended to describe EEPGL's on-going exploration, drilling and additional Liza Development (e.g. installation, hook-up, commissioning, drilling, and production operations), the equipment and facilities to be used, and how EEPGL will work together with the appropriate Guyana agencies to respond to an oil spill of different severities.

2 SCOPE

2.1 Project Overview

EEPGL submitted a development plan and applied for a Liza production license on December 13, 2016. EEPGL must obtain approval of the Application for Environmental Authorization that was submitted to the Guyana EPA on July 5, 2016 before offshore installation, drilling and production operations maybe initiated. An Environmental Impact Assessment (EIA) in support of such operations was submitted in February 2017 that includes multiple appendices including this OSRP, which sets forth the strategies and plan for how EEPGL will respond to an oil spill and other unplanned events. Final revisions have been incorporated reflecting key comments received during the 60-day review period and feedback received during a two day workshop with key stakeholders during which the OSRP was reviewed in detail that concluded in April. EEPGL was granted the rights to explore for hydrocarbons in the Stabroek Petroleum Prospecting License Area (referred to hereafter as the Stabroek Block) offshore Guyana (Figure 1). EEPGL has submitted a Liza Development Plan upon which a subsequent Liza Production License will be issued.



** NOTE: Map does not represent a depiction of the maritime boundary lines of Guyana.*

Figure 1: Stabroek Petroleum Production License Area in Green

There will be a variety of marine and aviation support equipment supporting the FPSO, installation vessels, and drill ships, as shown on Figure 2. The support vessels will consist of Platform Supply Vessels (PSVs) conducting re-supply trips to the FPSO and drill ships, Tug Vessels (TVs) supporting tanker offloading activities, and Multi-Purpose Vessels (MPVs) supporting subsea installation and maintenance activities. Based on current drilling activities and past experience with similar developments, it is estimated that during development drilling and FPSO/SURF installation, an average of 12 vessel trips per week may be made to the Project Development Area (PDA).

During FPSO/SURF production operations, it is estimated that this number will be reduced to approximately 7 vessel trips per week. The vessels are planned to be loaded and offloaded at shorebase facilities in Guyana and/or Trinidad. Figure 2 depicts a conceptual diagram and estimated number and types of logistical support equipment that will be utilized to support the Project.

In addition, it is estimated that during development drilling and FPSO/SURF installation a total of as many as 30 to 35 helicopter flights per week will be needed. During FPSO/SURF production operations, an estimated 20 to 25 round-trip helicopter flights per week will be necessary to support FPSO/SURF production operations and development drilling activities.

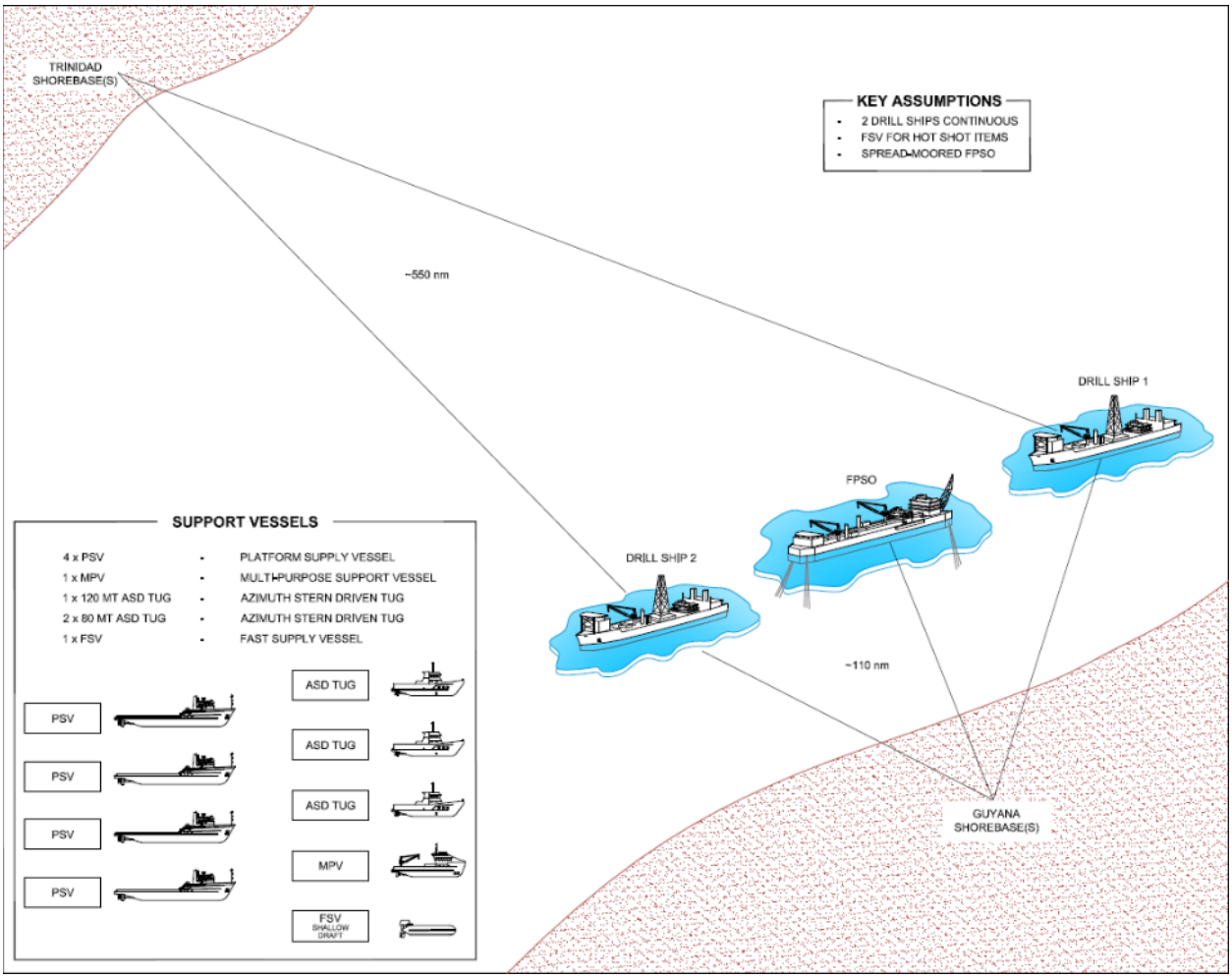
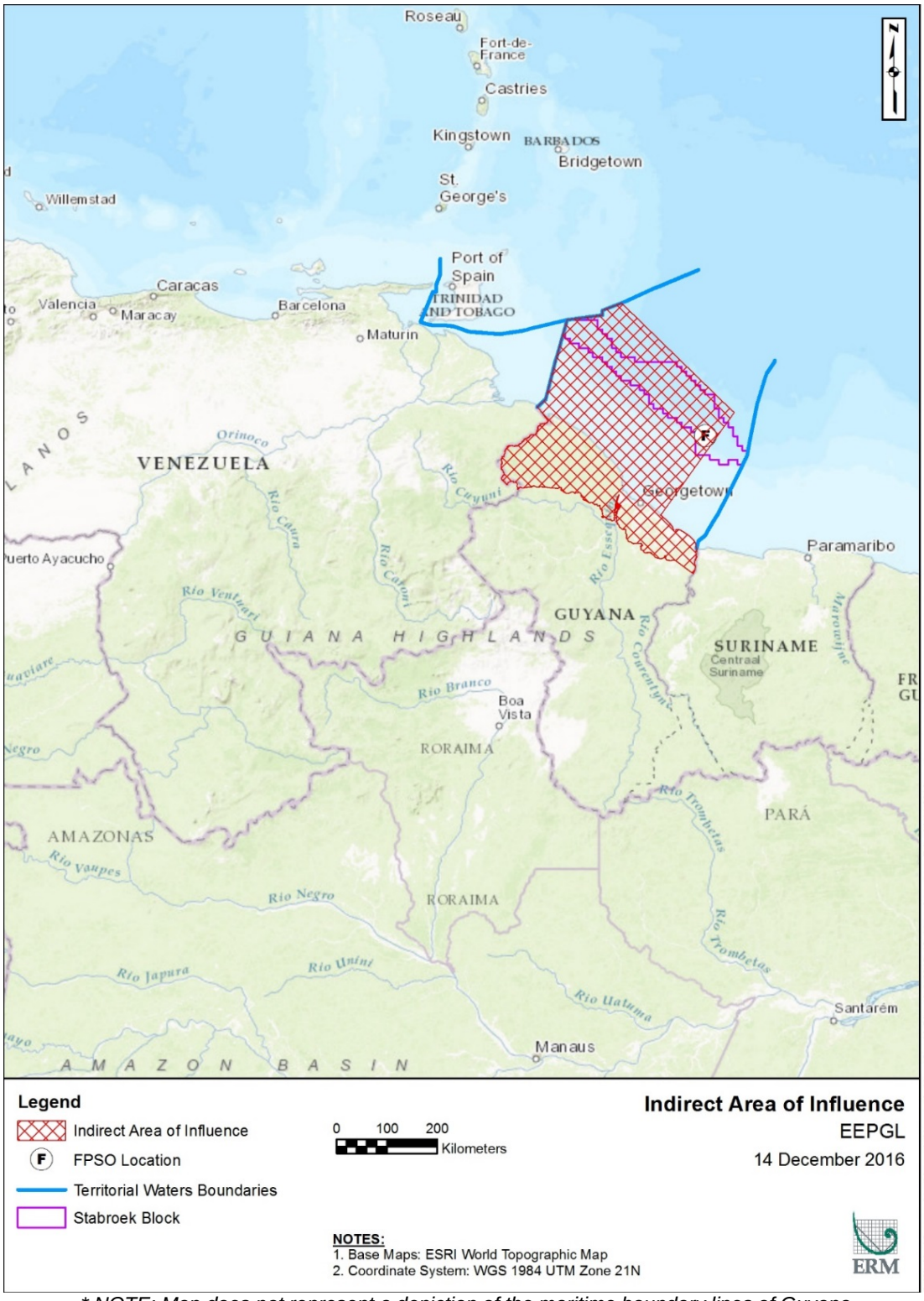


Figure 2: Liza Phase 1 Drilling and Operations Stage Peak Fleet Profile

2.2 Geographic Response Area

Oil spill modeling has determined the potential impact of a loss of well control event (Tier II-III) could include Trinidad and the Southern Caribbean, Lesser Antilles. Figure 3 shows the Guyana Geographical Response Area. EEPGL will manage and coordinate the response from Georgetown, Guyana and utilize in-country logistics for operations in all of the potentially impacted countries, if it is safe to operate there.



** NOTE: Map does not represent a depiction of the maritime boundary lines of Guyana.*

Figure 3: Guyana Geographic Response Area

2.3 Incident Management

The response management overview graphic (Figure 4) and supporting information provides guidance for an appropriate field and issues management response. This model depicts the interaction of both the field (tactical) response levels and Headquarters (strategic) support structure.

ExxonMobil tactical response teams include the Emergency Response Team (ERT), Incident Management Team (IMT) and Regional Response Team (RRT). Strategic response teams include the Region Emergency Support Group (ESG) and Business ESG. Additional information is available in the EEPGL Emergency Response Plan (ERP).

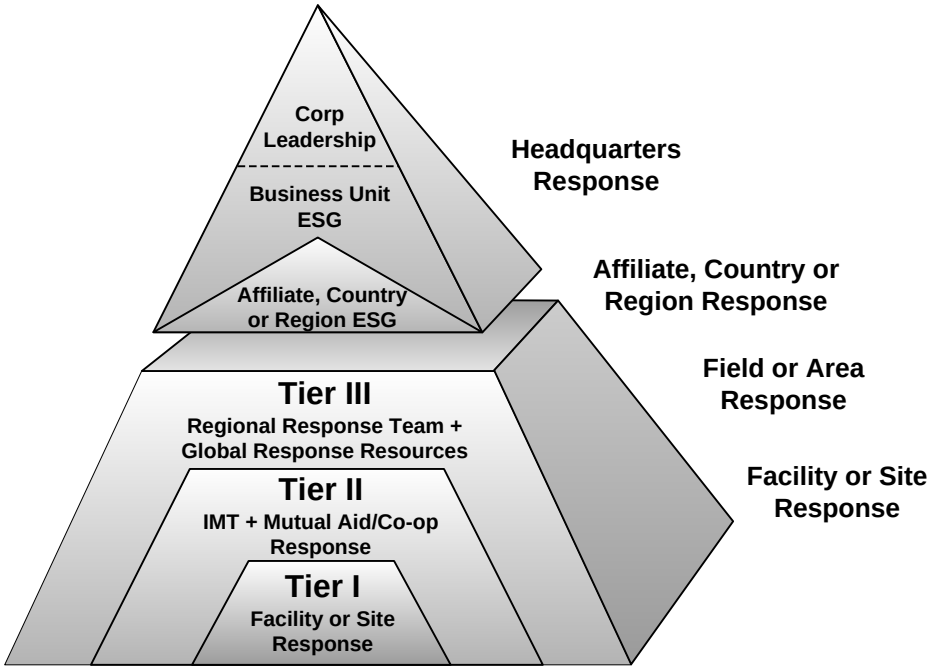


Figure 4: Emergency Management Overview

ExxonMobil has a tiered response approach to oil spill planning globally. Table 1 summarizes the tiered response approach adopted by EEPGL.

Table 1: Tiered Oil Spill Response Approach

Tier	Description
I	Incident is small, under control, and may involve a local company-managed resource response.
II	Incident is large, under control or spill source not immediately under control, and involves mutual aid cooperative response.
III	Incident is large, is not under control, and requires response by the appropriate RRT and specialized resources.

The on-site ERT will manage Tier I incidents in accordance with the site-specific ERP.

Figure 5 depicts the emergency response escalation model. EEPGL will proactively obtain additional support and resources to reduce the impact of a spill in the unlikely event it shows potential to exceed Tier I capabilities.

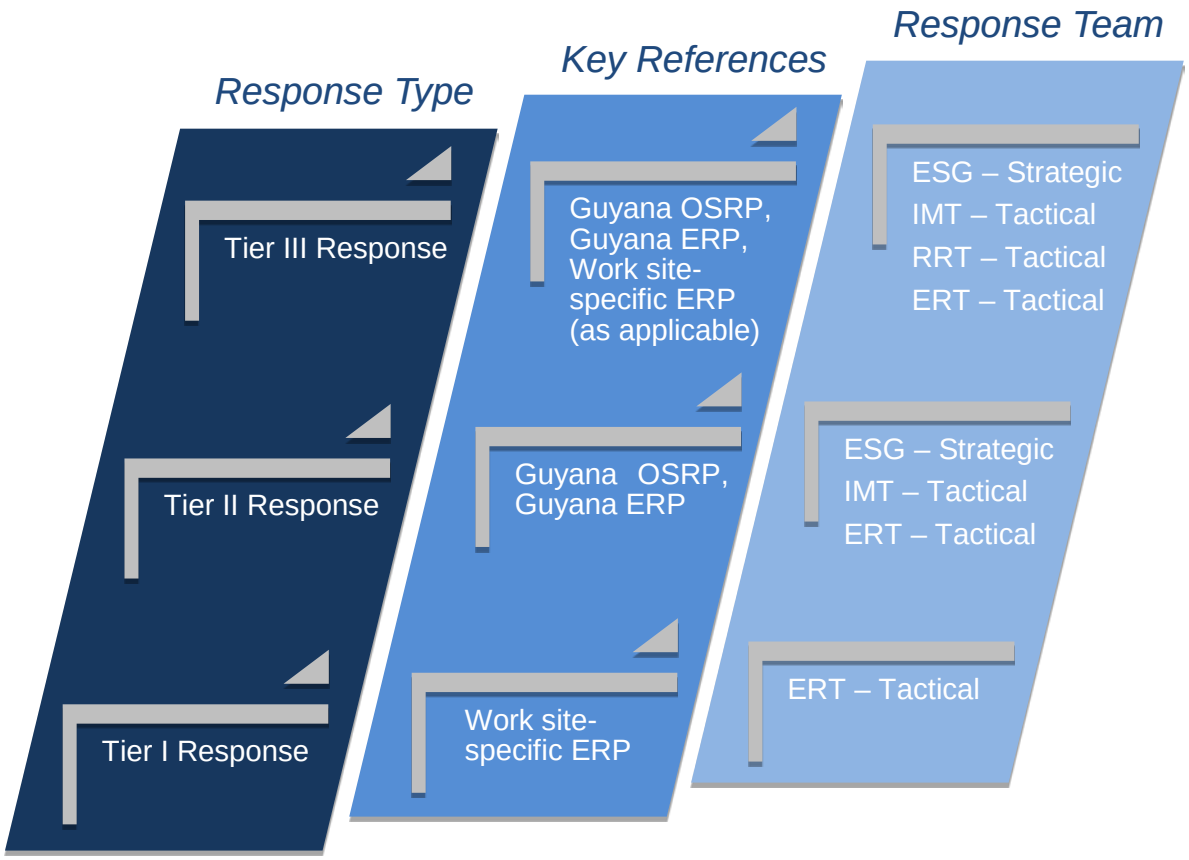


Figure 5: Emergency Response Escalation Model

The ERT will manage Tier I spill responses using the site-specific ERP and resources located on vessels and in port facilities in Guyana and Trinidad. Such resources as well as dispersant application from vessels will also be used for larger Tier II spills until supplemental OSR resources arrive on-scene.

For incidents that may exceed Tier I capabilities, EEPGL would notify Oil Spill Response Ltd (OSRL) in Southampton, UK[1] (Refer to forms in Appendices C.3 and C.4), to provide immediate incident management support as well as OSRL's global oil spill technical response teams and equipment.

[1] Oil Spill Response Ltd or OSRL merged with the Clean Caribbean & Americas (CCA) co-operative in 2013. The hertitage CCA equipment base and personnel located in Ft. Lauderdale, FL are now an integral part of a larger global response co-operative under the name OSRL.

At all stages of the response operation, EEPGL will work with the appropriate authorities in Guyana and any other affected countries, which will include rapid development of a plan to identify and engage potentially affected stakeholders and communities. EEPGL continues to work cooperatively with the CDC, GGMC and other local agencies and interested stakeholders on a routine basis to ensure open lines of communication are maintained and clear roles and responsibilities are understood and consistent with the agreed emergency response planning for offshore petroleum operations. In recognition of the CDC preparing a national oil spill response plan which is still in the draft stage, when this is finalized, appropriate updates to this OSRP will be incorporated.

Given the limited resources in-country, company will consider setting up a cooperative with a regional OSRO (e.g., Trinidad) to support Tier 2+ oil spill response prior to offshore execution. Whether using a direct agreement or a cooperative, Tier 2+ oil spill response readiness in-country is critical as such spills could potentially have transboundary impacts to neighboring countries.

The EEPGL OSRP is supported by the EEPGL ERP which provides a structured and systematic process for responding to incidents. The ERP outlines plans and procedures for engagement between the incident site, EEPGL and ExxonMobil management and the relevant authorities in Guyana. The ERP covers incidents associated with the shorebases utilized by EEPGL as well as the offshore operations in the Stabroek Block, including the possibility of hydrocarbon and chemical releases, search and rescue, offshore medical evacuation, medical emergency, fatality, fire or explosion at a work site, natural disaster and security or civil disturbance. While the ERP is the primary document for use in all emergencies, it is supplemented by this OSRP in the specific case of an oil spill.

2.4 Response Plan Relationships

2.4.1 Esso Exploration and Production Guyana Ltd (EEPGL) Emergency Response Plan (ERP)

The EEPGL ERP establishes a structured process for responding to events that pose, or could pose, a threat to the people, environment, assets, or reputation impacted by EEPGL activities.

The ERP provides guidelines to assist project, drilling, exploration, and facilities management in effectively responding to an emergency such as an oil spill. This plan is a country-level plan that is mainly focused on emergency response activities conducted at the EEPGL Emergency Response Center(s) (ERC). The EEPGL ERP also references work site-specific Emergency Response Plans such as the Drilling ERP.

2.4.2 Country National Plan

A draft national contingency plan prepared by International Maritime Organization (IMO) identifies the Guyana Coast Guard (GCG) of the Guyana Defense Force as the lead agency for oil spill response operations. However the draft has not yet been formally adopted. Responsibilities in the maritime sector are split between several departments and ministries. The Lands and Surveys Department of the Ministry of Agriculture has jurisdiction in river waters. The Transport and Harbors Department of the Ministry of Public Works, Communications and

Regional Development is responsible for port areas and territorial waters. However, the Coast Guard enforces all maritime regulations and is a key operational organization in any marine incident investigating reports of pollution in navigable waters on behalf of the relevant ministry and department. In addition, the Guyana Defense Force and the Fire Service also assume some operational responsibility for pollution response.

A Draft National Multi-Hazard Preparedness and Response Plan is currently under development by the Guyana Civil Defense Commission (CDC). By developing a national strategy for disaster risk reduction and management the CDC aims to be compliant with global and regional systems such as United Nation International Strategy for Disaster Reduction and the Caribbean Disaster Emergency Response Agency's Comprehensive Disaster Management Framework.

2.4.3 Legal Framework

National laws, regulations and conventions are applicable to EEPGL's activities in the Stabroek Block license area in the case of marine pollution.

Applicable National laws and regulations include:

- National Constitution of Guyana;
- The Environmental Protection Act 1996;
- The Guyana Geology and Mines Commission Act 1979.

Specific regulatory reporting requirements are covered in the EEPGL's ERP.

2.5 OSRP Owner Responsibility

Owner and Administrator: The EEPGL Venture Manager is the Owner of the EEPGL OSRP and the EEPGL OIMS/SSH&E Manager is the Plan Administrator.

Plan Review: The OSRP Administrator and Owner review this plan on an annual basis and/or if there is a significant change to the development drilling and planned production operations.

Site Specific Plans: Other Activity or Site-specific ER Plans for shorebases and those individual vessels owned and operated by others are the responsibility of the site-specific Emergency Response (ER) owners and administrators for those companies. These include the following planned vessel Shipboard Oil Pollution Emergency Plans (SOPEPs).

ONSHORE

- Fuel Storage Terminal Owner/Operator Emergency Response Plan; and
- Shorebase Owner/Operator Emergency Response Plan.

OFFSHORE

- FPSO Owner/Operator SOPEP;
- Conventional Crude Oil Tanker Owners/Operators SOPEP;
- Drill Ship Owners/Operators SOPEPs; and
- Other Installation, Supply, Support Vessel Owners/Operators SOPEPs.

EEPGL's On-Scene Incident Commander will communicate and coordinate with the owners/operators of such assets to ensure they have effectively implemented their ER/SOPEP in the event of a spill or release. Further discussion of such duties and responsibilities are outlined in Section 4. Hard copies of such site specific ER's and SOPEP's will be maintained at the physical asset's location or onboard the vessels with a copy of the FPSO and Drill Ships SOPEP's also maintained at EEPGL's Venture Office.

3 INITIAL RESPONSE ACTIONS

3.1 On-Scene Initial Response Actions

Figure 6 describes the immediate actions of on-scene personnel upon discovery of a spill, including a quick situation analysis and identification of actual or potential health and safety hazards. More detailed site-specific procedures can be found in the appropriate ERP.

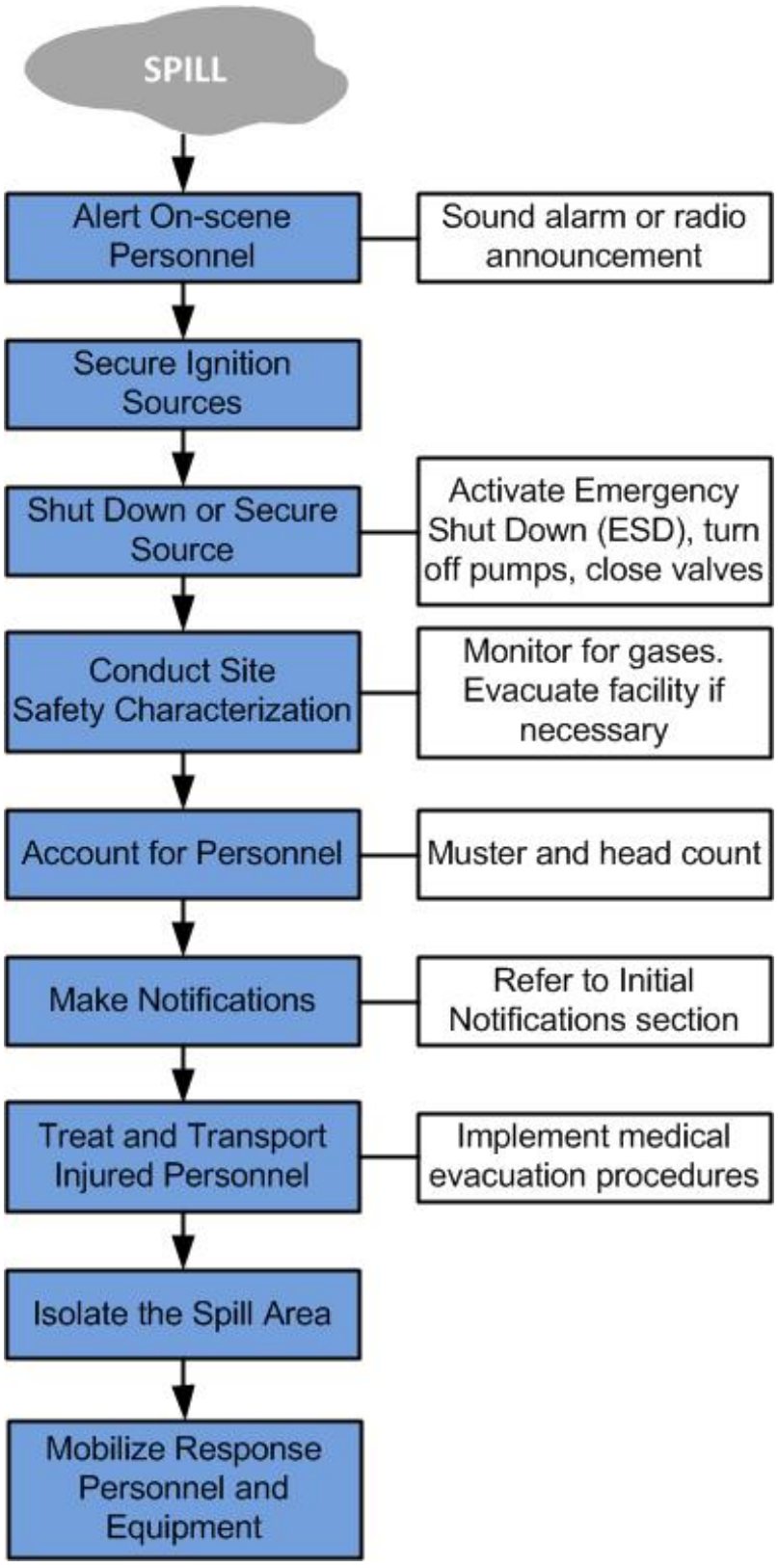


Figure 6: On-Scene Response Actions (Sample)

3.2 On Scene Incident Commander Initial Actions

The On-Scene Incident Commander is responsible for implementing the appropriate initial oil spill response actions including, but not limited to, those in Table 2.

Table 2: Incident Commander Initial Checklist

✓	Action
	Notify EEPGL Duty Manager immediately (use Initial Spill Report Form, Appendix C.1)
	Request resources required to carry out spill response activities.
	Activate personnel and equipment maintained by ExxonMobil.
	Activate required external oil spill response organizations.
	Act as liaison with the lead government organization.
	Authorize notification of applicable external organizations (Table 3).

For site-specific actions refer to the appropriate plans and the ExxonMobil Incident Management Handbook (IMH).

3.3 Initial Notifications

The notifications matrix details which organizations to notify for each incident Tier, once initial on-scene response actions have been addressed (Table 3). The EEPGL ERP provides specific internal and external incident reporting requirements.

Table 3: Notifications Matrix

Organization / Regulatory Body	Spill Criteria	Timing / Responsible Person	Tel number	Form	Email address / Fax number
Guyana Government Agencies					
Coast Guard Guyana Defence Force Ruimveldt Georgetown	All Tier Levels	Within 24 hours / Initial On- scene IC	+592-226-8488 (24 hrs)	N/A	
Harbor Master Transport and Harbors Department Stabroek Georgetown	All Tier Levels	Within 24 hours / Initial On- scene IC	+592-226-7842	N/A	
Guyana EPA Ganges Street, Sophia Georgetown, Guyana	All Tier Levels (subject to permit language)	Within 24 hours / ERT Incident Commander	+592 225-5467 +592 225-5469	N/A	
Maritime Administration Department (MARAD)	Tier II and III	Within 24 hours / ERT Incident Commander	+592 226 3356	N/A	
Guyana Geology and Mines Commission	All Tier Levels	Within 24 hours	+592 225-6691 +592 225-2862	N/A	
ExxonMobil					
EEPGL Duty Manager	All Tier levels	Immediately / Initial On Scene IC	TBD	Internal Notification Form	
NART – RRT	Tier II and III	Immediately / Initial On-scene IC	TBD	Internal Notification Form	
Key 3rd Party Operators					
FPSO Owner/Operator – SBM [Upon arrival at the Liza Direct Area of Influence (AOI)]	All Tier Levels	For all FPSO based incidents Immediately / Source Control / Branch Director	TBD	Internal Notification Form	
Crude Oil Tanker Owner/Operator (While offloading or within the Stabroek Block)	All Tier Levels	For all Tanker based incidents Immediately / Source Control / Branch Director	TBD	Internal Notification Form	

Organization / Regulatory Body	Spill Criteria	Timing / Responsible Person	Tel number	Form	Email address / Fax number
Drill Ship Owner/Contractor (While drilling or within the Stabroek Block)	All Tier Levels	For all Drill Ship based incidents Immediately / Source Control / Branch Director	TBD	Internal Notification Form	
Installation/ PSV/FSV Contractors	All Tier Levels	For all Vessel based incidents Immediately / Source Control / Branch Director	TBD	N/A	
Shorebase(s)	All Tier Levels	Immediately / Initial On Scene IC	TBD	Internal Notification Form	
Fuel Storage Terminal	All Tier Levels	Immediately / Initial On Scene IC	TBD	Internal Notification Form	
Response Contractors					
Oil Spill Response Ltd (Fort Lauderdale)	Tier II and III	Immediately / Initial On-scene IC	+1 954 983 9880	OSRL notification OSRL mobilization	+1 954 987 30001
NRC Trinidad	All Tier Levels	Immediately / Initial On-scene IC	+44 (0) 1908 467 800	N/A	
Wild Well Control	Loss of well control	Immediately if loss of well control / Initial On-scene IC	+1 281 784 4700	N/A	N/A
ROV contractor	Loss of well control	Immediately if loss of well control / Initial On-scene IC	TBD	N/A	TBD
Trendsetter Engineering Inc.	Loss of well control	Immediately if loss of well control / Initial On-scene IC	+1 281 465 8858	N/A	N/A
Relief Well: Halliburton Boots & Coots	Loss of well control	Immediately if loss of well control / Initial On-scene IC	+1 281 931 8884 +234 1271 5020	N/A	N/A

3.4 Initial Source Control Actions

Initial source control actions and resources to control the source of operational spills, including the initial actions to a loss of well control incident, are described in site specific response plans. Sustained source control response operations will be managed and coordinated by the IMT including the Source Control Branch under the Operations Section. See Figure 7 for example IMT with Source Control Branch.

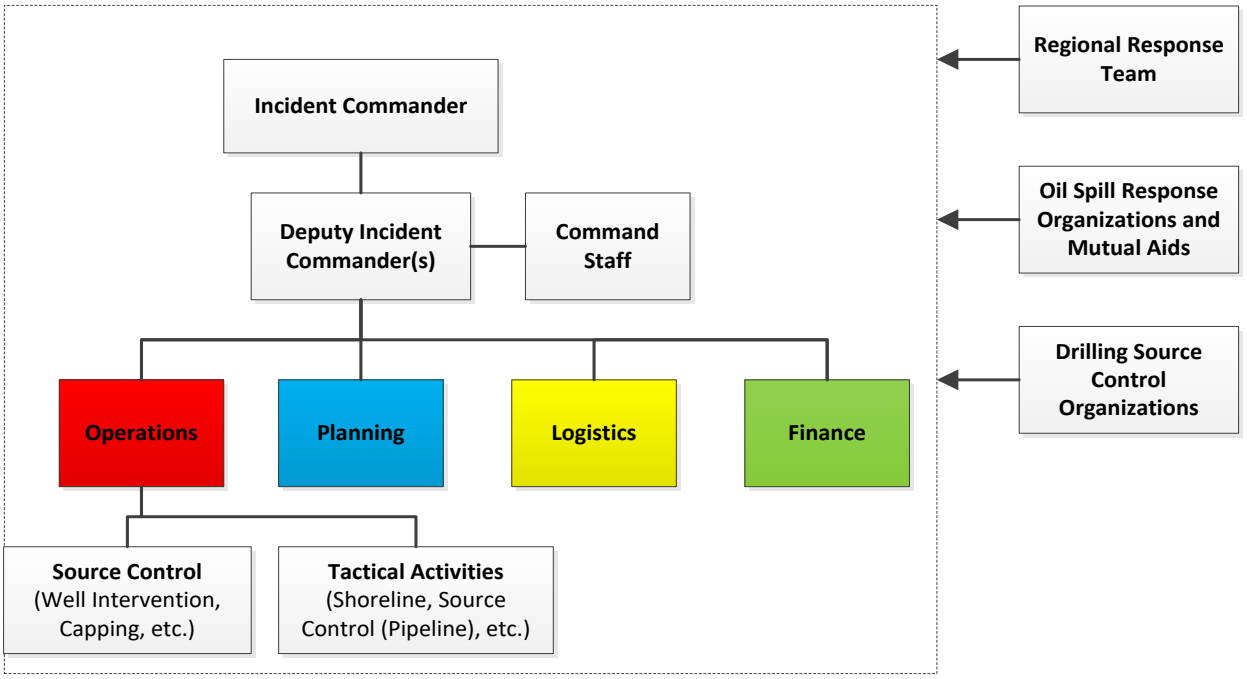


Figure 7: Example Incident Management Team (IMT) with Source Control Branch

3.5 Spill Assessment

An accurate estimation of total spill volume, location and movement is essential to determine the required response Tier, and to plan for and initiate spill cleanup operations. Quick estimation will aid in determining the:

- Equipment and personnel required;
- Potential threat to shorelines and/or sensitive areas, including ecological impact; and
- Waste storage and disposal requirements.

EEPGL will initiate a systematic search with vessels and aircraft (weather permitting) to locate the spill and determine its coordinates.

EEPGL will estimate spill size and movement using coordinates, photographs, drawings, and other information received from vessels, aircraft and satellite imagery. Spotters will photograph the spill from aircraft as often as necessary for operational purposes, and determine its movement based on existing reference points, such as vessels and familiar shoreline features. Modeling of the oil release may be utilized to predict the oil slick's surface movement or trajectory. Modeling will help to identify shorelines that may be at risk from oil stranding, predict the probable timing of that stranding, and provide information regarding how the oil is changing with time.

The Source Control Branch will estimate the volume and rate of a subsea well release.

4 OIL SPILL SCENARIOS

The following tables describe potential hydrocarbon release scenarios in terms of location, hydrocarbon type, volume and potential environmental impact. Appendix D of this OSRP includes coastal sensitivity and shoreline access maps. In addition, Section 3.0 of the Environmental and Socioeconomic Management Plan details the management measures to mitigate risks to resources (e.g., leak detection).

The following locations could experience a hydrocarbon release during the installation, drilling and production operation stages of the Liza Phase 1 FPSO Project offshore Guyana:

- Guyana fuel terminal;
- Guyana shorebase;
- Trinidad shorebase;
- The drill ship or ships;
- Offshore from vessels working on behalf of the Installation, Drilling, or Production Operations including the FPSO.

Section 6, RESPONSE STRATEGY IMPLEMENTATION, provides details of potentially appropriate response actions for each identified scenario. Section 7, RESPONSE RESOURCES, details resources available to EEPGL.

Hydrocarbons that could potentially be released during development drilling and production operations include crude oil, marine diesel, fuel oil, aviation fuel, lubricating oil, and non-aqueous drilling fluid. These scenarios are outlined in Table 4. The most appropriate response strategy to a given incident will depend, in part, on the properties of the hydrocarbon spilled. For example, heavy oils tend to persist in the environment longer than lighter hydrocarbons. A significant fraction of spilled diesel fuel, however, may be expected to evaporate and naturally disperse.

The properties of the crude oil are provided in Appendix A MODELING RESULTS. These modeling results, along with previous spill experience of different oil types, were used to complete the predicted impacts of each spill scenario.

Table 4: Possible Hydrocarbon Release Scenarios by Tier

SCENARIO								Potential Response Strategies
#	Tier	Location	Activity	Possible scenario	Oil Type	Spill Volume	Impact	
-	I	Offshore Drill Ship or FPSO	Bunkering	Operational spill. Release of aviation fuel during refueling of helicopter offshore	Aviation fuel	<10 bbls	Fuel enters the water and will rapidly evaporate	• 6.1 Surveillance and Monitoring • 6.2 Assisted Natural Dispersion
-	I	Offshore Helicopter	Aviation	Ditching of an aircraft	Aviation fuel	>10 bbls	Fuel enters the water and will rapidly evaporate	See Above
1	I	Onshore Shorebase, Terminal, Airport Offshore Vessels	Bunkering	Operational spill. Partial loss of storage tank contents or minor spill	• Aviation fuel • Marine diesel • Fuel oil • Lubricating fluids • Oily water • Drilling mud	<10 bbls	Contained onshore or on deck of vessel. No shoreline impact likely	• 6.4 Onshore/Near Shore Response • 6.9 Waste Management • 6.11 Decontamination • 6.12 Demobilization
2	I	Offshore Supply Vessels, Drill Ship or FPSO	Bunkering	Leak or release due to failure of equipment: transfer hose rupture during ship to ship product transfer or release due to human error	• Marine diesel • Fuel oil • Lubricating fluids • Oily water • Crude oil	<50* bbls	Contained on deck of vessel or enters the water, spreads rapidly creating a sheen on the water surface. No shoreline impact likely	• 6.1 Surveillance and Monitoring • 6.2 Assisted Natural Dispersion • 6.6 Offshore Containment and Recovery • 6.7 Wildlife Response • 6.9 Waste Management • 6.11 Decontamination • 6.12 Demobilization
3	I	Offshore Supply Vessels, Drill Ship or FPSO	Ballasting	Accidental discharge of untreated bilge water	• Bilge water • Oily water	<50 bbls	Spill enters the water and will spread rapidly creating a sheen on the water surface. No shoreline impact likely	• 6.1 Surveillance and Monitoring • 6.2 Assisted Natural Dispersion • 6.6 Offshore Containment and Recovery • 6.7 Wildlife Response • 6.9 Waste Management • 6.11 Decontamination • 6.12 Demobilization
4	II	Onshore Shorebase	Bunkering	Release of larger volume due to rupture of transfer hose in harbor.	Marine diesel	<100* bbls	Oil enters the water and will spread rapidly creating a sheen on the water	• 6.4 Onshore/Near Shore Response • 6.1 Surveillance and Monitoring • 6.2 Assisted Natural Dispersion • 6.9 Waste Management

SCENARIO								Potential Response Strategies
#	Tier	Location	Activity	Possible scenario	Oil Type	Spill Volume	Impact	
							surface	• 6.11 Decontamination • 6.12 Demobilization
5	II	Offshore Drillship	Drilling	Disconnect of riser in the event of the loss of Dynamic Positioning (DP)	NADF	<2200 bbls	NADF enters near the seafloor; no shoreline impact likely	• 6.1 Surveillance and Monitoring • 6.2 Assisted Natural Dispersion
6	II	Onshore Shorebase Supply Vessels	Bunkering	Release of larger volume due to rupture of transfer hose in harbor.	Marine diesel	500 bbls	Oil enters the water and will spread rapidly creating a sheen on the water surface. Refer to modeling results.	• 6.4 Onshore/Near Shore Response • 6.1 Surveillance and Monitoring • 6.2 Assisted Natural Dispersion • 6.9 Waste Management • 6.11 Decontamination • 6.12 Demobilization
7	II	Offshore Drillship/ Well workover	Drilling	Well control incident (e.g. wellbore fluids diverted overboard to protect personnel during well control operations	Wellbore fluids	<250	Spill enters the water. Localized impact. No shoreline impact likely. Refer to modeling results.	• 6.1 Surveillance and Monitoring • 6.2 Assisted Natural Dispersion • 6.6 Offshore Containment and Recovery • 6.5 Dispersant Application • 6.7 Wildlife Response • 6.9 Waste Management • 6.11 Decontamination • 6.12 Demobilization
8	III	Offshore FPSO	Bunkering	Operational spill. Release of crude oil during tanker offloading	Crude oil	2500 bbls*	Potential for localized / area wide impact. Refer to modeling results.	See Above
9	III	Drillship/ Well workover	Drilling	30 day well control incident at seafloor of well.	Wellbore fluids	20,000 bbls oil/day Max. 30 days*	Potential for regional / transboundary impact. Refer to modeling results.	See Above

Hydrocarbon releases under Scenarios 1 through 4 would all be small and under control quickly, and would be managed with locally available spill control equipment. A temporary visible sheen on the water surface may occur, water quality would be temporarily impaired in a small area, a very sensitive receptor (e.g., plankton and possibly some shorebirds) may be locally affected, but there is not considered to be potential for any long-term or ecosystem level impacts on ecologically important or protected species.

A hydrocarbon release under Scenario 5 would involve a spill of approximately 2,200 bbl of NADF into the ocean near the seafloor. Under this scenario, the spill would be somewhat controlled because the volume is limited to the capacity of the drilling riser. There is the potential for temporary impacts on several resources/receptors, such as water quality and marine fish and wildlife, but these impacts would be generally short term and limited in area, with rapid resource/receptor recovery expected.

Hydrocarbon release under Scenario 6 would involve a spill of approximately 500 bbl of diesel into the adjacent river or water body where a shorebase is located. Under this scenario, the spill would be quickly controlled and contained because of the relatively small volumes and the ready access to spill control equipment.

Hydrocarbon releases under Scenarios 7 (minor well control release during drilling), 8 (release during offloading from FPSO to tanker), and 9 (major well control incident) would all involve an oil spill requiring the implementation of both our local and regional response resources as well as OSRL's global oil spill technical response teams and equipment, which are further described in Section's 5 -7. Oil spill modeling was performed for scenarios 2, 4, 8 and 9 listed above and during two difference seasons summer and winter each and the results provided in Appendix A.

5 RESPONSE STRATEGIES

5.1 Response Strategy Overview

An oil spill response includes a range of response tools and techniques, response strategies and tactics. It can be constrained by physical conditions, prevailing weather and sea conditions, and safety considerations. EEPGL will evaluate each deployment in terms of feasibility, effectiveness and potential to reduce negative environmental impact (i.e., net environmental benefit). EEPGL will respond with the intent of minimizing the negative impacts of the response and cleanup, as determined by a Net Environmental Benefit Analysis (NEBA, see Section 5.2 and Appendix G. The NEBA process presented in Appendix G is an evaluation tool that supports decision making. In the event of a release, EEPGL and ExxonMobil technical experts would review the existing NEBA analysis and update with specifics for the spill at hand for submission to the Guyana EPA as soon as practical.

During EEPGL's operations, it is the objective of the on-site ERT to contain any spill at the source, whether it be onshore (shorebase or port) or onboard a vessel (i.e. PSV, FSV, installation, drillship, tug, tanker or FPSO) and minimize any impacts to the environment, using the equipment available at the worksite. In the event of an on-water release, EEPGL will ensure that initial response actions are implemented and the required notifications are made. The

incident and response will be continuously monitored, and all appropriate response strategies will be considered.

If released oil is predicted to reach a shoreline, EEPGL will continue to leverage all available resources to stop the release at the source, utilizing provided containment, mechanical recovery, open burning, surface and subsurface dispersant application. EEPGL will also consider and evaluate shoreline protection measures (based on consultation with the appropriate government authorities) and outcomes from the NEBA to identify the combination of key response strategies that would be appropriate, given the specific situation, fate, and trajectory of the oil spill and weather conditions. Local regulatory approval and the ExxonMobil Oil Spill Dispersant Guidelines will govern the application of dispersants. Acceptance of response strategies for scenarios identified in this plan serves as preapproval; however, in the event of an incident, all relevant agencies will be notified and consulted, as appropriate, prior to implementation. This includes the use of dispersant.

The following flowchart (Figure 8) provides an overview of actions taken by the EEPGL ERT and IMT in the event of an emergency. A final decision on all necessary actions to be implemented will be determined on a case by case basis tailored to the particular incident and individual circumstances.

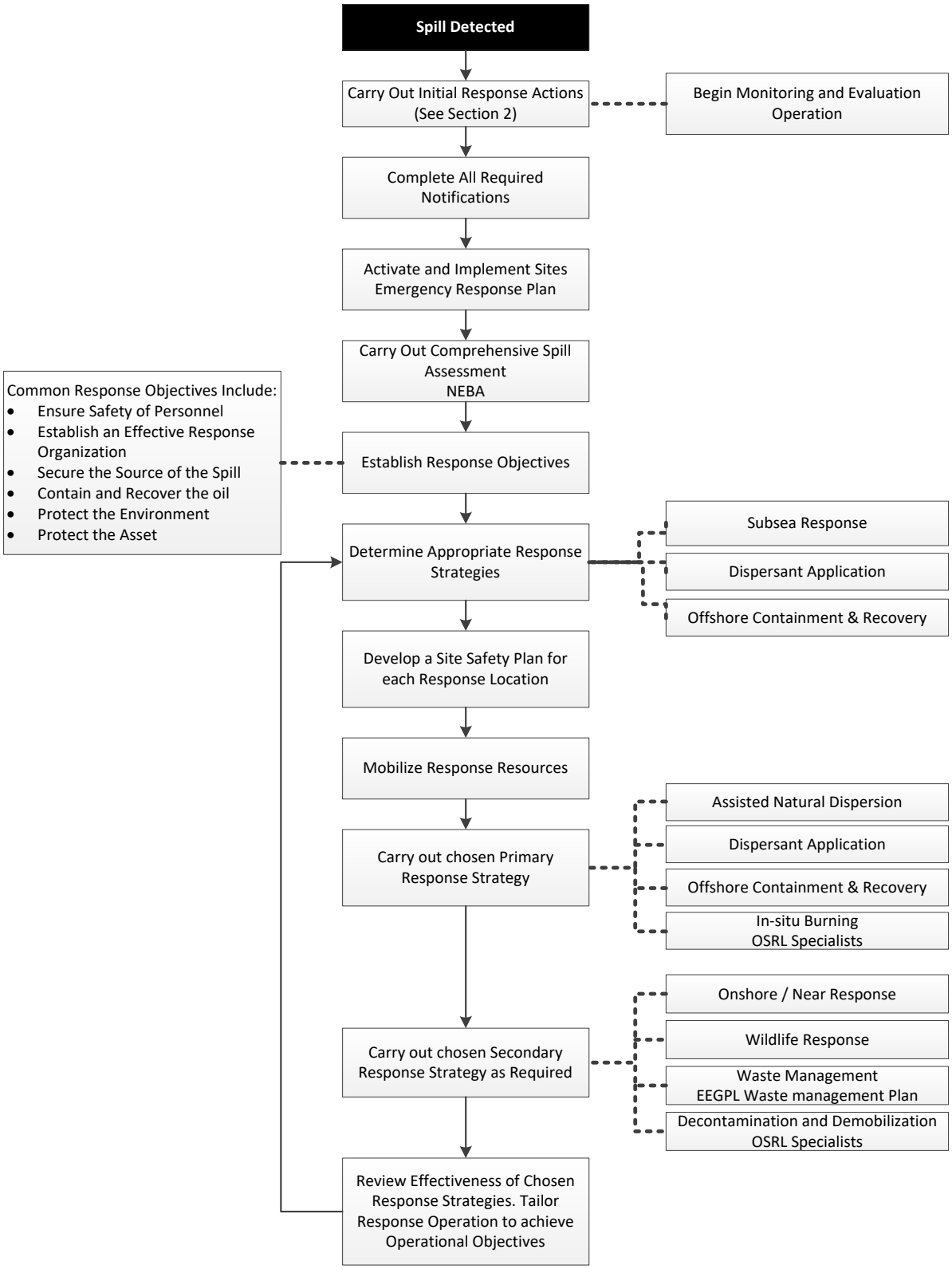


Figure 8: Emergency Response Generic Actions Flowchart

5.2 NEBA

EEPGL has completed a Net Environment Benefit Analysis (NEBA) for a Tier III scenario resulting from a loss of well control during the drilling of production wells for the Liza Phase 1 FPSO Development Project and well as a Tier II crude spill resulting from a loading hose malfunction. These releases are designed to account for the response to smaller spills and are a key input to the overall Incident Response Planning and in preparation of this OSRP. The results of the oil spill modeling, NEBA, EIA and a detailed review of this OSRP were performed over a two day workshop with more than 50 key governmental authorities and stakeholders.

NEBA compares the impacts of available response options including, in some cases, leaving the oil to degrade naturally, and selects the option or combination of options that minimizes overall harm to environmental and socioeconomic resources (including cultural sensitivities). The use of NEBA will ensure that EEPGL selects the most appropriate response techniques available to minimize overall environmental impact based on the conditions and sensitivities of an actual incident. In select situations the NEBA may be updated and performed again at the time of a significant spill (Tier III) to further refine and optimize the response strategies to be used given the specific conditions and circumstances existing at the time of the event.

Refer to Section 7 for a list of available resources and Appendix G for the NEBA Report.

5.3 Appropriate Response Strategies

EEPGL will respond to a release as far offshore as possible, using all appropriate tools and tactics to minimize shoreline impact. In consultation with the Guyana EPA, EEPGL will develop Incident Response Plans that could include the following response strategies for an offshore release:

- Respond with aerially applied dispersants, which can be quickly deployed and treat large surface areas rapidly and efficiently.

The safety of responders also needs to be considered in the evaluation of response strategies. Response tactics depend upon a variety of environmental conditions.

- Implement subsea dispersant application as soon as possible, if warranted, to treat most if not all oil spilled at the source before it encounters surface water resources;
- Deploy in situ burning equipment to burn thick oil near the source;
- Continue to use aerially applied dispersant as a primary response tool for oil further from the source where mechanical recovery/in situ burn operations are less effective;
- Utilize aerial dispersant application during calm seas on emulsified oil;
- Outfit vessels of opportunity (VOO) with dispersant delivery and mechanical containment and recovery systems to provide a fleet of vessels that can be a line of defense against surface oil approaching shorelines.

Shoreline protection and cleanup may be needed for some scenarios, in which case, sensitive shorelines will receive prioritization for protective booming.

Depending on the volume, mechanical recovery at sea is possible due to the anticipated oil thicknesses, but may be difficult due to the active metocean conditions.

There is a health and safety hazard posed by high atmospheric concentrations of hydrocarbons. Air quality should be monitored at all times and personnel should be evacuated immediately if an exclusion zone is required. Consideration for air quality monitoring is included in the Site Safety Plan.

Figure 9 below shows the cone of response when responding to a loss of well control event using all the available response strategies at once.

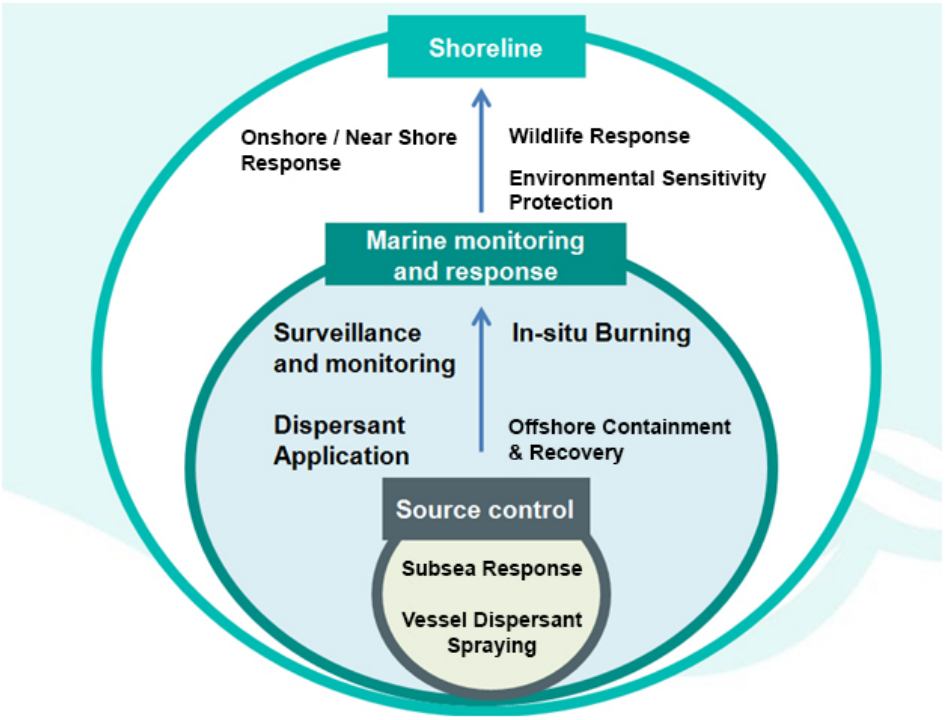


Figure 9: Cone of Response Diagram

5.4 Trans-boundary Impacts

In the event that there is an incident that impacts areas outside the Guyana Exclusive Economic Zone (EEZ), EEPGL will work with representatives for the respective locations to:

- Coordinate operations and communication between different command posts;
- Create a trans-boundary workgroup to manage waste from a product release – including pinpointing waste-handling locations in the impacted region and managing commercial and legal issues;
- Identify places of refuge in the impacted region where vessels in mechanical trouble could go for repairs and assistance;
- Determine how EEPGL and the impacted regional stakeholders can work together to allow equipment and personnel to move to assist in a spill response outside the region while still retaining a core level of response readiness within the two jurisdictions;
- Assigning or accepting financial liability during a response to a trans-boundary event;
- Work with local communities within the impacted area to raise awareness of oil spill planning and preparations.

6 RESPONSE STRATEGY IMPLEMENTATION

The following sections describe the implementation of each response strategy available to EEPGL.

6.1 Surveillance and Monitoring

Surveillance and monitoring is a key strategy relevant to all incidents that enter the marine environment. Surveillance and monitoring teams can fulfill the following response objectives:

- Verify oil spill scale and location;
- Monitor effectiveness of applied response strategies;
- Visually quantify spill volume;
- Direct operations – dispersant application, containment and recovery, shoreline assessment, in situ burning;
- Monitor wildlife.

The resources mobilized will vary depending on the scale of the incident. At a minimum, personnel will take visual observations, and vessel owners/operators will implement their ER/SOPEP's, deploying the Tier I response equipment they have onboard. Depending on the stage of the Liza Phase 1 FPSO Development Project this could include: the FPSO, drill ships, tanker, tugs, installation vessels, PSV's, or FSV's, and EEPGL will request updated oil spill modeling from response organizations or support organizations internal to the Corporation. For Tier II or Tier III incidents EEPGL will scale up to a full surveillance plan using helicopters, fixed wing aircraft and satellite imagery.

The IMT will assign an Air Operations Branch as part of the Operations Section for large or complex incidents. The Air Operations Branch will coordinate aerial support according to operational needs and document operational assignments in an ICS-220 Air Operations Summary form, which will be included in the Incident Action Plan (IAP).

The Air Operations Branch Director is responsible for addressing response considerations including flight authorizations and restrictions, air clearances, government support, aerial logistics and operational constraints (e.g. weather, visibility). All air operations must follow the Site Safety Plan and additional emergency procedures specific to the operation.

Figure 10 illustrates the key steps involved in surveillance and monitoring; refer to the ExxonMobil IMH and the OSRL Field Guides for further details. Refer to Section 7, for a list of available resources.

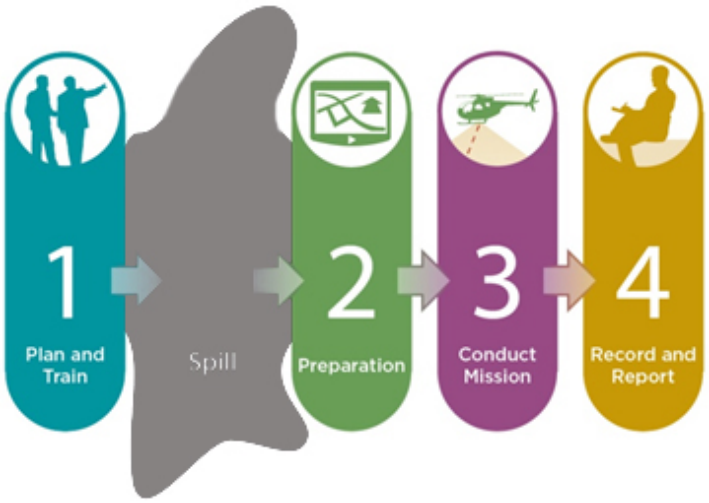


Figure 10: Surveillance and Monitoring Key Steps

6.2 Assisted Natural Dispersion

Assisted natural dispersion is the process of speeding up the natural breakdown of hydrocarbons without the use of chemicals. This strategy is suitable for smaller spills or in combination with other strategies for larger spills.

To assist the natural dispersion process techniques such as prop washing or water hoses can be implemented to introduce energy and agitate the hydrocarbons, thereby assisting with the breakup of a surface slick and promoting biodegradation.

6.3 Operational Spill Cleanup

Operational spills are small in volume and easily contained on land, on deck or in very close proximity to a vessel. These spills can originate from shore facilities, vessels or the drill ship. Equipment used for operational spills include sorbent pads, booms, shovels and PPE. This equipment is stored close to the work site for ease of deployment.

- Shorebases in Guyana and Trinidad have site specific ER Plans and are equipped with Tier I spill response kits;
- Vessels maintain a Shipboard Oil Pollution Emergency Plan (SOPEP) and associated equipment onboard the vessel.

For further details on operational spill cleanup, refer to the Incident Management Handbook and Field Response Guide found in Appendix B.

6.4 Onshore/Near Shore Response

6.4.1 Harbor Containment and Recovery

EEPGL will use harbor containment and recovery should a PSV or FSV release hydrocarbons in Port. The harbor response team will employ a strategy that considers tides, currents, wind, vessel traffic, and local infrastructure and stakeholder input. EEPGL will deploy equipment available on site and in the Port (such as or similar to the equipment and trained personnel at the Guyana Fuel Terminals and resources held by NRC for Trinidad) immediately following a release.

Figure 11 illustrates the key steps involved in harbor containment and recovery; refer to the ExxonMobil IMH and OSRL Field Guide for detailed information. Refer to Section 7, for a list of available resources.

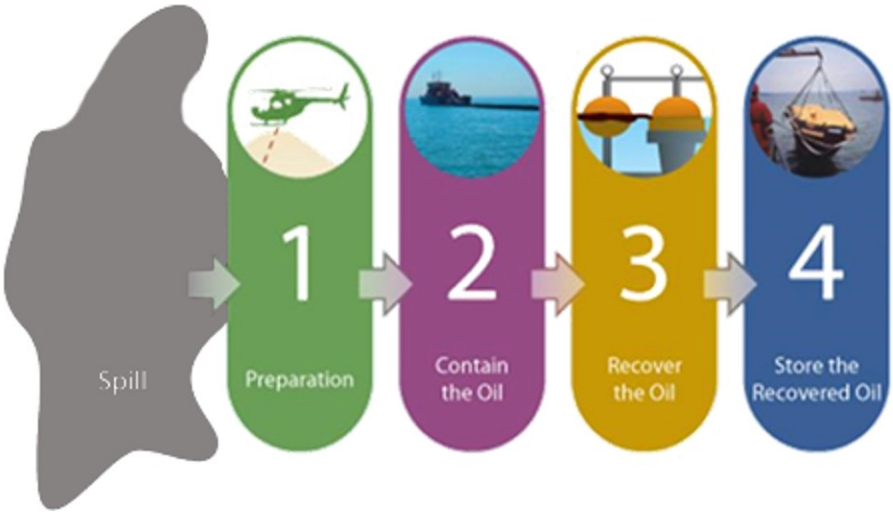


Figure 11: Harbor Containment and Recovery Key Steps

6.4.2 Shoreline Response

EEPGL will implement a shoreline response if released hydrocarbons show the potential to affect a shoreline, prioritizing environmentally or socio-economically sensitive areas (ESAs). These are ranked using an Environmental Sensitivity Index (ESI) and corresponding resource/receptor ratings to identify those projected areas, special status species, fish and other marine life on which these local coastal communities and indigenous peoples depend and live, as assessed in the Environmental Impact Assessment for the Liza Phase 1 FPSO Development Project.

This will consist of using vessel dispersant application to prevent approaching slicks from impacting ESAs and using shoreline booming to protect sensitive areas and provide collection points for hydrocarbon recovery. Initial equipment (e.g., dispersant, mechanical recovery) will come from in country/Region and will be supplemented as necessary via OSRL from Ft. Lauderdale, FL and other bases.

EEPGL has pre identified the environmental and socio-economical sensitive areas that could be impacted by a major oil spill. These coastal sensitivity maps have been provided in Appendix D of this OSRP. In addition, further information can be found in Section 7.4 of the Environmental Impact Assessment and Section 3.0 of the Environmental and Socioeconomic Management Plan for such unplanned events. The IMT will use this information for response planning, including development of protection strategies.

Figure 12 illustrates the key steps involved in a shoreline response; refer to the ExxonMobil IMH and OSRL Field Guide for detailed information. Refer to Section 7 for a list of available resources.

Figure 12: Shoreline Response Key Steps

6.5 Dispersant Application

Dispersants have been used successfully to reduce shoreline and surface impact during many oil spill incidents. When used properly, dispersants can rapidly reduce the volume of oil on the sea surface and accelerate the natural biodegradation process. Dispersants can reduce or eliminate the potential for oil to impact shorelines. EEPGL will only apply dispersants if there is a direct advantage to protecting environmental or socio-economical sensitivities (determined using NEBA, Section 5.2 and Appendix G) and they have obtained regulatory approval.

Vessel mounted systems will be used to apply dispersant in small-scale incidents and aircraft will apply dispersant on large oil slicks. Dispersant (and associated vessel spray equipment) will be kept at the shorebase or other easily accessible location where it can be easily loaded on vessels for application. OSRL will conduct aerial dispersant application and will likely base the operation out of the Georgetown airport. In the unlikely event of a well blowout, dispersant is injected subsea at the wellhead location on the seafloor using specialized equipment and Remotely Operated Vehicles (ROVs).

In Guyana, dispersant usage is subject to permission from the Guyana EPA. EEPGL and Guyana EPA both recognize that pre-planning is essential for selecting the best strategy and achieving an effective response. As mentioned in Section 5.1, acceptance of response

strategies for scenarios identified in this plan serves as preapproval; however, in the event of an incident, all relevant agencies will be notified and consulted, as appropriate, prior to implementation, including use of dispersant. In this regard, EEPGL is seeking pre-approval from the EPA for the potential use of the three primary (i.e., most broadly approved and studied) dispersants: Corexit 9500, Finasol OSR 52, and Dasic Slickgone NS. These dispersants have been found to be of low toxicity, effective across a broad range of oil types and environmental conditions, and are readily available globally. For reference, in a 2010 study conducted by the US EPA, Corexit 9500A was found to be of lower toxicity during standard aquatic toxicity tests than several other commercially available products, i.e., slightly toxic to practically non-toxic (Comparative Toxicity of Eight Oil Dispersant Products on Two Gulf of Mexico Aquatic Test Species, U.S. Environmental Protection Agency; Office of Research and Development, June 30, 2010). Safety Data Sheets (SDS) for each of the above mentioned products have been provided in Appendix C.2.

Requesting approval at the time of an incident delays the response, potentially increasing environmental damage. EEPGL will use the Dispersant Spraying Considerations Flowchart (Appendix B) as a guide for whether to use dispersants. Dispersant will be applied according to manufacturers' guidelines and the operating procedures of the spray applicators.

EEPGL will work with the EPA to develop a dispersant application, monitoring and evaluation strategy. The dispersant use application form captures all relevant information to assist in this process (Refer to Appendix C.2).

Figure 13 illustrates the key steps involved in dispersant operations; refer to the ExxonMobil IMH and the OSRL Field Guides for further details. Refer to Section 7, for a list of available resources.

Figure 13: Dispersant Application Key Steps

6.6 Offshore Containment and Recovery

EEPGL is likely to use containment and recovery operations for spills that enter the sea.

OSRL will provide containment and recovery resources for an offshore response. EEPGL will source Vessels of Opportunity (VOOs) to provide platforms for the containment and recovery systems. Barges will store and transport recovered waste in accordance with the Waste Management Plan (Refer to Section 8.1).

Figure 14 illustrates the key steps involved in containment and recovery operations; refer to the ExxonMobil IMH and OSRL Field Guide for detailed information. Refer to Section 7, for a list of available resources.

Figure 14: Containment and Recovery Key Steps

6.7 Wildlife Response

In the event of an oil spill there is potential for wildlife to either become oiled or require protection from the oil. Both require specialist knowledge and regulatory backing.

A Wildlife Response Plan (WRP) specific to Guyana has been developed and provided as Appendix E to allow for a timely, coordinated and effective protection, rescue, and rehabilitation of wildlife to minimize any negative impacts of a spill. The WRP outlines the measures to avoid and mitigate impacts to wildlife, as well as rescue and rehabilitation of affected or injured wildlife should such measures be required.

Details of the wildlife that could be impacted are provided in the Environmental Impact Assessment for the Liza Phase 1 FPSO Development Project.

Should a wildlife response be required, EEPGL will call upon the Sea Alarm Foundation via OSRL to provide specialist advice and assistance with carrying out a response. Opportunities to engage and train further members of the local oil spill response contractor as well as potential members of the potentially affected communities will be evaluated to expand such local resources.

6.8 In Situ Burning

In situ burning is a technique for burning spilled hydrocarbons on the water's surface. EEPGL is only likely to use in situ burning for large-scale Tier III incidents. OSRL will provide the resources required.

Hydrocarbons must be contained within fire retardant boom with sufficient thickness to achieve a successful burn. Other factors that influence burn success include:

- Weather and sea state;
- Volatility of the hydrocarbons;
- Suitable vessel availability; and
- Regulatory approval.

Figure 15 illustrates the key steps involved in burning operations; refer to the ExxonMobil IMH and OSRL Field Guide for detailed information. Refer to Section 7, for a list of available resources.

Figure 15: In Situ Burning Key Steps

6.9 Waste Management

EEPGL will manage hazardous waste resulting from clean-up activities and ensure appropriate disposal. Large spills can result in significant quantities of waste in various forms:

- Recovered oil;
- Oily water mixed with recovered oil;
- Sorbent materials;
- Oiled containment boom;
- PPE;
- Oiled sediment;

- Oiled vegetation;
- Oiled debris;
- Deceased wildlife.

Effective waste management will minimize secondary contamination, thereby minimizing waste volume. EEPGL have developed a Waste Management Plan (WMP) (refer to Appendix 1 of the Environmental and Socioeconomic Management Plan), which may be adapted as required if a spill is likely to produce more waste than can be handled by their regular waste contractor. Additional waste management provisions including those associated with the disposition of any deceased wildlife is found in Appendix E, the Wildlife Response Plan.

Figure 16 illustrates the key steps involved in waste management; refer to the ExxonMobil IMH and OSRL Field Guide for detailed information. Refer to Section 7, for a list of available resources.

Figure 16: Waste Management Key Steps

6.10 Subsea Response

The Drilling ERP contains managerial and logistical details on debris clearance, subsea dispersant injection, well capping and relief well drilling. The Tanker Owner/Operator will implement an ERP should any spill occur during tanker offloading and the FPSO ERP will have similar details on the surface and subsea response for a spill from either the FPSO, during tanker offloading or SURF (Subsea umbilical, riser, flowline) equipment during production operations.

If a Tier III well control incident occurs involving the release of wellbore fluids into the sea, EEPGL will be responsible for containing the source. This team is responsible for performing site survey, conducting debris removal operations (as required), evaluating and executing well intervention options, installing subsea dispersant application hardware, and mobilizing and installing a capping device/auxiliary equipment as required. Initially, the team will attempt to operate the existing subsea well control equipment through intervention. If required, the team

will mobilize and install a capping device to shut-in the well at the sea floor. Once under control, the forward plan will be designed and executed according to the details of the incident itself. If a relief well is required, it will be drilled to intersect the original well and address specific issues encountered in the original wellbore.

OSRL's Subsea Well Intervention Service (SWIS) provides EEPGL with access to a Subsea Incident Response Toolkit (SIRT), Global Dispersant Stockpile (GDS) and multiple Capping Stack Systems (CSS). The CSS and SIRT includes equipment that can be mobilized directly to the well site:

- Survey & debris clearance equipment;
- Intervention equipment;
- Dispersant hardware application system*;
- Capping stack systems and auxiliary equipment.

*Dispersant will be mobilized simultaneously through the OSRL GDS service via the EEPGL IMT. For detailed information on the implementation of a subsea response, refer to the Drilling ERP.

The key steps involved with a subsea response are:

Figure 17: Subsea Response Key Steps

Similar response strategies as those previously described and depicted in Figures 12-16 will be evaluated and utilized for those potential spill scenarios associated with production operations as described in Table 4. Both the tanker and FPSO owner/operators will coordinate their responses to any spill or release that occurs during tanker offloading.

6.11 Decontamination

In the event of a spill, an incident-specific Decontamination Plan will be developed by EEPGL relevant with the nature and extent of the spill to prevent further oiling through secondary contamination. Decontamination is the process of removing or neutralizing contaminants on

personnel and any equipment that has come into contact with the oil or oily wastes. To ensure the safety of the responders, the public and prevent further potential impact to the environment a decontamination plan and dedicated area with clearly delineated hot (exclusion), warm (contamination reduction) and cold (clean support) zones will be developed and established. Decontamination procedures are supplemental to the Site Safety Plan. The Planning Section of the Regional Response Team will support development of the Decontamination Plan with input from Operations and Logistics.

The decontamination procedures will depend on the type and volume of oil that has been spilled, and the type of equipment used during the clean-up operation. Regular decontamination during the response is necessary for the personnel involved with direct clean-up efforts, the vessels involved in the response, and a wide range of spill-related equipment. Any spill response contractor will follow established guidelines for decontamination operations in order to facilitate proper decontamination through the duration of the clean-up effort.

Establishing a field decontamination process is a priority. Regular decontamination will occur in the field, particularly during a large-scale response, so all personnel must be briefed on the decontamination requirements at the beginning of the spill response in order to ensure functioning decontamination operations.

Supervisory personnel are responsible for ensuring that all decontamination activities are occurring according to the guidelines. At the end of the response effort, all the vessels and equipment that have been used at the site will undergo a more thorough cleaning in order to ensure their suitability for future use, including normal operations.

For detailed information on the implementation techniques involved with decontamination, refer to the relevant Field Guide and IMH.

6.12 Demobilization

Once an incident has stabilized and operations are being completed, a decision will be made to commence demobilization of resources (personnel and equipment) as appropriate. An incident-specific Demobilization Plan will be developed incorporating guidance from the Resource Unit Lead, Operations, Logistics and Legal.

The Resource Unit will then coordinate demobilization of resources in accordance with the approved Demobilization Plan.

There are a number of tools available to assist in the determination of cleanup endpoints, including:

- Shoreline Assessment Manual, Third Edition, NOAA, 2000;
- Shoreline Assessment Job Aid, NOAA, 2007;
- Marine Oil Spill Response Options for Minimizing Environmental Impacts, NOAA, API and USCG, 1998;
- Options for Minimizing Environmental Impacts of Freshwater Spill Response, NOAA and API, 1995.

7 RESPONSE RESOURCES

Table 5 lists the resources available to EEPGL for each potential response strategy. Table 6 provides a further summary of the representative oil spill response equipment to be provided on the FPSO.

Table 5: Oil Spill Response Resources*

Response Strategy	Resources Available	Quantity	Location
Surveillance and Monitoring	Heli-port / Shorebase	2	Guyana Airport / Shorebase (Examples: Correia International Airport / John Fernandes Port Shorebase or similar, Guyana)
	Helicopters	3	Infield helicopter provider
	Helicopters	As required	National Helicopter Services Limited or similar, Trinidad
	Tracking Buoy	As required	Horizon Marine or similar
	OSRL Trained personnel Fluorometry Satellite Imagery Tracking buoys	Refer: Section 7.3.2, Oil Spill Response Limited (OSRL)	
Assisted Natural Dispersion	PSV's / FSV	6	Infield
Operational Spill clean-up	SOPEP material Spill Equipment at shoreside facilites	As required	Onboard all vessel's, at shorebases in Guyana and Trinidad, Fuel Terminals [Examples: SOL Terminal (Guyana), NRC base (Trinidad)]
Onshore/near shore	Onshore/near shore package Fence Boom Skimmers Temporary storage	TBD	Guyana Fuel Terminal (SOL Terminal or similar, Guyana)
			Trinidad Shorebase (NRC base or similar)
	OSRL	Refer: Section 7.3.2, Oil Spill Response Limited (OSRL)	

Response Strategy	Resources Available		Quantity	Location
Dispersant Application	Dispersant Spray Package 4000 liters chemical dispersant Afedo Spray nozzles		2	Guyana Shorebase (John Fernandes Port Shorebase or similar), Guyana
	OSRL Vessel mounted spray equipment Aerial spray platform Trained personnel		Refer: Section 7.3.2, Oil Spill Response Limited (OSRL)	
	Global Dispersant Stockpile		Refer to: Section 7.3.3, Global Dispersant Stockpile	
Offshore containment and recovery	OSRL Offshore boom Offshore skimmers Temporary storage Trained personnel		Refer: Section 7.3.2, Oil Spill Response Limited (OSRL)	
Wildlife	OSRL	Wildlife response equipment	Refer: Section 7.3.2, Oil Spill Response Limited (OSRL)	
	Sea Alarm Foundation (SAF)	Technical expertise		
	ExxonMobil Biomedical Sciences, Inc. (EMBSI)	Wildlife expertise	Refer: Wildlife Response Plan (Appendix E)	
In Situ Burning	OSRL Fire resistant boom Ignition equipment Trained personnel		Refer: Section 7.3.2, Oil Spill Response Limited (OSRL)	
Waste Management	Waste contractor: TBD		N/A	Guyana
	OSRL		Refer: Section 7.3.2, Oil Spill Response Limited (OSRL)	
Subsea Response	OSRL Subsea Well Intervention Services (SWIS)		Refer: Section 7.3.3, Global Dispersant Stockpile (GDS)	
	ROV contractor ROVs onboard Technicians 8 (4 man crew per Drill Ship)		4 (2 per Drill Ship)	TBD
	Trendsetter Engineering Inc.		N/A	Houston, TX

Response Strategy	Resources Available		Quantity	Location
	Engineers / Technicians to support mobilization and installation of capping equipment			
	Relief Well: Halliburton Boots & Coots active ranging technology		N/A	Houston, TX
	Additional available equipment: Wild Well Control Well CONTAINED BOP Intervention Subsea Dispersant application kit Debris removal kit Capping Stack system		See WellCONTAINED (TM)	Aberdeen, Scotland
Multi strategy use	Drillship		Up to 2	Infield
	FPSO*		1	Infield (See Table 6 for a list of the common spill response equipment kept onboard)
	Crude Oil Tanker		1	Infield (During scheduled tanker offloading)
	PSV's / FSV	PSV (Similar in class to the Hornbeck Commander, 320 ft class)	4	Infield
		FSV (Similar in class to Chouest Fast Hauler)	1	
	Installation Vessels	MPV (Multi-Purpose Support vessel)	1	
	Tugs	1x 120 MT Azimuth Stern Driven (ASD) Tug 2 x 80 MT ASD Tugs	3	
	Vessel's of Opportunity (VOO's)	Various	N/A	Various

** Note: All equipment and vessels specified are reflective of the peak resources needed during concurrent drilling and production operations.*

Table 6: FPSO Sample List of Common Oil Spill Response Equipment*

FPSO	Detailed List	Quantity
Container # 1	25 m sections of RO Boom 1500 Offshore Boom with ASTM Connectors	2
	Ro Skim Weir Skimmer	1
	15 m Outrigger float arm 3 PARTS with connector BOAT	1
	DOP 250 Dual Screw Pump (Interchangeable with Terminator Skimmer)	1
	Hydraulic Hose Set 40 m	1
	Hose reel for 40 m Hose Set with Hydraulic Winch	1
	Hydraulic Winder for RO Boom Swwep System in 20,ISO Container	1
	Towing set for Ro Sweep System	1
	Repair Kit For Ro Boom 1500 and skimmer	1
	1 Box Plugs BOON and 3 Key	1
	Box PAD Absorbent	1
	Gloves	5
	Disposal coveralls	5
	Ropes	2
	Board	1
Container # 2	Ro Boom 1500with ASTM Conectors	200 m
	Towing set for Ro Boom 1500	1
	Winder Hydraulic for 200m Ro Boom 1500	1
	Powerpack 10kW for Hydraulic Winder with Onboard Boom, inflator, Spark Arrestor & Automatic Shutdown valve	1
	Hose set for 10kW Powerpack	1
	Repair kit for Ro Boom 1500	1
	Spares kit for 10kW Powerpack	1
	Box PAD Absorbent	1
	Gloves	5
	Disposal coveralls	5
	Ropes	2
	Board	1
	Terminator Self Adjusting Weir Skimmer Head with Radio Controlled Thrusters	2

FPSO	Detailed List	Quantity
Container # 3	Desmi Helix Brush Skimmer Adaptor for Terminator skimmer	1
	DOP 250Dual Screw Pump (Interchangeable with Ro Sweep system)	1
	Hose set 40m for Terminator with Thrusters	1
	Hose reel For 40m Hose Set for Terminator with Thrusters & Brush Skimmer Adaptor	1
	Spares kit for Terminator	1
	For use with Ro Sweep Hydraulic Winder, onboard Boom, Inflator for Ro Sweep, Operation of DOP 250 Dual Screw Pump with Ro Sweep & Terminator Skimmer.	1
Container # 4	Spares kit for 50kW Powerpack	1
	Oil Spill Kit Box in Process Area: 5 pack plastic bags 200 L 2 Buckets, 4 pair of hand gloves, 4 packers, 2 disposal coveralls 2 CARTON BOXES OF LUBETECH ROLLS 2 BAGS OF HYDROCARBON ABSORBENT PAD OR ROLL PAD 10 OIL SPILL TAG + 2 rolls BARRIER TAPE	1
Container # 5	AFT Oil Spill Reserve Equipment: 3 Plastic Drums; 2 Boxes (Empty); 1 Box with 8 Chemical Absorbant Pads and Industrial Spillage Absorbent.	1

7.1 Tier I Resources

7.1.1 Mobilization

The EEPGL on site ERT is responsible for mobilizing Tier I resources.

The Tier I equipment held at EEPGL's onshore and offshore operations, including shorebases, fueling terminal, support vessels, drill ship, tankers and FPSO will be available for rapid deployment in the event of an incident. See site specific ER plans for onshore facilities and individual vessel SOPEPs.

7.2 Tier II Resources

Equipment and trained personnel are available through the terminals and shorebases to initiate an onshore/nearshore response to a Tier II incident.

Vessel dispersant spray operations will be initiated from the PSVs and supported from the shorebases or other accessible locations as needed to supplement other Tier II response actions.

Given the type and quantity of hydrocarbons identified in the EEPGL risk assessment, the distance of the Liza Phase 1 FPSO and drill ships from the coastline, and that oil spill modeling completed for the loss of both a well control, riser or tanker offloading scenario indicated that oil is unlikely to impact a shoreline in less than approximately 5-10 days; it is estimated that regional and international resources can be cascaded into a response in sufficient time to be effective. Therefore, in the event country/Region resources are insufficient, EEPGL would immediately activate additional resources such as ExxonMobil's RRT and OSRL (see Tier III Arrangements Section 5) early in an incident response operation.

In addition, EEPGL could call upon their in-country contracted companies to provide specific technical or logistical assistance (e.g., aircraft, road transportation, and waste management), as well as Vessels of Opportunity located in Guyana and Trinidad, as needed.

7.3 Tier III Resources

7.3.1 ExxonMobil's Regional Response Teams

The ExxonMobil RRT is comprised of two geographically-based units:

- Europe-Africa-Middle East / Asia-Pacific RRT;
- North America RRT.

The first point of contact for EEPGL is the Emergency Preparedness and Response Coordinator for North America RRT, who can initiate activation following instructions from the Venture Manager. Although organized geographically, resources from all RRT units can be mobilized.

The RRT is organized in accordance with the Incident Command System (Figure 18). The organization is led and the incident managed by the Incident Commander and the Command Section, supported by Operations, Planning, Logistics and Finance Sections. The support

sections are further sub-divided into branches and units depending on the scale and type of incident.

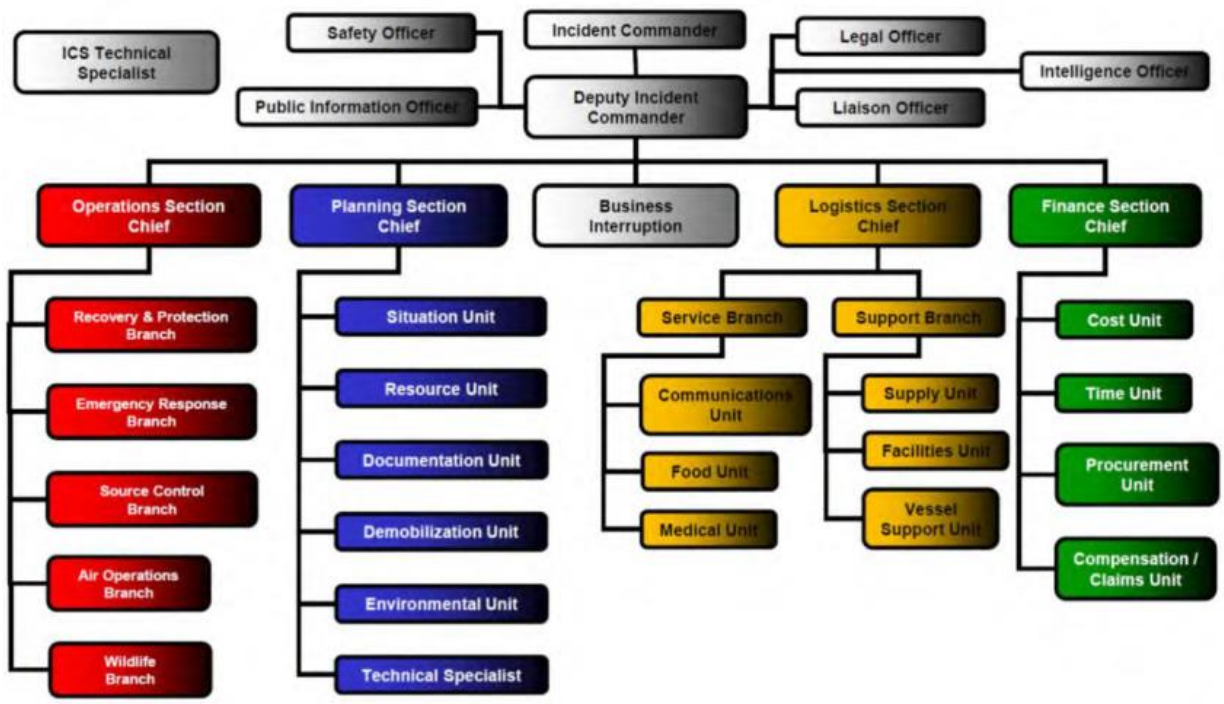


Figure 18: Sample Incident Command System Organization

The RRT includes trained individuals and specialists, with assigned roles and responsibilities, who can be deployed at short notice to address a broad range of emergency situations.

The RRT can be partially or fully activated. Partial activation may be implemented when functional support is required by ERTs at incident sites. Should this occur, RRT members will typically be deployed within the existing on-site ERT structure. For larger incidents, that require an extensive amount of tactical work, an intermediate group called the IMT may be established to provide tactical management support for the ERT. Functional support can be called upon independent of RRT activation, if required

For large emergencies and incidents in remote locations, full activation may be implemented. In Guyana, partial or full activation of the RRT is likely for all Tier II and Tier III incidents, to help manage a major tactical response. In the event that the RRT is activated, an RRT Command Center will be established by the North American RRT.

7.3.2 Oil Spill Response Limited (OSRL)

EEPGL is a Participant member with OSRL, and therefore has immediate access to Tier III technical advice, resources and expertise 365 days a year on a 24 hour basis.

Table 7 summarizes the OSRL service level agreement (SLA) available to EEPGL.

Table 7: OSRL Service Level Agreement (SLA) Summary

Service	Service Standard		EEPGL Membership Type: Participant	
Response notification, mobilization, service and advice	Notification of a spill should be placed to one of the following locations:			
	OSRL BASE	Fort Lauderdale, USA		
	TELEPHONE	+1 954 983 9880		
	FAX	+1 954 987 3001		
	EMAIL	dutymanagers@oilspillresponse.com		
	FORMS	Refer to Appendix C.2: OSRL Notification Form		
	The Duty Manager will speak and advise EEPGL immediately, or call EEPGL back within 10 minutes.			
Nominated Contact	OSRL must receive an official mobilization authorization from one of EEPGL's Nominated Call-Out Authorities (anyone can notify OSRL).		EEPGL's Nominated Authority: Greg DeMarco Arthur Powers	
Spill response equipment	SLA response equipment is housed in secure facilities in Southampton, Fort Lauderdale, Bahrain and Singapore. Response equipment is customs cleared response ready. Refer to: OSRL Yearbook for a complete list of equipment available, www.oilspillresponse.com and refer to the equipment stockpile status report http://www.oilspillresponse.com/activate-us/equipment-stockpile-status-report			
	As per the SLA, EEPGL can mobilize up to 50% of the global stockpile. If there is more than one spill EEPGL can mobilize 50% of what remains.			
Dispersant stockpile	If there was an incident, the spiller is entitled to 50% of the ~680m^3 of dispersant located in Southampton, Singapore, Fort Lauderdale and Bahrain. OSRL may be able to obtain further dispersant through the Global Response Network (GRN) and other organizations, if required.			
World-wide transportation of equipment	Aircraft Type	Location	Dispersant Capacity	Range
	C-130 Hercules	Singapore, Seletar	13,000 liters	2000 nm in 8 hours
	Boeing 727	UK, Doncaster	17,500 liters	2,400 nm in 6 hours
	• Aerial dispersant coverage is provided within a six hour notice period. • 24 hour access to global network of cargo and passenger charter services through a dedicated broker.			
Oil spill trajectory and tracking	Trajectory and stochastic services for surface or subsurface oil spills on request, and backtrack services for surface oil spills using commercial modeling software:			
	OILMAP		Oil Spill Contingency and Response Model (OSCAR)	
	Satellite imagery services can be provided on request.			
Response Personnel	OSRL will provide the following response personnel on a first come, first served basis: • 1 x Senior oil spill response manager • 1 x Oil spill response manager • 15 x Spill response specialists / responders • 1 x Logistics Service branch coordinators			
	A Technical Advisor can be dispatched to offer support to EEPGL when they have an oil spill incident or the potential for an incident to occur. This is provided free of charge for the initial assessment period of up to 48 hours. If a full response team is then mobilized, the technical advisor will form part of the available team headcount.			

7.3.3 Global Dispersant Stockpile (GDS)

The GDS is an additional 5,000 m³ of dispersant located across the OSRL bases and in France (Table 8). The dispersant types are those with the largest worldwide approval. Copies of the Safety Data Sheets (SDS's) for all three of these products have been furnished as part of Appendix C.2.

Table 8: OSRL GDS Quantities and Locations

Dispersant	Quantity	Storage Location
Slickgone NS	350 m^3	Singapore
	500 m^3	Southampton, UK
	800 m^3	Saldanha, South Africa
Finasol OSR52	350 m^3	Singapore
	500 m^3	Southampton, UK
	1,500 m^3	Vatry, France
Corexit 9500	500 m^3	Rio de Janeiro, Brazil
	500 m^3	Fort Lauderdale, USA

OSRL and EEPGL mobilization responsibilities depend on the location of the stockpile (Figure 19). For all GDS dispersant located in Southampton, Singapore and Fort Lauderdale, normal SLA logistics and mobilization agreements apply. OSRL will mobilize the GDS alongside all other Tier III equipment.

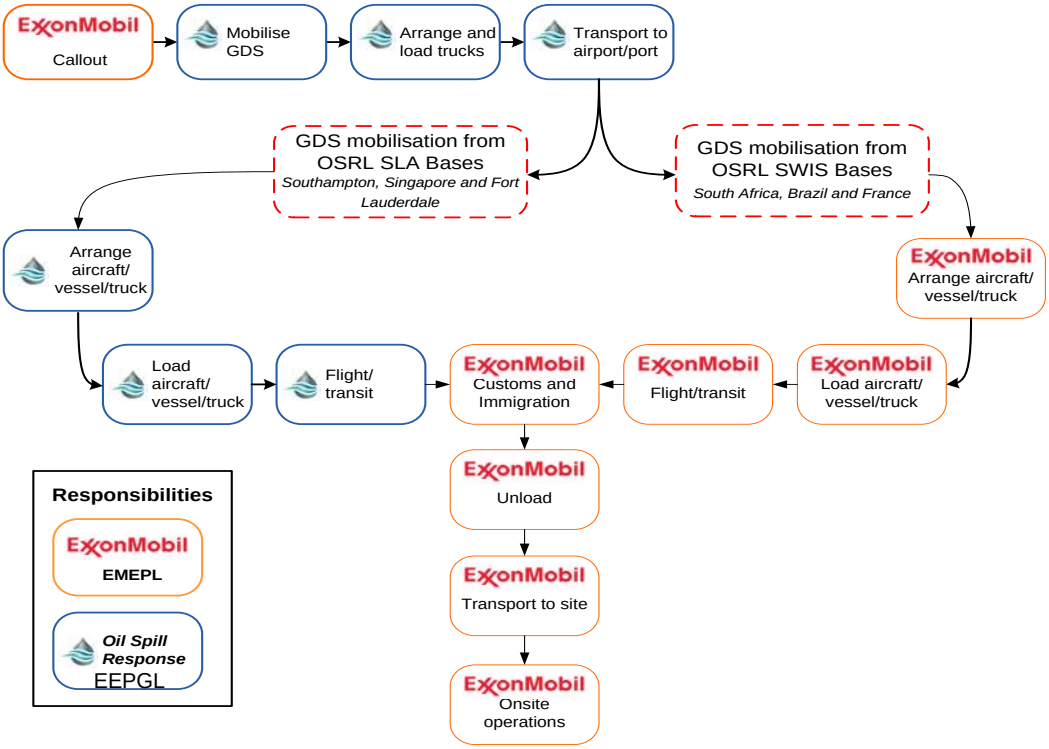


Figure 19: GDS Mobilization Responsibilities

EEPGL would mobilize the GDS through the OSRL Duty Manager. Unlike the SLA, EEPGL can mobilize 100% of the GDS for a single incident; 5,000 m^3 has been estimated to support both a subsea and/or surface response for 30 days, which is consistent with data collected from the 2010 Macondo incident.

Arrival of Tier III equipment and the SLA dispersant is expected in Cheddi Jagan International Airport within 3 days. The re-supply to EEPGL response operations will be arranged between EEPGL and the dispersant's manufacturer.

EEPGL will be responsible for designating the preferred port, arranging the airplane/vessel (in the case of a subsea well response), accepting the dispersant at the port, coordinating customs clearance, in country logistics plus confirming the use of dispersant with local environmental body. The OSRL Duty Manager will advise the operator of the logistical requirements of the GDS.

7.3.4 Subsea Well Response

EEPGL has access to the OSRL Subsea Well Intervention Service (SWIS), Oceaneering, Wild Well Control, Trendsetter Engineering and Halliburton Boots & Coots Services.

The OSRL SWIS provides EEPGL with access to a Subsea Incident Response Toolkit (SIRT) and multiple subsea well Capping Stack Systems (CSS), as required. The CSS and SIRT include equipment that can be mobilized directly to the well site:

- Survey and debris clearance equipment;
- Intervention equipment;
- Dispersant hardware application system*;
- Capping stack systems and auxiliary equipment.

*Dispersant must be mobilized simultaneously through the OSRL GDS service via the EEPGL IMT (Section 7.3.3).

SWIS holds and maintains four CSSs and two SIRTS globally:

- 15k PSI Subsea Well Capping Stack – Norway and Brazil;
- 10k PSI Subsea Well Capping Stack – South Africa and Singapore;
- Subsea Incident Response Toolkit – Norway and Brazil.

In the event of activation the capping stack providing the fastest response time would be mobilized to the operational area. Further details are outlined in the Drilling specific ERP.

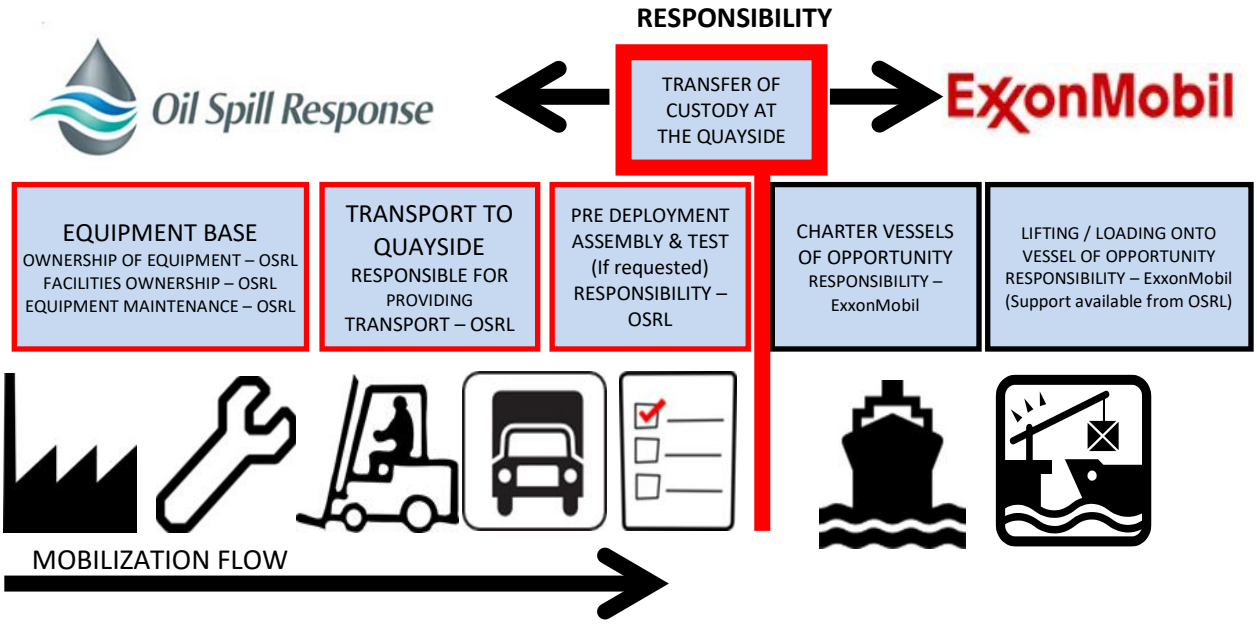


Figure 20: CSS Mobilization Responsibilities for OSRL and ExxonMobil

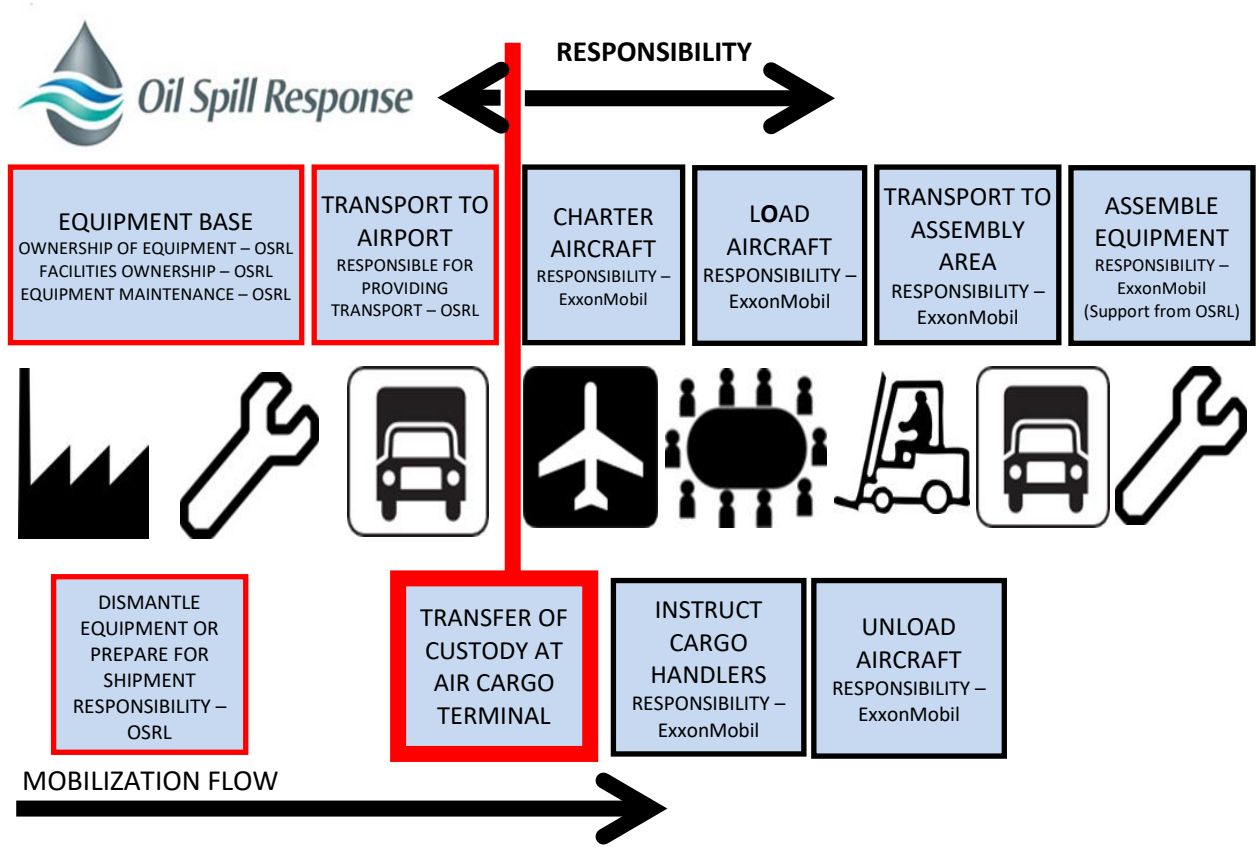


Figure 21: SIRT Mobilization Responsibilities for OSRL and ExxonMobil

In order to mobilize this equipment the following flow chart (Figure 22) should be considered.

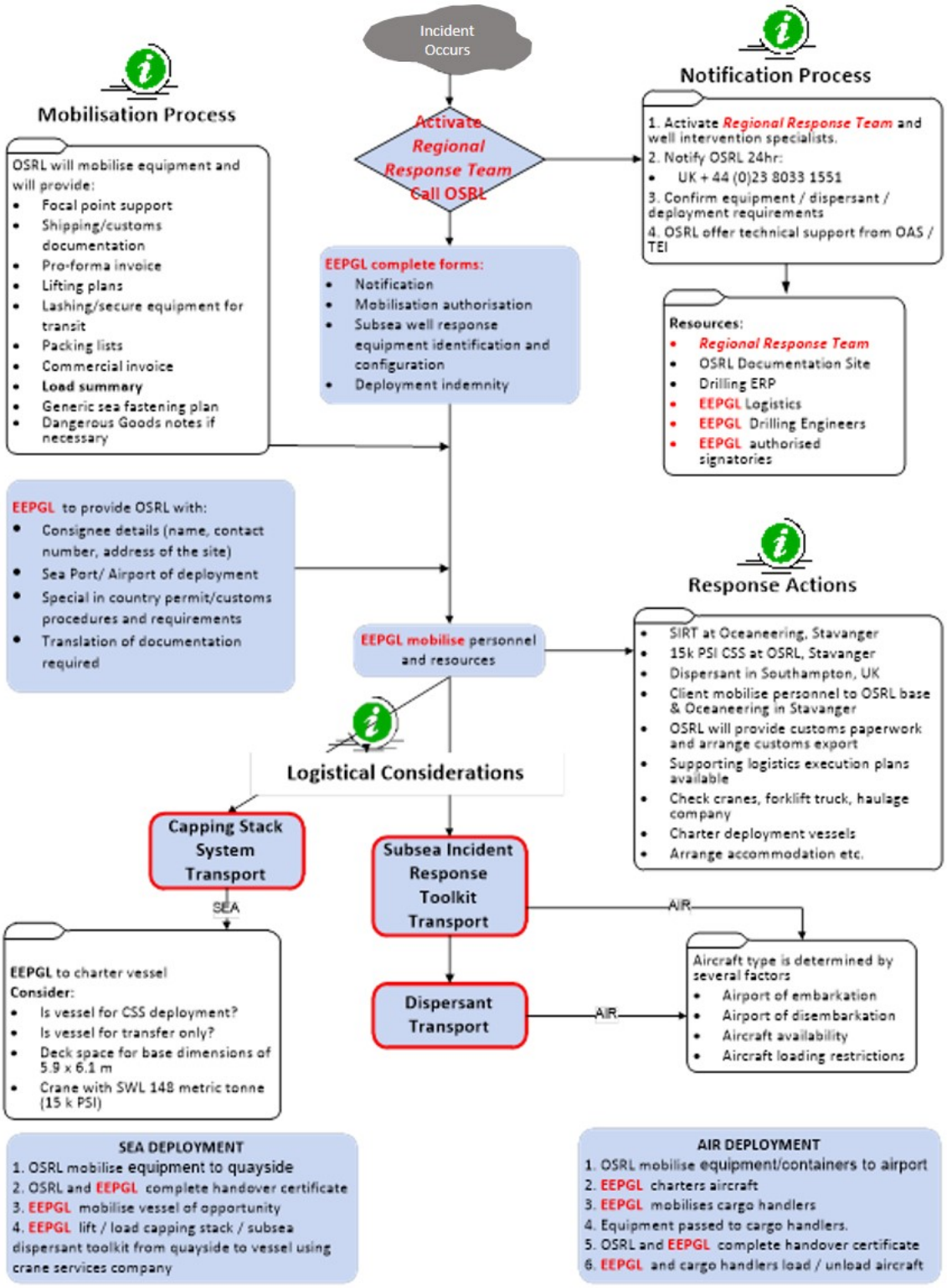


Figure 22: SWIS Mobilization

8 EXERCISES AND TRAINING

EEPGL conducts oil spill training courses and exercises (desktop and in-field) for operations offshore Guyana. The training, drills, and exercises familiarize response personnel with their duties and responsibilities in an oil spill.

8.1 Oil Spill Training

Training requirements depend on an individual's role and experience. There is some overlap between the IMT and the ERT training. This is beneficial since, for example, this provides the IMT with a clear appreciation of the factors likely to affect the performance of a particular technique or piece of equipment and at the same time gives the ERT a better understanding of the overall strategy.

EEPGL ERT and IMT members, which includes the Regional Response Team, will receive oil spill response training listed in Table 9 (or equivalent training such as XOM ICS 100/200 CBT and University of Spill Management) based on their response position.

Table 9: OSR Training Course Information

IMO Course Level	Oil Spill Incident Response Personnel	Course Outline
Level 1	ERT members	Provides training on practical aspects of oil properties, response techniques, health and safety, boom and skimmer deployment, dispersant application, use of sorbents, shoreline cleanup, debris/waste handling and disposal and wildlife casualties.
Level 2	On-Scene Commanders and ERT Leaders	Provides detailed training in oil spill behavior, fate and effects, spill assessment, operations planning, containment, protection and recovery, dispersant use, shoreline cleanup, site safety, storage and disposal of waste, media relations, record keeping, command and control management, communications and information, liability and compensation, response termination and post incident review/briefing.
Level 3	IMT members	Provides an overview of the roles and responsibilities of Senior Personnel in the management of oil spill incidents, cause and effect of oil spills, response policy and strategies, contingency planning, crisis management, public affairs and media relations, administration and finance and liability and compensation.

8.2 Incident Command System Training

ERT and IMT members will receive appropriate ICS Training listed in Table 10 based on their roles and responsibilities.

Table 10: ICS Training Course Information

ICS Course Level	Oil Spill Incident Response Personnel	Course Outline
100	Tactical Response Team Members	This course is a web based course aimed at introducing the ICS, basic terminology, common responsibilities, ICS principles and features. A foundation is set that will allow personnel to function appropriately in an ICS. Completing ICS 100 is prerequisite to completing ICS 200.
200		This course is also web based that builds on the foundation information from ICS 100. ICS 200 is required for first level supervisors involved in responding to the incident at the site, Site Response Team. Completing ICS 200 is prerequisite to completing higher level ICS training. Topics covered should include: principles and features, organizational overview, incident facilities, incident resources and common responsibilities.
300	On-Scene Commanders, ERT Leaders and IMT	This course provides description and detail of the ICS organization and operations in supervisory roles on expanding incidents. Topics covered should include: organization and staffing, resource management, Unified Command, transfer of Command, event and incident planning, air operations and establishing incident objectives.
400		This course is designed for more Senior personnel who are expected to perform in a management capacity in the Incident Command Team or IMT. Topics covered should include: General and Command staff, major incident management, multi-agency coordination and ICS for Executives.

8.3 Oil Spill Exercises

Oil spill response exercises test incident response personnel function and responsibilities. They improve oil spill incident response teams skills and awareness, and provide management with an opportunity to assess equipment, measure performance, obtain feedback from participants, update and correct the contingency plans, and give a clear message about the company's commitment to oil spill prevention and response.

An exercise schedule is determined based upon local needs annually by the EEPGL OIMS/SSH&E Manager, which is approved by the EEPGL Country Manger. A suggested guideline including schedule and type of oil spill exercise is outlined in Table 11.

Table 11: Oil Spill Exercise Overview and Schedule

Exercise Type	Description and Purpose	Frequency
OSRP Orientation	A contingency plan orientation exercise is a workshop which focuses on familiarizing the ERT and IMT with their roles, procedures and responsibilities in an oil spill. The aim is to review each section of the plan, encourage discussion, and by using local knowledge and expertise, make useful and practical improvements to the plan where required.	As required or directed
Notification and Callout Exercise	A notification exercise practices the procedures to alert and call out the ERT and IMT. They are normally conducted over the telephone or radio, depending on the source of initial oil spill report. They test communications systems, the availability of personnel, travel options and the ability to transmit information quickly and accurately. This type of exercise will typically last 1-2 hours and can be held at any time of the day or night.	Quarterly
Practical Oil Spill Equipment Deployment Exercise	Simple deployment exercises give personnel a chance to become familiar with equipment, or they may be a part of a detailed emergency response scenario, where maps, messages, real-time weather and other factors are included. The exercise is designed to test or evaluate the capability of equipment, personnel, or functional teams within the oil spill response. In deployment exercises, the level of difficulty can be varied by increasing the pace of the simulation or by increasing the complexity of the decision-making and coordination needs. A deployment exercise would typically last from 4-8 hours.	Semi-annually
IMT Tabletop Exercise	A tabletop exercise uses a simulated oil spill to test teamwork, decision-making and procedures. The exercise needs to be properly planned with a realistic scenario, clearly defined objectives for participants, exercise inputs, and a well briefed team in control of the running and debriefing of the exercise. A tabletop exercise will typically last from 2-8 hours.	Annually
Full-scale Incident Management Exercises	Full-scale exercises provide a realistic simulation by combining all of the elements of the tabletop exercise (maps, communications, etc.) and the deployment of related personnel and equipment. This complexity requires the response to be more coordinated than in basic tabletop or deployment exercises. The effort and expense in organizing a realistic full scale exercise means that it is recommended that they be run only once every two years. It may also be cost effective to run full-scale exercises in partnership with other organizations within the region and the ESG. Full-scale exercises can create a very intense learning environment that tests cooperation, communications, decision making, resource allocation and documentation. People involved in full-scale incident management exercises should have attended earlier tabletop exercises. Organizing a realistic full-scale exercise could take many months, requires an experienced planner and a large support team to run the exercise. The full scale exercise will generally last at least one day and often carry on overnight into a second or third day.	Every 3 Years during Production Operations

Exercise Type	Description and Purpose	Frequency
Joint Exercises (e.g., with other Operators or Regulators)	Joint exercises provide a realistic simulation by combining the full scale oil spill response equipment deployment and tabletop incident management to handle a major spill scenario. The spill scenario involves major consequences to a very wide range of resources, threatening national interests and requiring national and regional cooperation and coordination. Joint exercise involves very wide range of personnel from many different organizations, possibly in various locations, together with a range of equipment deployment opportunity. This exercise is designed to build confidence in EEPGL's preparedness to effectively and efficiently deal with oil spills at all scales. This will also enhance the cooperation among the government and industry at national and regional level in responding to major and/or trans-boundary spills. A joint exercise will generally last at least one day and often carry on overnight into a second or third day.	Every 3 Years during Production Operations

Appendix A MODELING RESULTS

A.1 Modeling Overview

Oil spill modeling was performed for five hypothetical oil spill scenarios, ranging from higher probability small volume operational releases at the water surface to the unlikely large volume spill related to production or drilling operations originating either at the sea surface or from a subsea release at the seabed. These ranged as noted in Table 4 from smaller Tier I incidents of a single release of 50 bbls of marine diesel or crude oil (# 2) to a loss of well control event resulting in 20,000 bbls of wellbore fluids being released for a maximum duration of 30-days (#9). In these five scenarios the oil spill modeling was applied to determine the most likely trajectory for a spill from each scenario and to quantify the oil's fate as it interacts with the environment.

The oil spill modeling was performed in several steps. The first step was to utilize the historic data and perform stochastic modeling. In this type of modeling the spill location and volume are utilized to determine how the spill would respond under actual historic wind and hydrodynamic (currents) conditions. The modeling tool selects about 100- 200 random start times during the season of interest and utilizes the paired met ocean data to examine the fate and trajectory of each of this model runs. The combined output for a single stochastic analysis is presented in Figure A1.

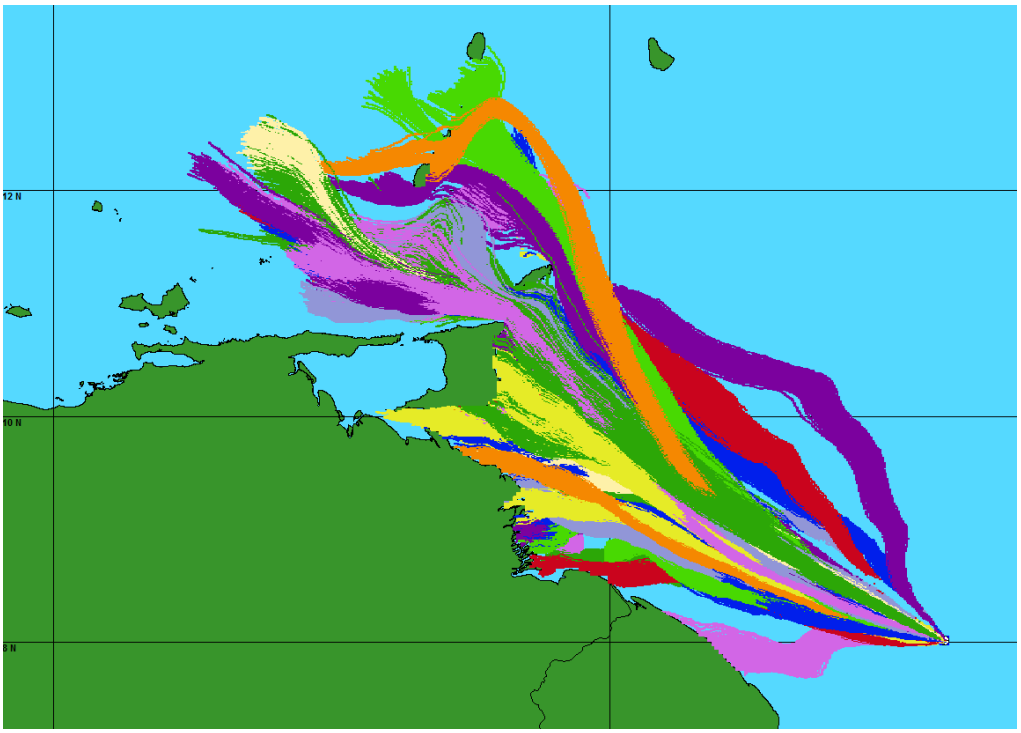


Figure A1: Example Model Iterations that are Utilized to Produce Stochastic Outputs

The results of this phase of the analysis are then post-processed to determine the following:

- The probability of oil on the water surface
- The probability of oil on the shoreline
- The timing of oil to destination

These three key factors are the primary inputs required for oil spill response. They provide an understanding of the probability that oil will be in a particular location from a release. The information also provides a sense for time to travel, so if a particular resource has a high probability of impact, the timing of impact is available so that a response can be mounted to that spill at the water surface or to provide timing for protection prior to the oil's arrival.

The individual data from the stochastic analysis in then reviewed once again to select a particular single, or deterministic, model run for further analysis. That model run can be selected based upon a variety of properties:

- Shortest time to shoreline impact
- Largest swath over the water surface
- Greatest shoreline impact

In the EEPGL analyses, the greatest shoreline impact was selected as the parameter of interest for additional examination when shorelines were at risk from the release. This trajectory and fate was utilized for further examination in the second phase of the analysis. The trajectory and fate results were used to predict and determine spill pathways and quantify potential ecological and socioeconomic impacts from such events for both the summer season (June through November), as well as the more conservative winter season (December through May) when current speeds and northerly winds are stronger.

Initial modeling results were run to show the ***unmitigated*** impacts not taking into account the immediate actions and sustained response and mitigation measures that would be employed in the event of a spill or release. This is done to examine the probability of the shoreline stranding and predict the timing of that stranding. A summary list of the spill prevention, mitigation measures and embedded controls found in the Environmental Impact Assessment (EIA) and supporting plans can be found in Appendix F.

A Net Environmental Benefit Analysis for the Guyana Tier II and Tier III oil spill scenarios utilized new model runs based on the implementation of those response strategies and mitigation measures set forth in this OSRP. New deterministic modeling results were prepared and have been provided in Appendix G along with a comparison of spill parameters. The comparison tables provide a quick mechanism to understand the environmental benefits of the mitigation that was undertaken.

Fate and Trajectory

Fate (weathering) and trajectory (movement) models were used to simulate oil transport and predict the changes the oil undergoes as it interacts with water, air, and land (oil fate). The models were used to simulate spill events using the best available characterization of the wind and hydrodynamic (marine currents) forces that drive oil transport.

The models quantify the potential consequences from a spill, which can then be used to guide response planning and prioritize response asset deployment. There are typically two modes under which the models can be used: 1) the **stochastic** (statistical) mode that examines *many releases* from the same point utilizing the full range of historical data for wind and currents; and, 2) the **deterministic** mode that examines a *single release* utilizing specific historic wind and hydrodynamic datum from the range of potential data, or utilizing forecast data for an ongoing or future event. The corresponding coastal sensitivity maps that were used to identify and characterize the resources/receptors with the potential to be impacted by a spill based on the modeling results have been provided in Appendix D.

Metocean Conditions

Currents in the upper water column off the Guyana coast are strong and flow towards the northwest along the coast of South America over the entire year. The Guiana Current is part of the regional flow between South America, Africa and the Caribbean Sea, extending from Guyana to the Caribbean.

A.1.1 Oil Spill Model Scenarios

A series of stochastic and deterministic model simulations were run to determine the fate of the oil released for three different products for five different scenarios at the offshore location during two different seasons. Table A1 lists the scenarios that were modeled.

Blowout scenarios consist of 30 days of oil and gas discharge at the wellhead. The blowouts were simulated using the OILMAP DEEP blowout model to determine the discharge plume geometry, define the oil droplet sizes and provide inputs for the SIMAP model simulations. All SIMAP model simulations were run for the 30-day discharge period plus an additional 21 days after oil discharge ceased. An additional model scenario was run at the Ranger area of interest using a small discharge opening in order to investigate the effect it has on the fate of the oil. The smaller opening will result in formation of smaller oil droplets in the blowout plume which will keep a greater fraction of the spilled volume in the water column. No spill response activities were simulated.

Table A1: Oil Spill Scenarios Defined for the Oil Spill Modeling

# Scenario	Release Volume	Released Product	Season
2a	50 bbl	Marine Diesel	Summer
2b	50 bbl	Marine Diesel	Winter
4a	250 bbl	Marine Diesel	Summer
4b	250 bbl	Marine Diesel	Winter
2c	50 bbl	Crude Oil	Summer
2d	50 bbl	Crude Oil	Winter
8a	2,500 bbl	Crude Oil	Summer
8b	2,500 bbl	Crude Oil	Winter
9a	20,000 bbls	Wellbore Fluids	Summer
9b	20,000 bbls	Wellbore Fluids	Winter

A.1.2 Exposure Thresholds

Minimum oil thickness thresholds are used in the SIMAP model in the determination of the probability of oil contamination. The thresholds are specific to the type of impact being considered, either ecological or socio-economic, and they are used in the calculation of oiling probability to determine if oil is present in a quantity sufficient to cause a particular impact.

Floating oil thickness is of interest because it can determine if mechanical recovery is possible and because different surface slick thicknesses will have different effects on waterfowl and other animals at the sea surface. Surface oil is often expressed in units of g/m^2, where 1 g/m^2 corresponds to an oil layer that is approximately 1 micron (µm) thick. Table A2 lists approximate thickness and mass per unit area ranges for surface oil of varying appearance. Dull brown sheens are about 1 µm thick. Rainbow sheen is about 0.2-0.8 g/m^2 (0.2-0.8 µm thick) and silver sheens are 0.05-0.2 g/m^2 (0.05-0.2 µm thick; NRC, 1985).

Crude and heavy fuel oil that is greater than 1 mm thick appears as black oil. Light fuels and diesel that are greater than 1 mm thick are not black in appearance, but appear brown or reddish. Floating oil will not always have these appearances, however, as weathered oil would be in the form of scattered floating tar balls and tar mats where currents converge.

A typical approach to using oil spill models in OSRP is to first apply the stochastic model to determine the probability and timing for the spill scenarios of interest. The stochastic approach captures variability in the trajectories by simulating hundreds of individual spills and generating a map that is a *composite* of all of the trajectories and provides a *probability footprint* showing the most likely path for a given spill scenario. Spill scenarios are typically modeled in stochastic mode to provide composite footprints to estimate probability and timing for each season or wind regimes in the region.

Table A2: Oil Thickness (µm) and Equivalent Mass (g/m^2) and Appearance on Water (NRC, 1985)

Minimum	Maximum	Appearance
0.05	0.2	Colorless and silver sheen
0.2	0.8	Rainbow sheen
1	4	Dull brown sheen
10	100	Dark brown sheen
1,000	10,000	Black oil

The SIMAP model uses specific oil thickness thresholds for calculating the probability or likelihood of the presence of oil on the sea surface or shoreline. Oil thickness thresholds defining the minimum value for expected potential effects to the sea surface and shoreline are listed in Table A3. Socio-economic thresholds were used in all modeling for this project (0.01 µm for surface oiling and 1.0 µm for shoreline oiling). All calculations of the probability of oil shoreline and sea surface contamination are based on these oil thickness thresholds.

Table A3: Oil Thickness Thresholds for Sea Surface and Shoreline Oiling

Threshold Type	Threshold (Mass/Unit Area)	Threshold (Thickness)	Rationale (Socio-economic, Ecological)	Appearance
Oil on Water Surface	0.01 g/m^2	0.01 µm, 0.00001 mm	Socio-economic: A conservative threshold used to determine effects on socio-economic resources (e.g., fishing may be prohibited when sheens are visible on the sea surface).	Fresh oil at this thickness corresponds to a slick being barely visible as a colorless or silvery/grey sheen.
Oil on Shoreline	1.0 g/m^2	1.0 µm, 0.001 mm	Socio-economic This is the threshold for potential effects on socio-economic resource uses, as this amount of oil may conservatively trigger the need for shoreline cleanup on amenity beaches, and impact shoreline recreation and tourism.	May appear as a coat, patches or scattered tar balls.

A.2 Model Input Data

A.2.1 Oil Properties

The physical and chemical properties of the oil are used by the OILMAP DEEP and SIMAP models in calculations of the transport and fate of the spill. The oil used in the models is light crude that can incorporate water when spilled, which can increase both the volume and viscosity. Assessment of this type of oil indicated that while it can take on water, it will not emulsify quickly as some crude oils can. This will serve to keep the oil relatively non-viscous for many hours depending on spill and environmental conditions, which improves the window of opportunity for oil spill response. Table A4 lists some of the properties of the oil used in the model simulations.

Table A4: Properties of the Crude Oil Used in the Spill Modeling

Density (g/c @25°C)	Viscosity (cP@25°C)	API Gravity	Pour Point (°C)	Maximum Water Content (%)
0.84579	12.797	35.8	12.78	30

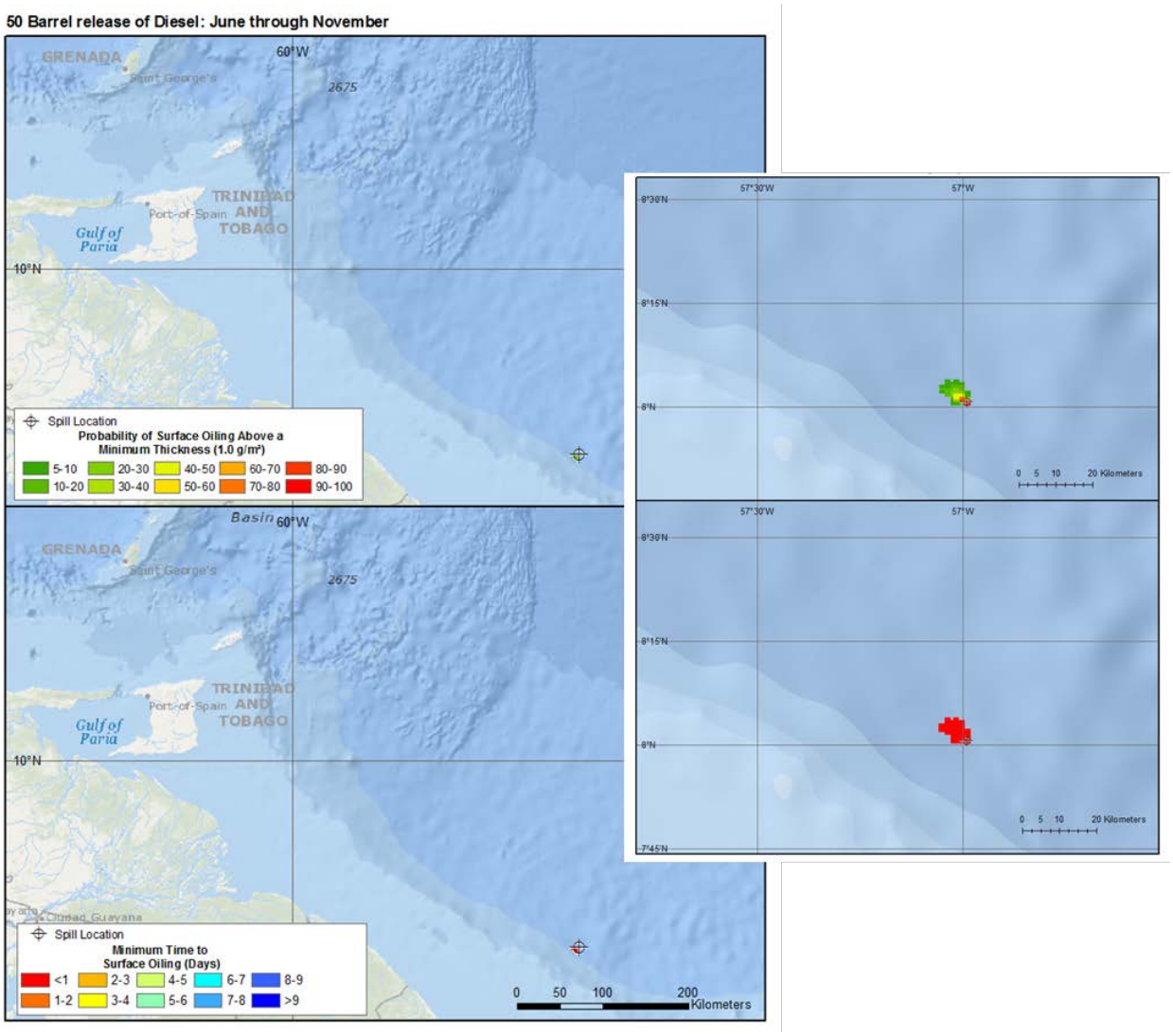
A.3 Stochastic Model Results

The stochastic modeling results predicted that surface oil would generally travel towards the northwest in all scenarios during both the summer and winter seasons. The probability of any shoreline oiling is generally low, with the smaller volume spills very unlikely to reach the shoreline, and when they do the probability is less than 5%. The oil spill model indicates that even in the unlikely event of a larger volume spill, there is only a 5 to 10 percent chance of shoreline oiling in Guyana. In the case of such a loss of well control, it is predicated that it would take 5 to 15 days for oil to reach shore in the absence of any spill response.

Not all of the individual spill events are predicted to result in oil stranding in excess of the 1 µm thickness threshold with the highest risk to the shoreline of Trinidad and Tobago due to the predominant current flow through the Stabroek Block and into the Caribbean. The probability of oil exposure on the sea surface remains greater than 50% from the discharge site to the coast of Trinidad and Tobago and into the Caribbean Sea. It should be kept in mind that the probabilities are calculated using a minimum oil thickness of 0.01 µm which appears on the sea surface as colorless to silver sheen. The sea surface area oiled for individual spill events ranked as the 95th percentile ranges from 835 to 19,400 km^2. None of the marine diesel spills are predicted to reach the shoreline. Two crude oil and the wellbore fluid scenarios are predicted to reach the Guyana shore, oiling between 25 km and 57 km at a thickness of 1 micron.

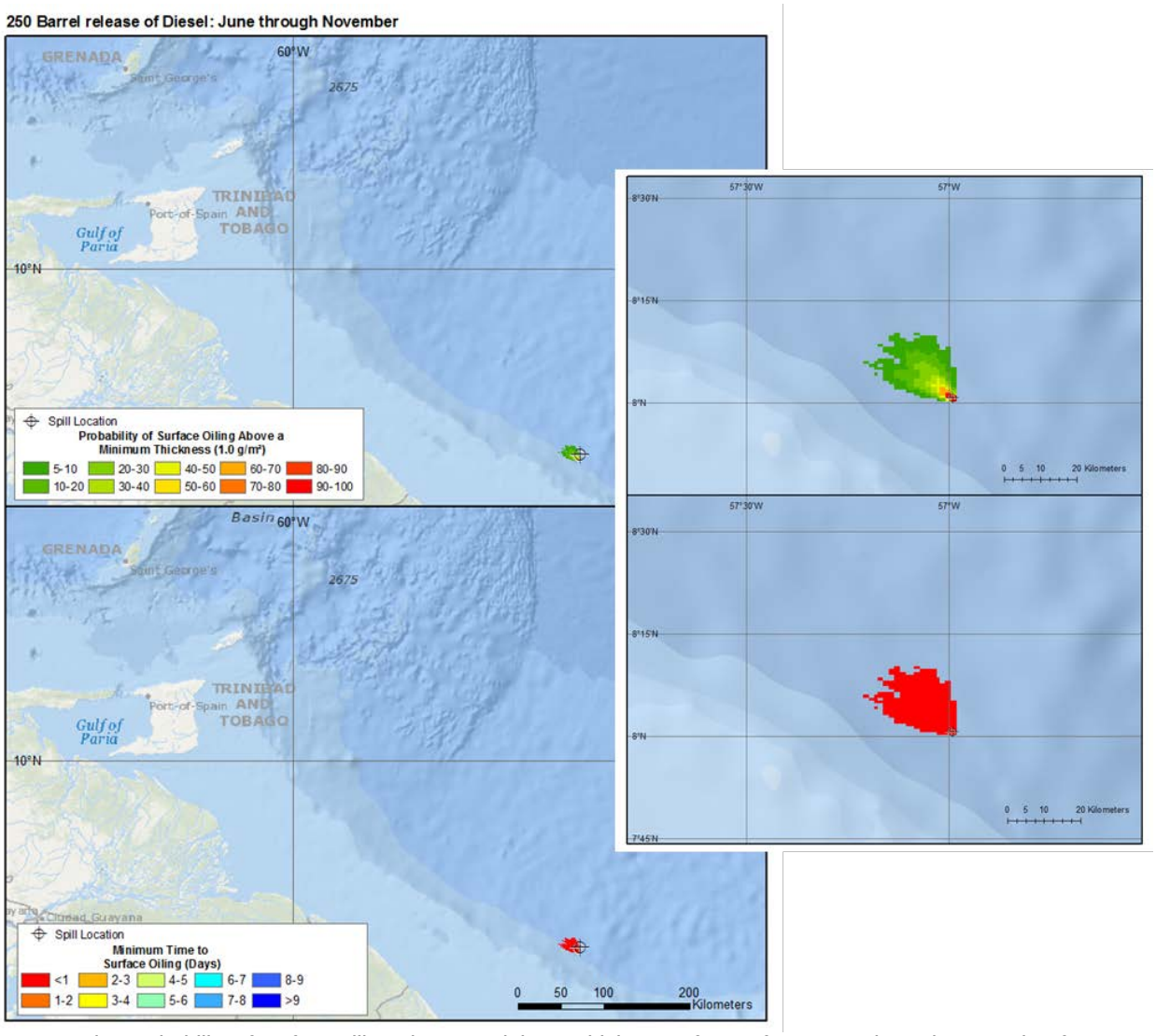
Subsequent modeling runs were performed taking into consideration the implementation of all appropriate response strategies and mitigation measures as noted to prevent oil from reaching shore and effectively reducing the environmental impacts associated with the two largest spill scenarios namely a 2500 bbl release during tanker offloading of crude and the second the loss of well control resulting in a release of 20,000 bbls/day for 21 continuous days until a capping stack can be put in place to cease the release from the well.

A.3.1 Marine Diesel Summer (June through November) – Unmitigated



Top Panel – Probability of surface oiling above a minimum thickness of 1 µm from June through November for a 50 barrel release of Marine Diesel. Bottom Panel – Minimum time for surface oil thickness to exceed 1 µm.

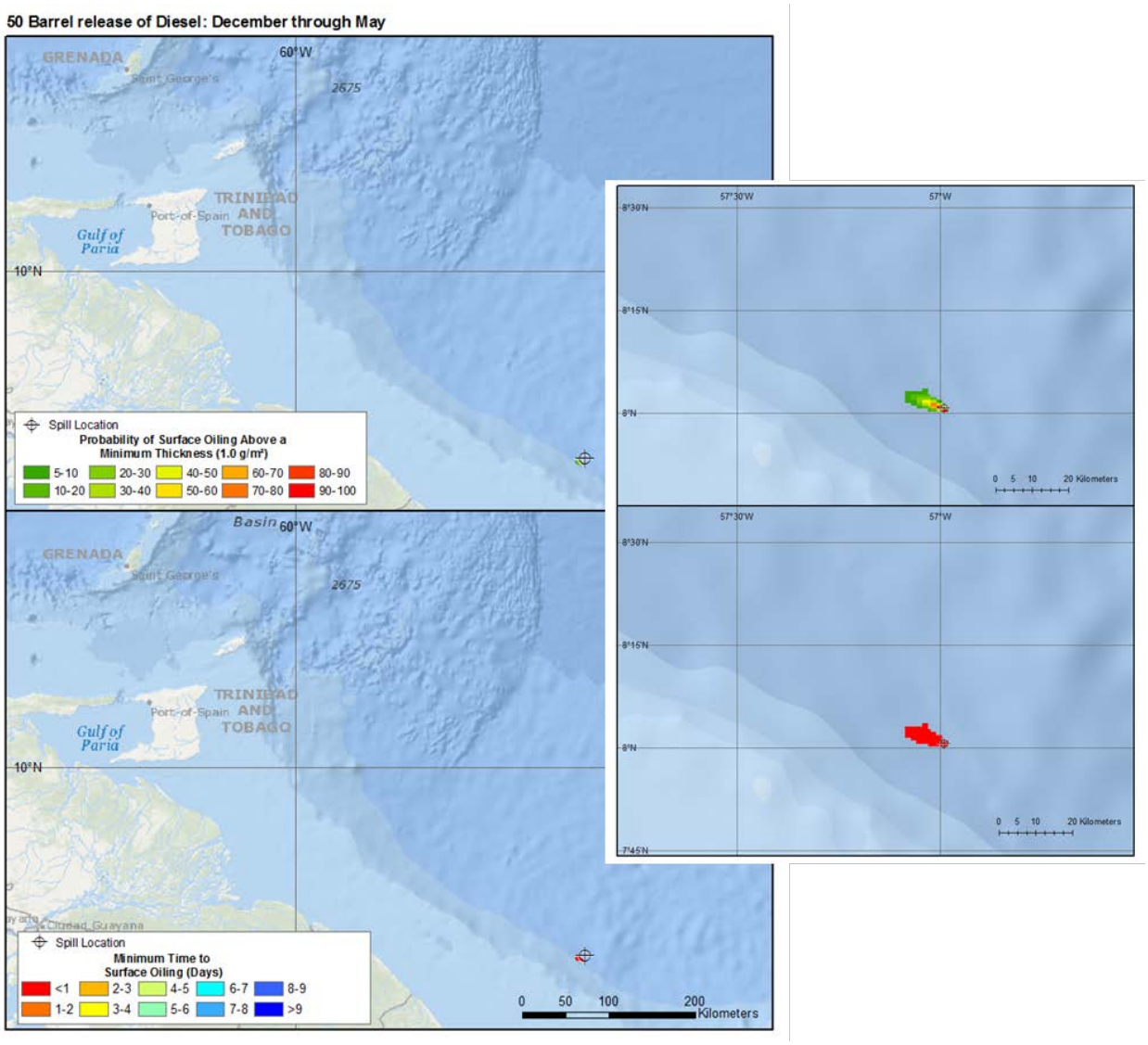
Figure A2: Water Surface Results – 50 Barrel Scenario – Unmitigated



Top Panel – Probability of surface oiling above a minimum thickness of 1 µm from June through November for a 250 barrel release of Marine Diesel. Bottom Panel – Minimum time for surface oil thickness to exceed 1 µm.

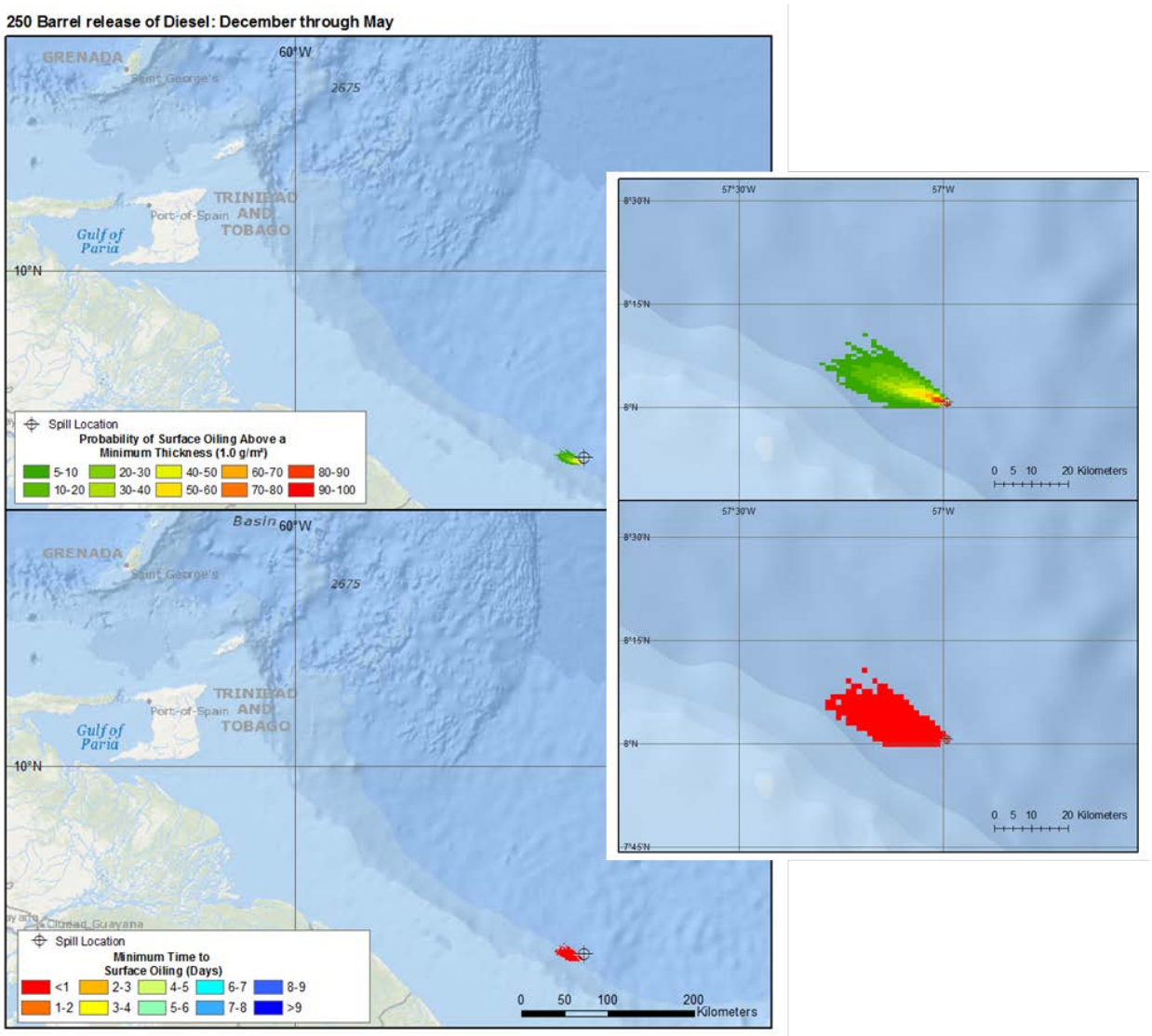
Figure A3: Water Surface Results – 250 Barrel Scenario – Unmitigated

A.3.2 Marine Diesel Winter (December through May) – Unmitigated



Top Panel – Probability of surface oiling above a minimum thickness of 1 µm from December through May for a 50 barrel release of Marine Diesel. Bottom Panel – Minimum time for surface oil thickness to exceed 1 µm.

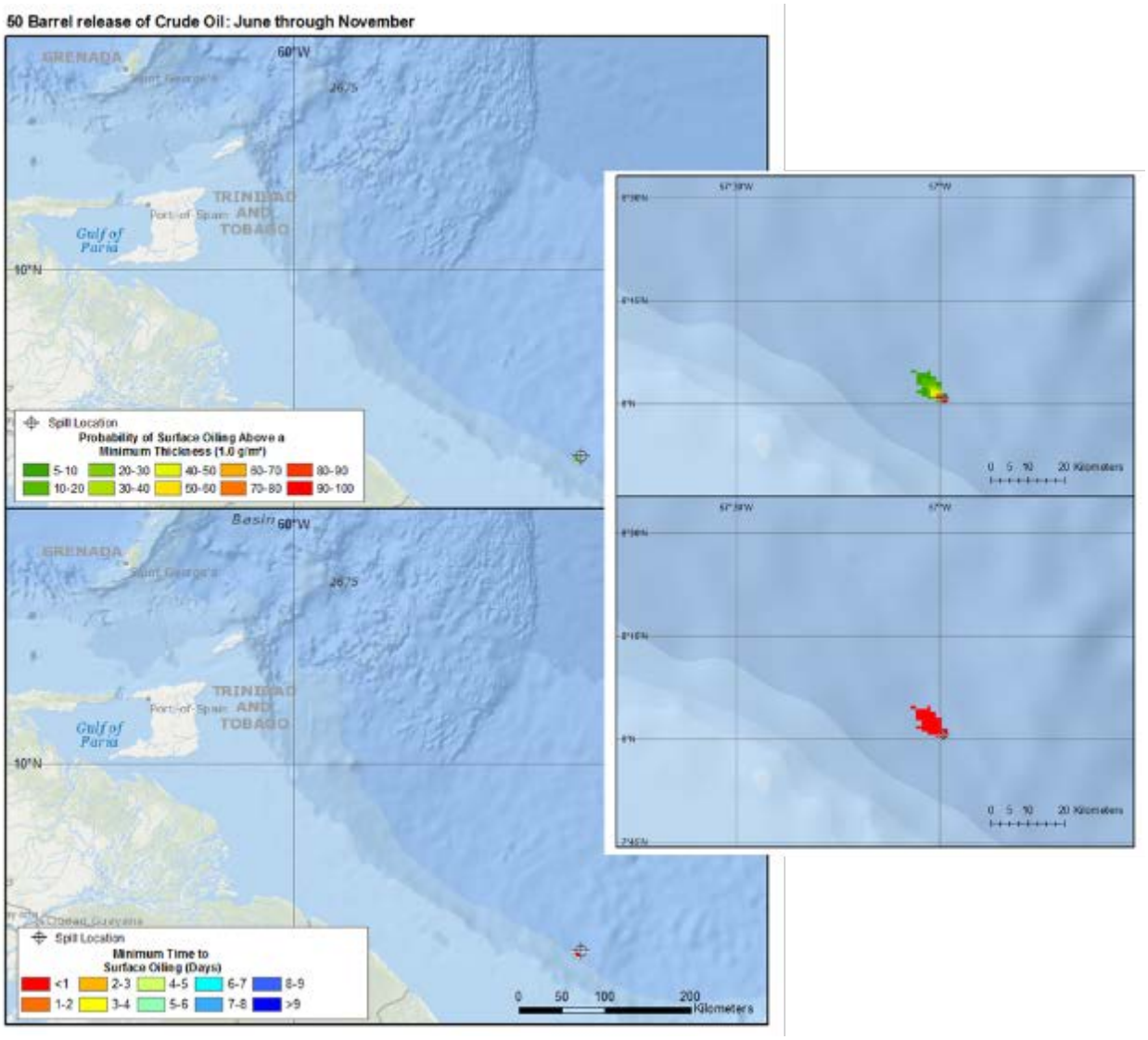
Figure A4: Water Surface Results – 50 Barrel Scenario – Unmitigated



Top Panel – Probability of surface oiling above a minimum thickness of 1 µm from December through May for a 250 barrel release of Marine Diesel. Bottom Panel – Minimum time for surface oil thickness to exceed 1 µm.

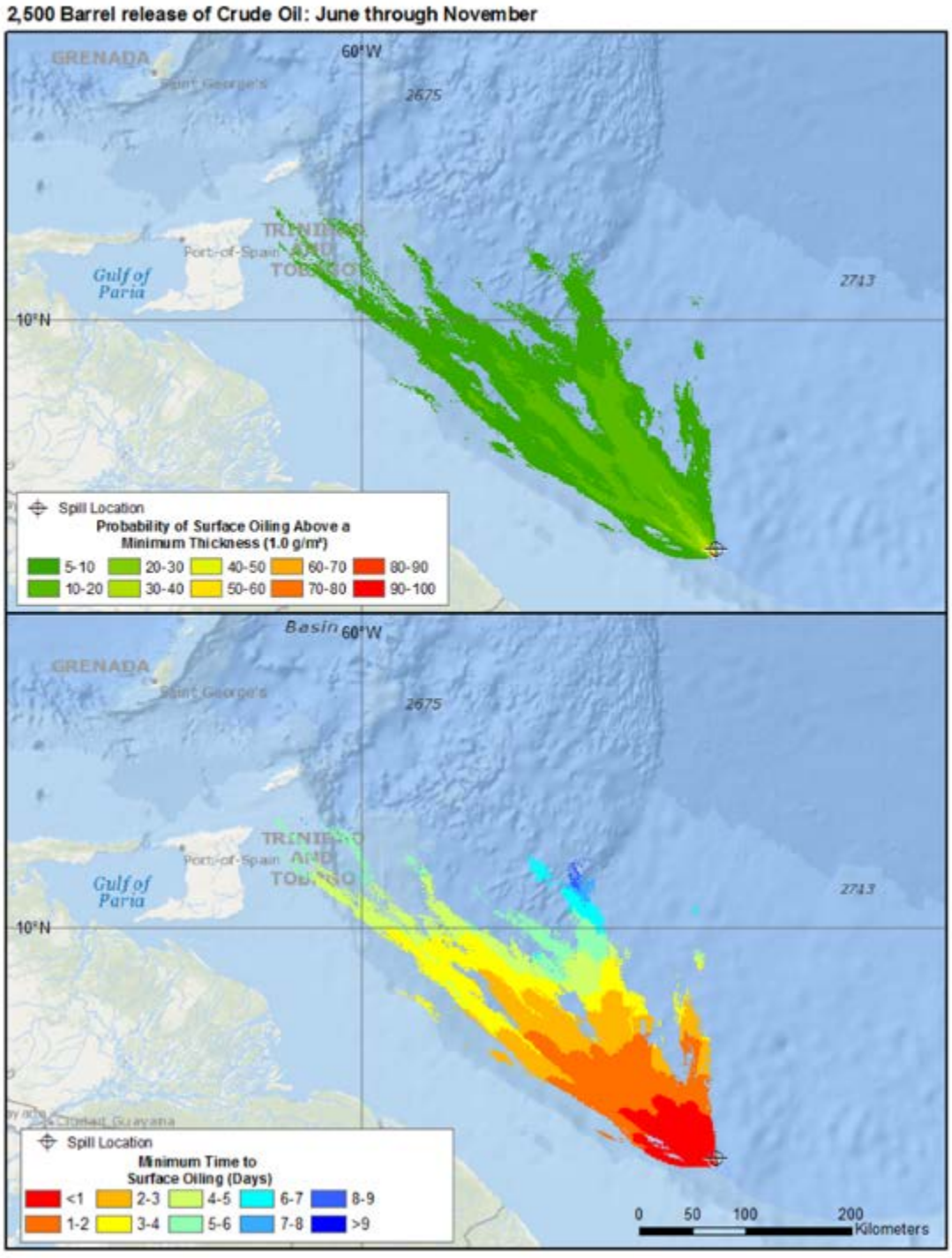
Figure A5: Water Surface Results – 250 Barrel Scenario – Unmitigated

A.3.3 Crude Oil Summer (June through November) – Unmitigated



Top Panel – Probability of surface oiling above a minimum thickness of 1 µm from June through November for a 50 barrel release of Crude oil. Bottom Panel – Minimum time for surface oil thickness to exceed 1 µm.

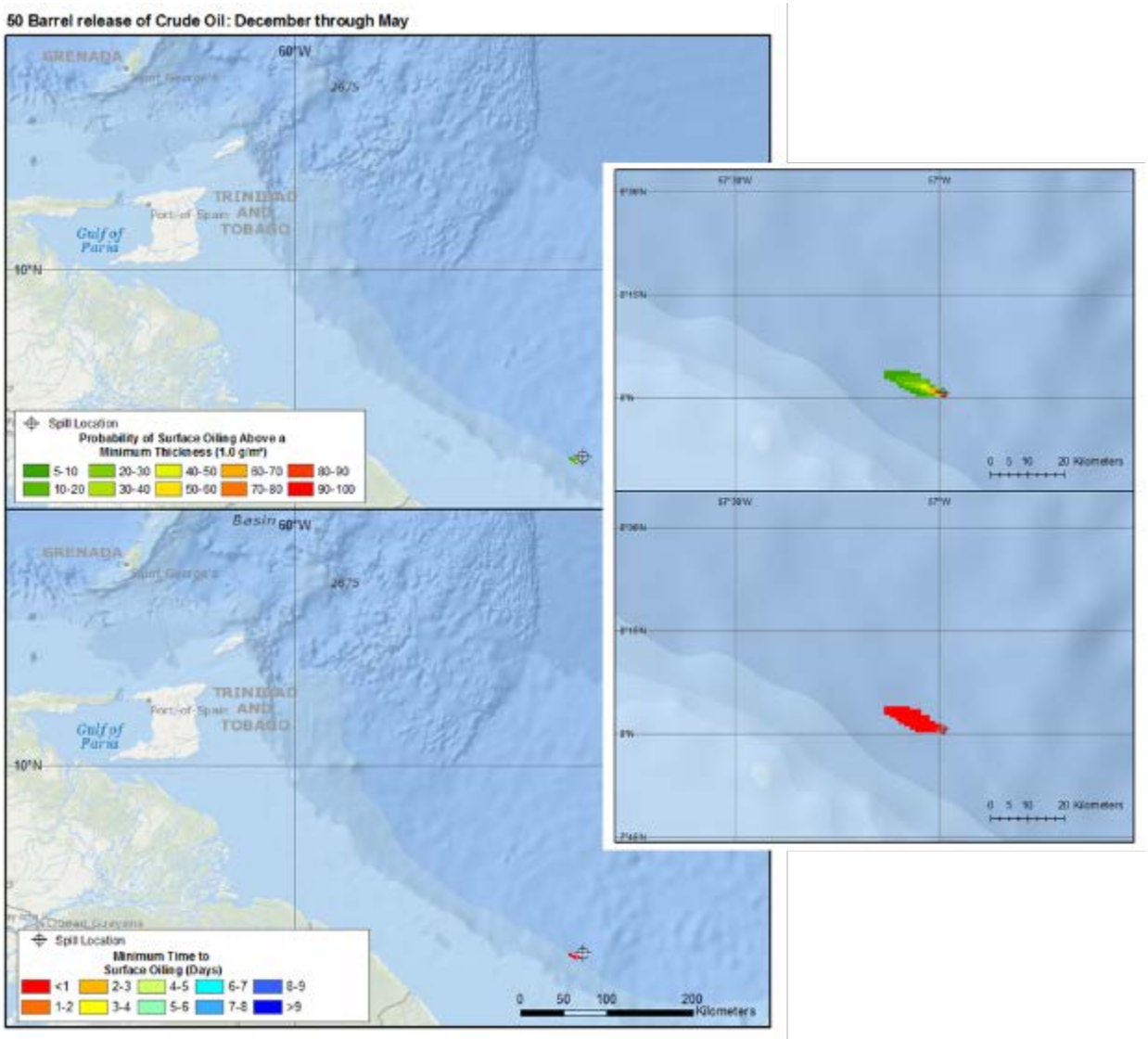
Figure A6: Water Surface Results – 50 Barrel Scenario – Unmitigated



Top Panel – Probability of surface oiling above a minimum thickness of 1 µm from June through November for a 2,500 barrel release of Crude oil. Bottom Panel – Minimum time for surface oil thickness to exceed 1 µm.

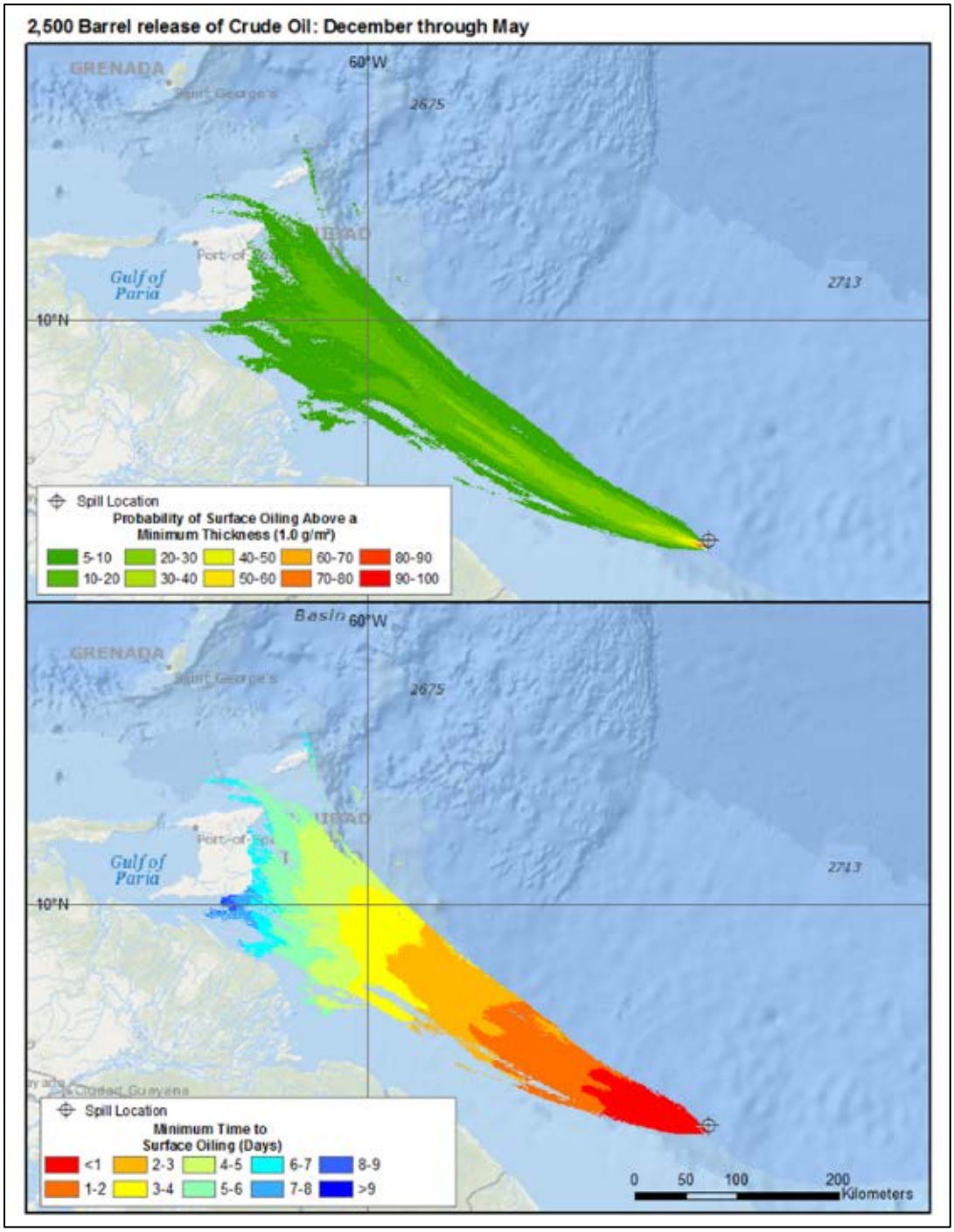
Figure A7: Water Surface Results – 2,500 Barrel Scenario – Unmitigated

A.3.4 Crude Oil Winter (December through May) – Unmitigated



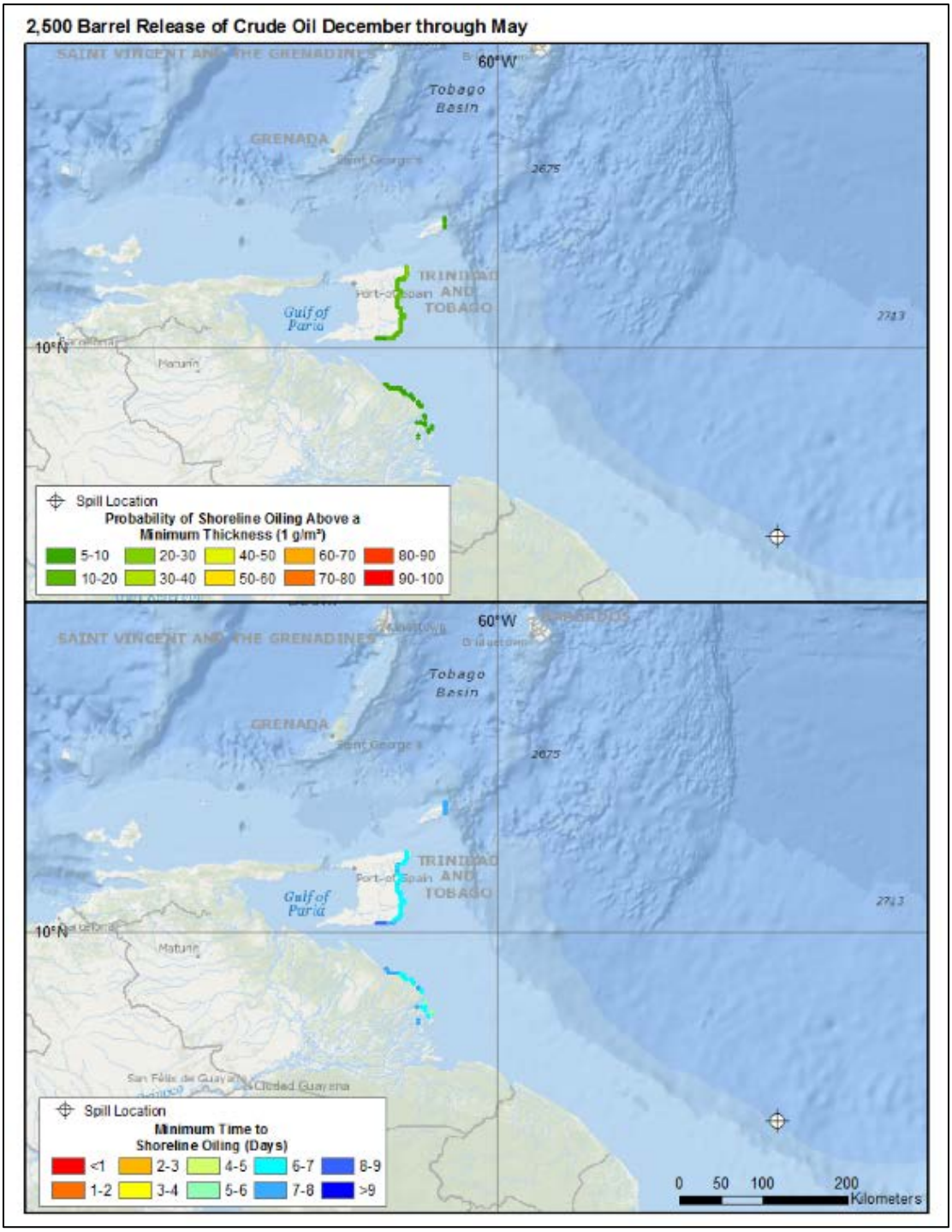
Top Panel – Probability of surface oiling above a minimum thickness of 1 µm from December through May for a 50 barrel release of Crude oil. Bottom Panel – Minimum time for surface oil thickness to exceed 1 µm.

Figure A8: Water Surface Results – 50 Barrel Scenario – Unmitigated



Top Panel – Probability of surface oiling above a minimum thickness of 1 µm from December through May for a 2,500 barrel release of Crude oil. Bottom Panel – Minimum time for surface oil thickness to exceed 1 µm.

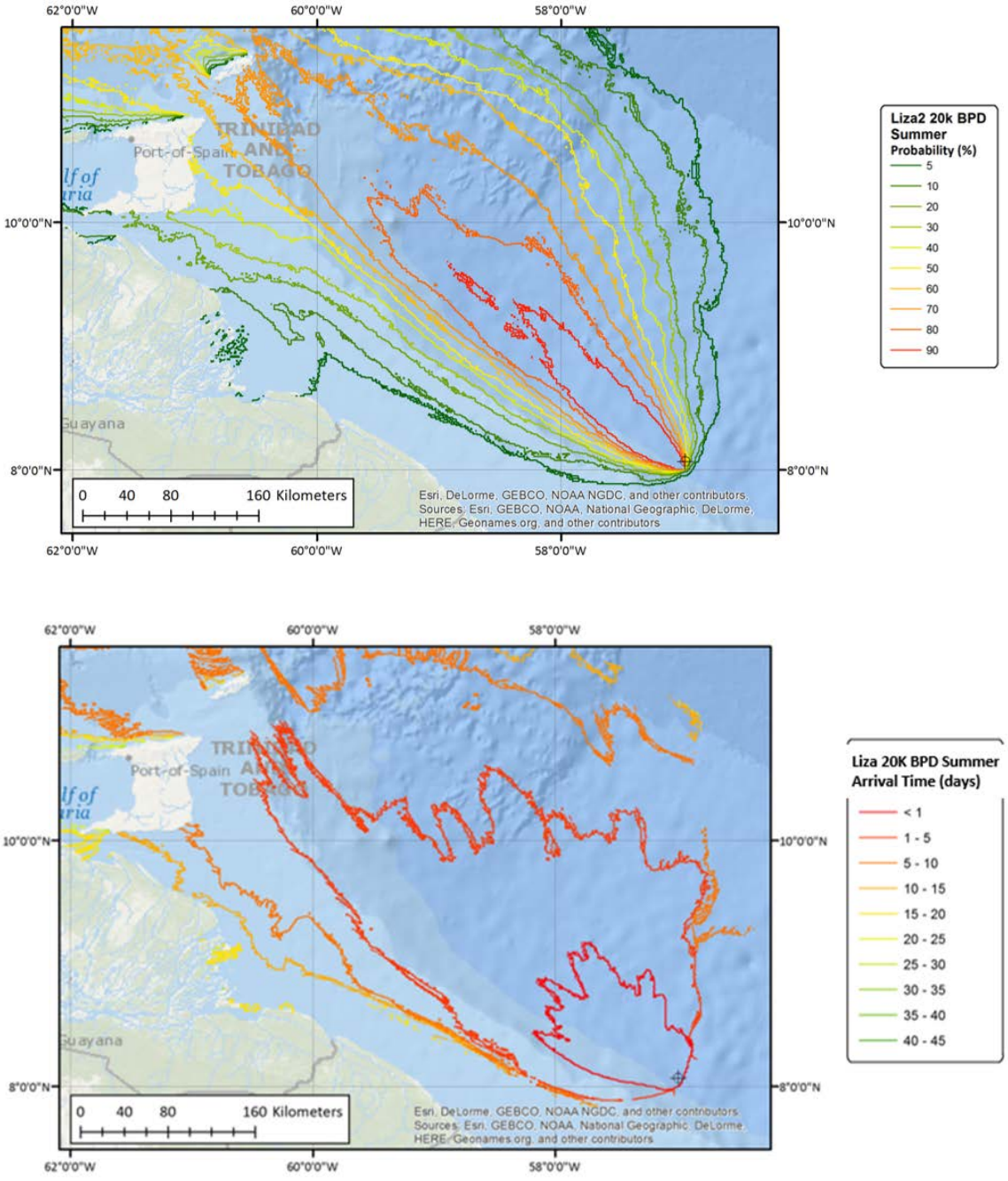
Figure A9: Water Surface Results – 2,500 Barrel Scenario – Unmitigated



Top Panel – Probability of shoreline oiling above a minimum thickness of 1 µm for months December through May for a 2,500 barrel release of Crude oil. Bottom Panel – Minimum time for shoreline oil thickness to exceed 1 µm.

Figure A10: Oiled Shoreline Results – 2,500 Barrel Scenario – Unmitigated

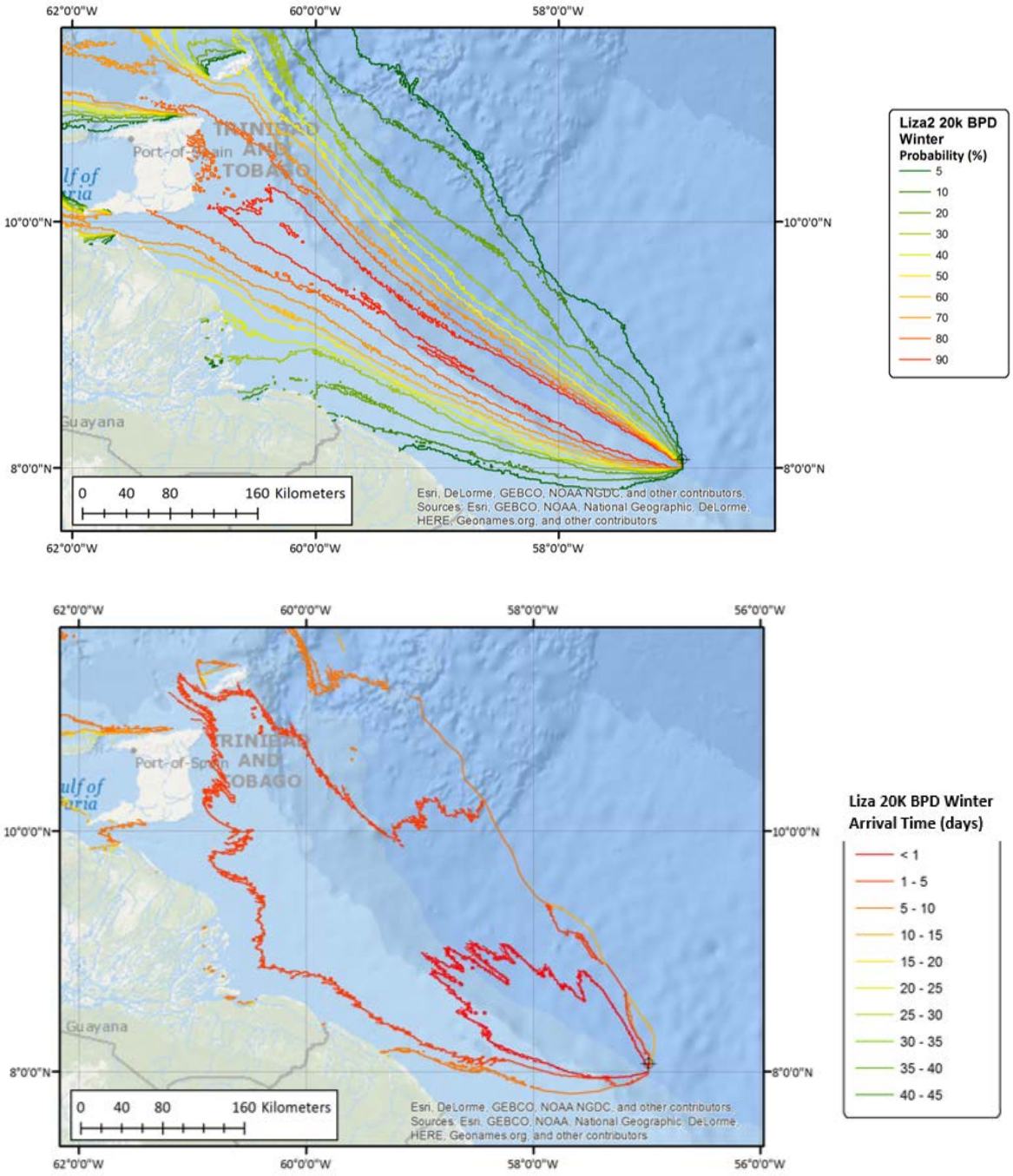
A.3.5 Wellbore Fluids Summer (June through November) – Unmitigated



Top Panel – Unmitigated Probability of shoreline oiling above a minimum thickness of 1 µm for months June through November for a 20,000 barrel a day release of Crude oil for 30 days. Bottom Panel – Unmitigated Minimum time for shoreline oil thickness to exceed 1 µm.

Figure A11: Water Surface Results – 20,000 Barrel per Day Scenario for 30 days – Unmitigated

A.3.6 Wellbore Fluids Winter (December through May) – Unmitigated



Top Panel – Probability of shoreline oiling above a minimum thickness of 1 µm for months December through May for a 20,000 barrel a day release of Crude oil for 30 days. Bottom Panel – Minimum time for shoreline oil thickness to exceed 1 µm

Figure A12: Water Surface Results – 20,000 Barrel per Day Scenario for 30 days – Unmitigated

A.4 Deterministic Model Results – Unmitigated and Mitigated*

Each individual spill event simulated in a stochastic scenario produces a unique spill trajectory. Depending on environmental conditions at the time of release, the spill will take a different path, resulting in different impacts. The 95th percentile spill event for shoreline stranding by oil with a thickness greater than 0.01 µm was selected from each stochastic scenario in the summer and winter seasons. These deterministic results are presented in summary tables listing the sea surface area swept by oil with a thickness greater than 0.01 µm and the length of shoreline oiled with a thickness greater than 1 µm. (Table A5).

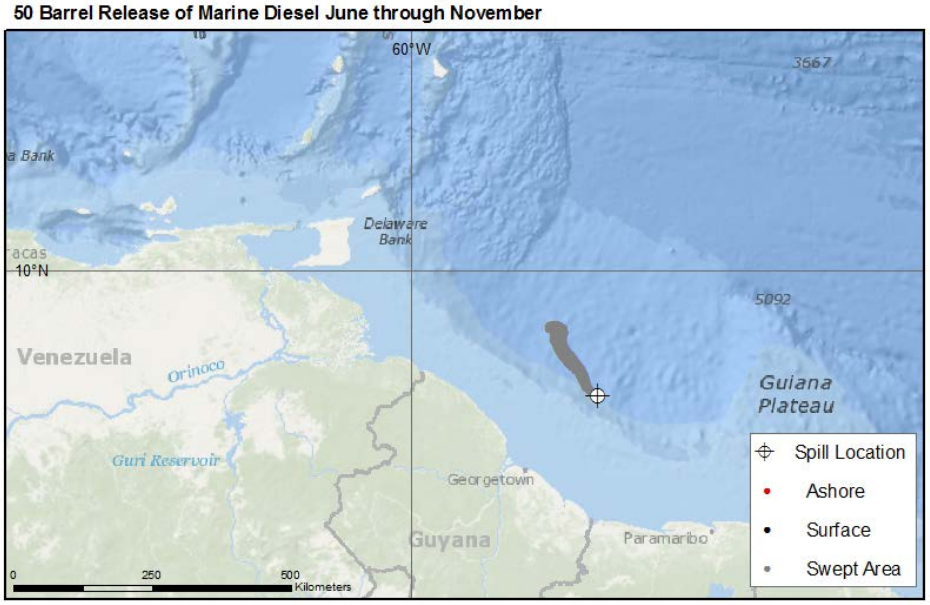
Oil effects summary for the 95th percentile spill event for sea surface area swept by oil above a thickness of 0.01µm. Surface area is the maximum sea surface area swept above a threshold of 0.01 µm thick. Shoreline length is the maximum length of shoreline oiled above a threshold of 1 µm thick.

The time of first arrival of oil on shore for the spill events that reached shore ranked as the 95th percentile ranges from 5.9 to 9.3 days (Table A5). Differences in seasonal wind speed and direction as well as small differences in spill site location result in a wide range in sea surface exposure to oil (835 km^2 through 408,789 km^2) and shoreline length oiled (25.1 km though 355 km). Stronger easterly winds result in more significant shoreline oiling, particularly in Venezuela and Trinidad and Tobago, while lower wind speeds allow the surface plume to be transported to the north of Trinidad and Tobago and swept into the Caribbean Sea.

Table A5: Oil Effects Summary for 95th Percentile for Shoreline Impact

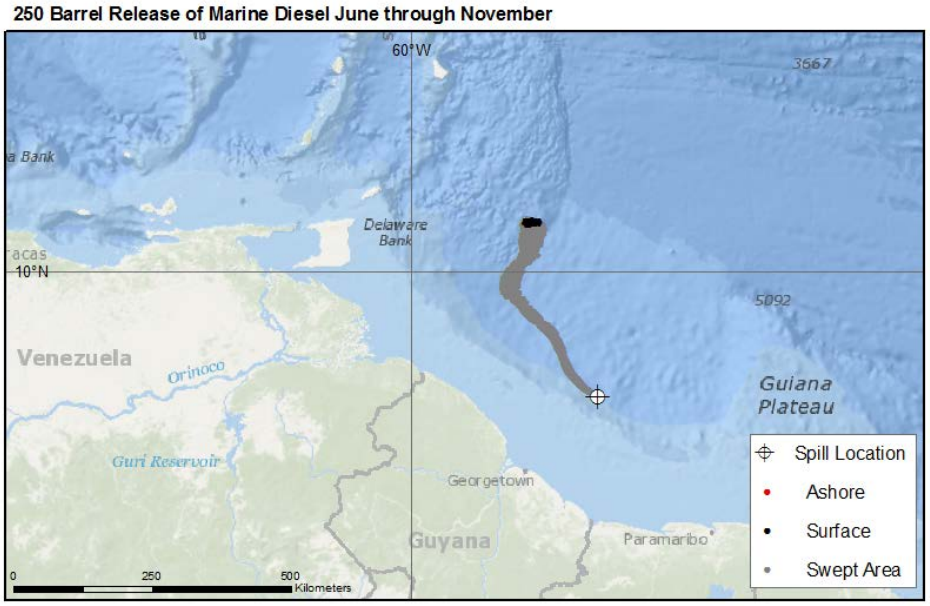
Spill Location	Season	Figure	Surface Area (km^2)	Shoreline Length (km)	Time to Shore (Days)
Marine Diesel – 50 bbl	Summer	A13	854	0	n/a
	Winter	A15	835	0	n/a
Marine Diesel – 250 bbl	Summer	A14	5,450	0	n/a
	Winter	A16	5,520	0	n/a
Crude Oil – 50 bbl	Summer	A17	6,390	0	n/a
	Winter	A20	6,500	25.1	5.9
Crude Oil – 2,500 bbl (Unmitigated)	Summer	A18	13,800	56.6	9.25
	Winter	A21	19,400	41.9	8.5
Crude Oil – 2,500 bbls (Mitigated*)	Summer	A19	719	0	n/a
	Winter	A22	854	0	n/a
Wellbore Fluids – 20,000 bbls per day for 30 days (Unmitigated)	Summer	A25	312,474	215	9.3
	Winter	A23	408,789	355	6.4
Wellbore Fluids – 20,000 bbls per day for 30 days (Mitigated*)	Summer	A26	7,168	0	n/a
	Winter	A24	13,860	0	n/a

The modeled unmitigated spill trajectories for each spill location listed above have been provided in Figures A13–A18, A20, A21, A23 and A25 and mitigated spill trajectories for the two largest spills in Figures A19, A22, A24 and A26.



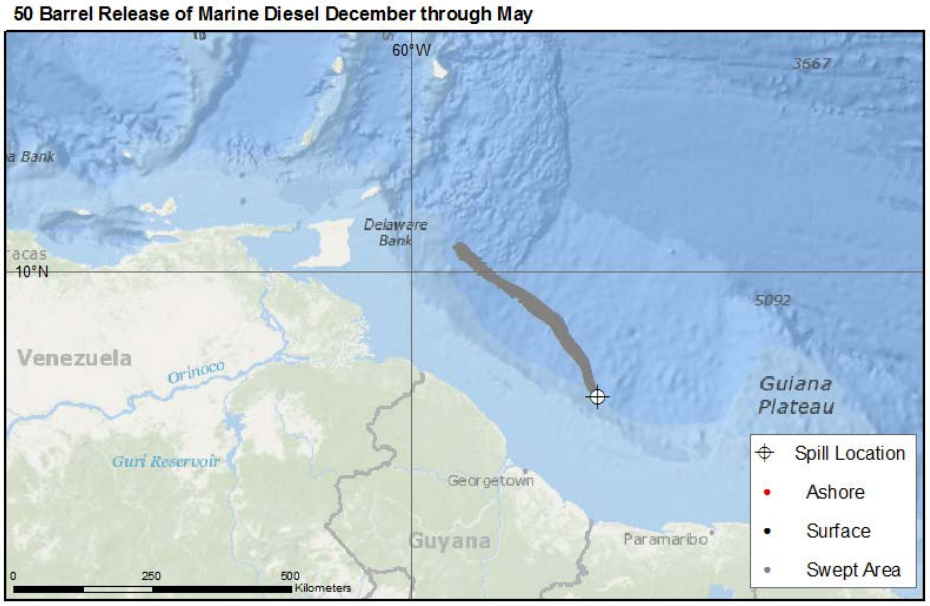
Unmitigated area swept results for the 95th percentile surface area oiled 50 bbl release during summer months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black (none in this scenario), and shoreline oiling is displayed in red (none in this scenario)

Figure A13: Marine Diesel Summer (June through November) – 50 Barrel Scenario



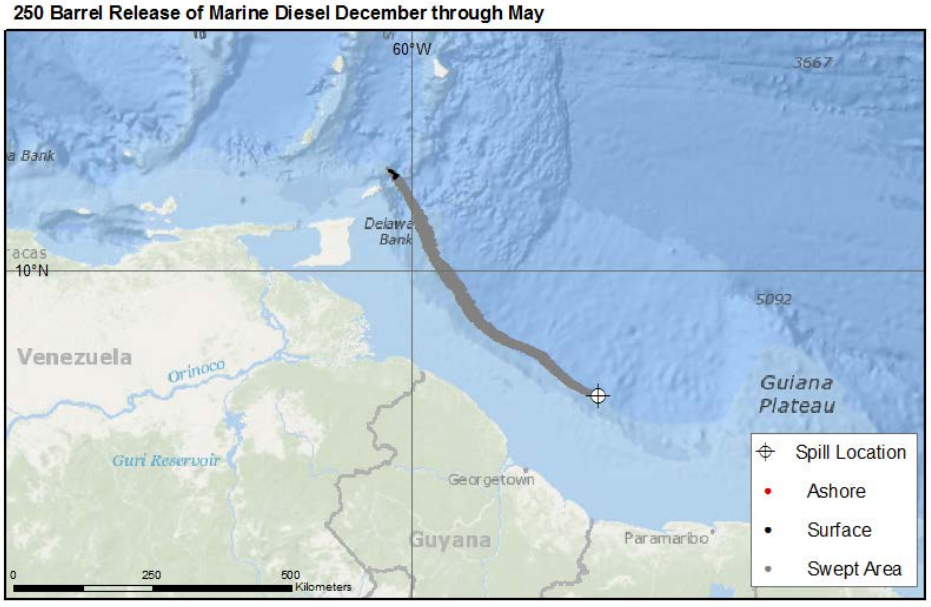
Unmitigated area swept results for the 95th percentile surface area oiled 250 bbl release during summer months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black, and shoreline oiling is displayed in red (none in this scenario)

Figure A14: Marine Diesel Summer (June through November) – 250 Barrel Scenario



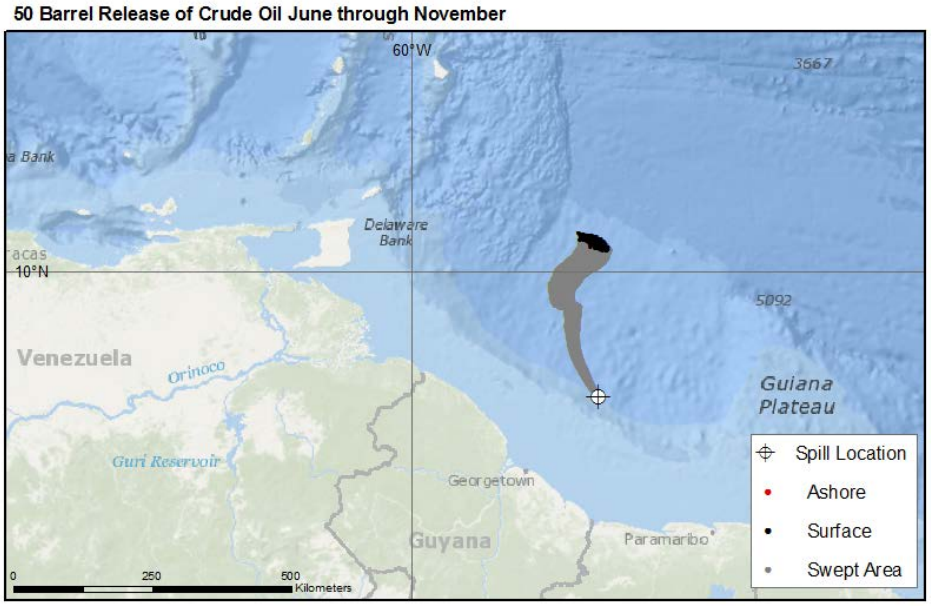
Unmitigated area swept results for the 95th percentile surface area oiled 50 bbl release during winter months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black (none in this scenario), and shoreline oiling is displayed in red (none in this scenario)

Figure A15: Marine Diesel Winter (December through May) – 50 Barrel Scenario



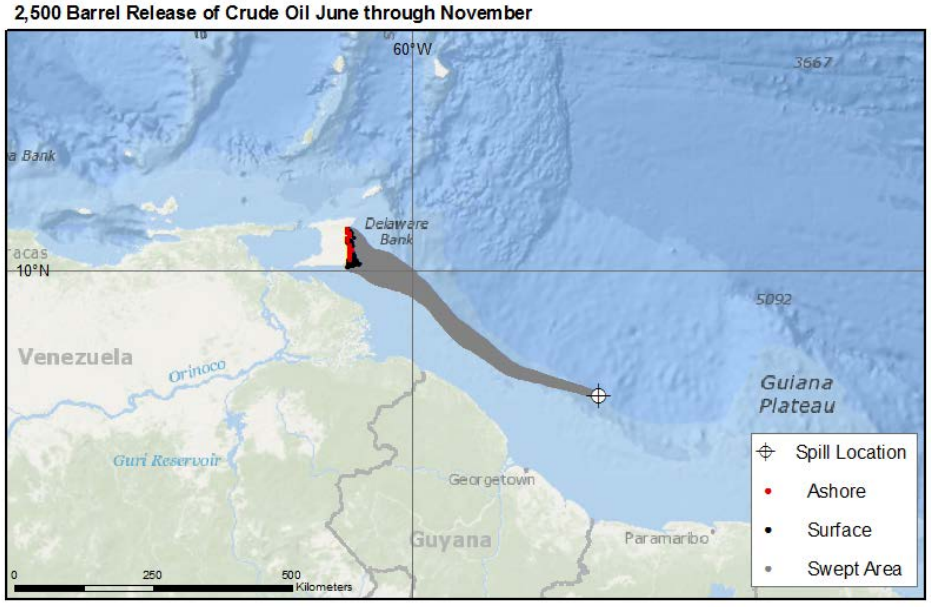
Unmitigated area swept results for the 95th percentile surface area oiled 250 bbl release during winter months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black, and shoreline oiling is displayed in red (none in this scenario)

Figure A16: Marine Diesel Winter (December through May) – 250 Barrel Scenario



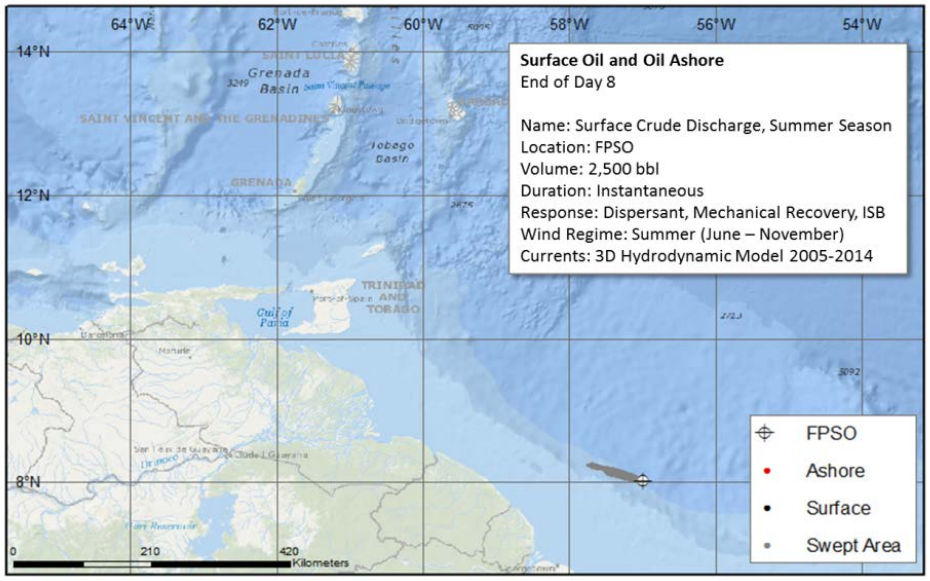
Unmitigated area swept results for the 95th percentile surface area oiled 50 bbl release during summer months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black, and shoreline oiling is displayed in red (none in this scenario)

Figure A17: Crude Oil Summer (June through November) – 50 Barrel Scenario



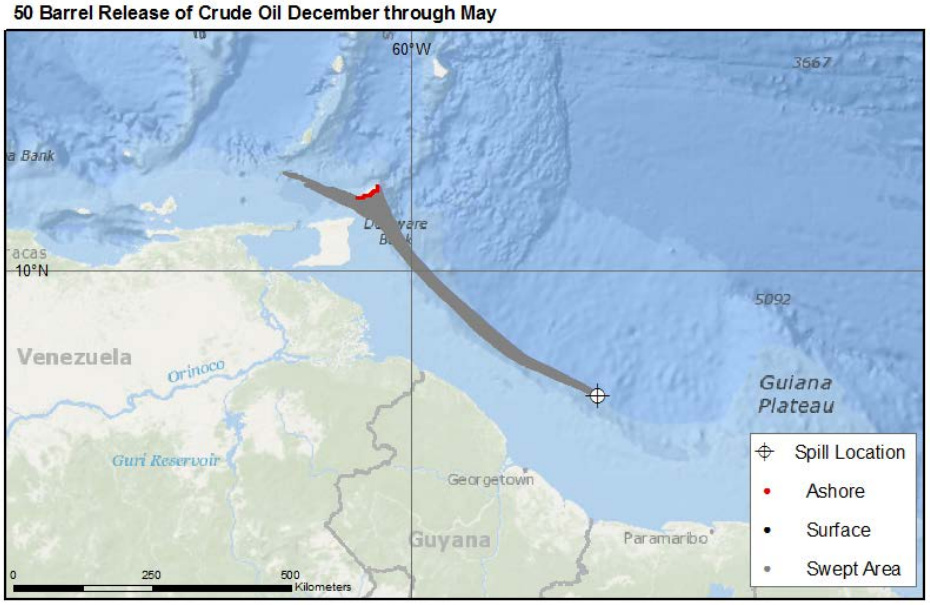
Unmitigated area swept results for the 95th percentile surface area oiled 2,500 bbl release during summer months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black, and shoreline oiling is displayed in red

Figure A18: Crude Oil Summer (June through November) – 2,500 Barrel Scenario



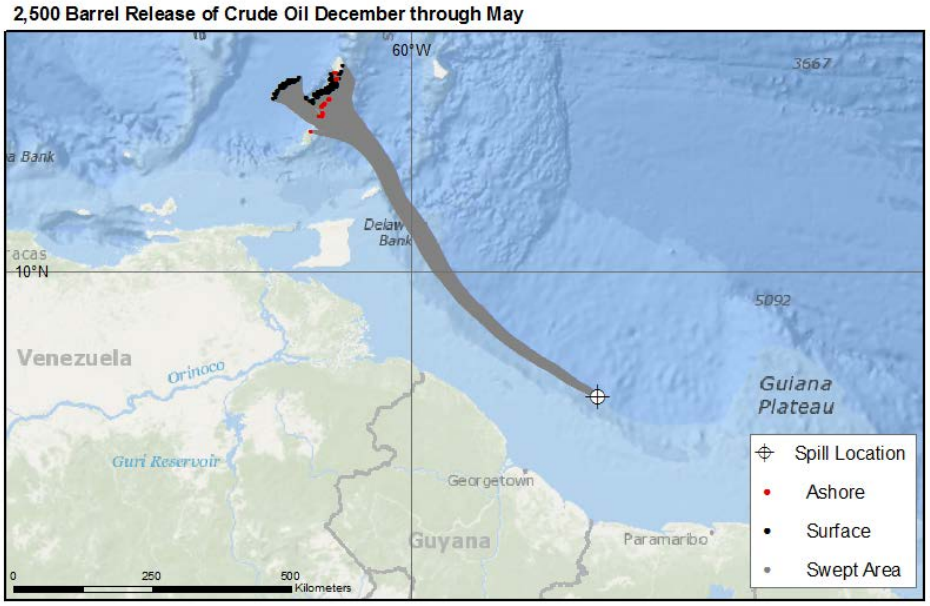
Mitigated area swept results for the 95th percentile shoreline area oiled 2,500 bbl release during summer months. Area swept is displayed in grey, no shoreline oiling occurred, and no surface oil remains.

Figure A19: Crude Oil Summer (June through November) – 2,500 Barrel Scenario – Mitigated



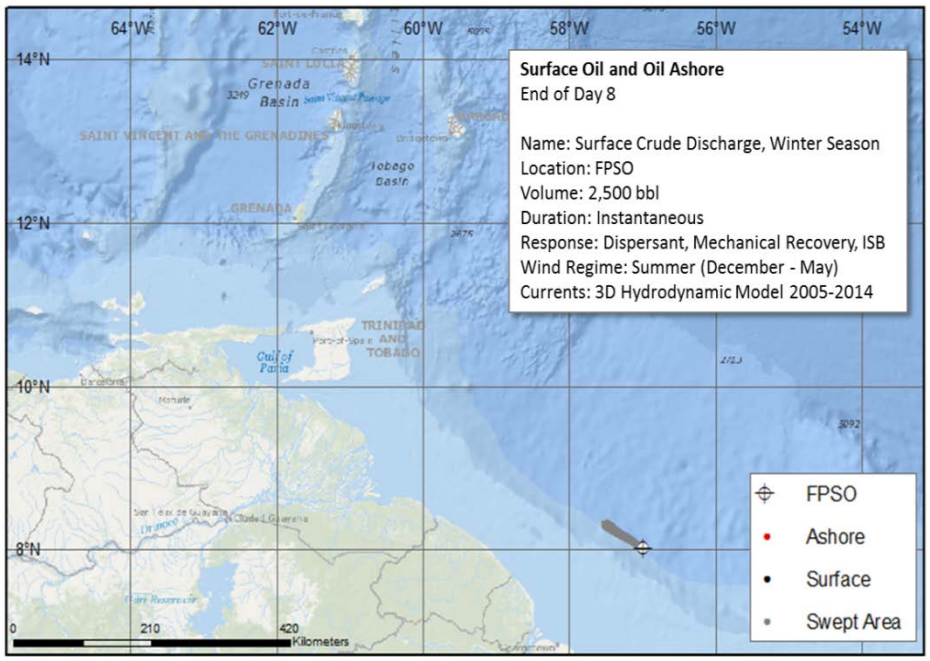
Unmitigated area swept results for the 95th percentile surface area oiled 50 bbl release during winter months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black, and shoreline oiling is displayed in red

Figure A20: Crude Oil Winter (December through May) – 50 Barrel Scenario



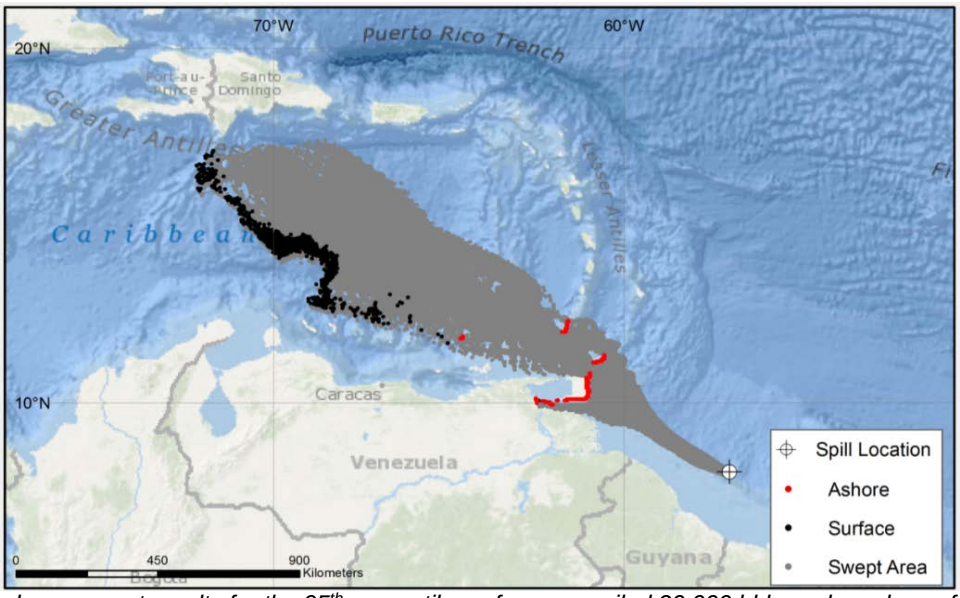
Unmitigated area swept results for the 95th percentile surface area oiled 2,500 bbl release during winter months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black, and shoreline oiling is displayed in red

Figure A21: Crude Oil Winter (December through May) – 2,500 Barrel Scenario



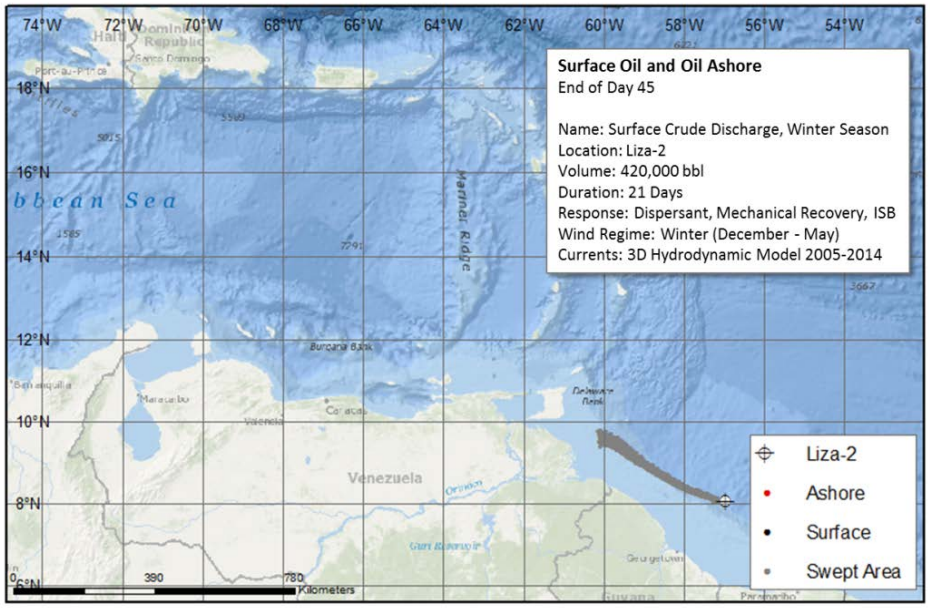
Mitigated area swept results for the 95th percentile shoreline area oiled 2,500 bbl release during winter months. Area swept is displayed in grey, no shoreline oiling occurred, and no surface oil remains.

Figure A22: Crude Oil Winter (December through May) – 2,500 Barrel Scenario – Mitigated



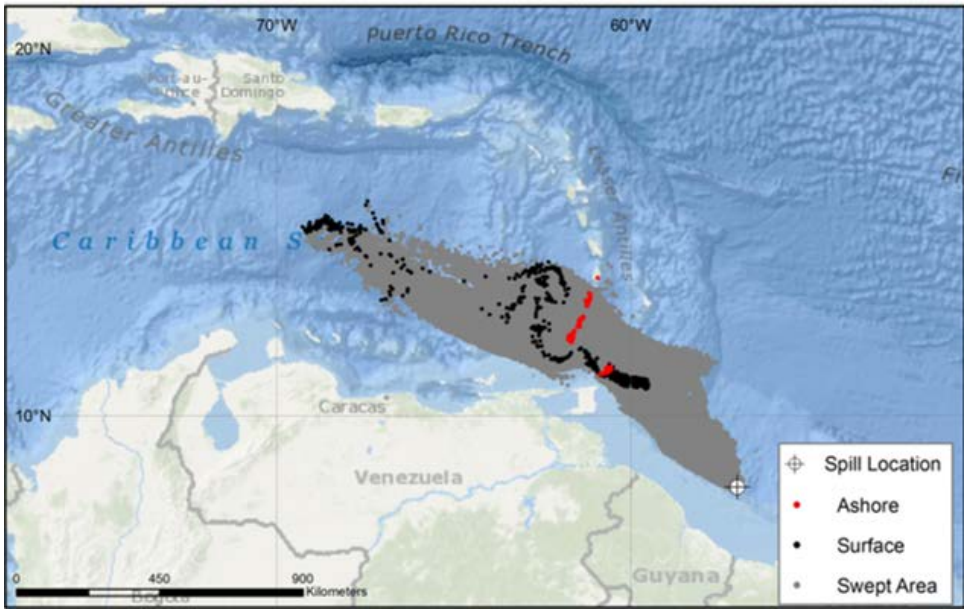
Unmitigated area swept results for the 95th percentile surface area oiled 20,000 bbl per day release for 30 days during winter months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black, and shoreline oiling is displayed in red

Figure A23: Wellbore Fluids Winter (December through May) – 20,000 Barrel per Day Scenario for 30 Days



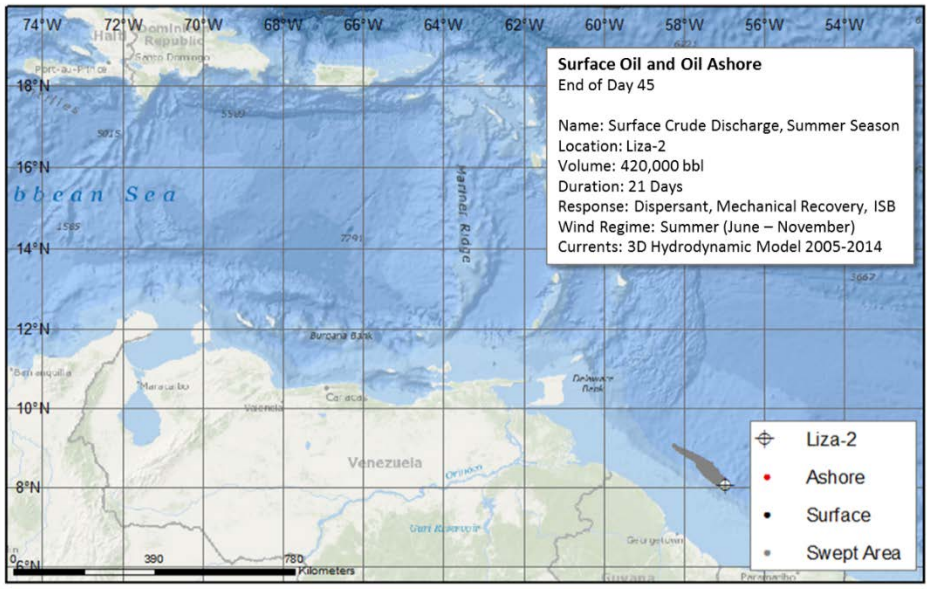
Mitigated area swept results for the 95th percentile shoreline area oiled 20,000 bbl per day release for 21 days during winter months. Area swept is displayed in grey, no shoreline oiling occurred, and no surface oil remains.

Figure A24: Wellbore Fluids Winter (December through May) – 20,000 Barrel per Day Scenario for 21 Days – Mitigated



Unmitigated area swept results for the 95th percentile surface area oiled 20,000 bbl per day release for 30 days during summer months. Area swept is displayed in grey, surface oil droplets remaining at the end of the 10 day scenario are presented in black, and shoreline oiling is displayed in red

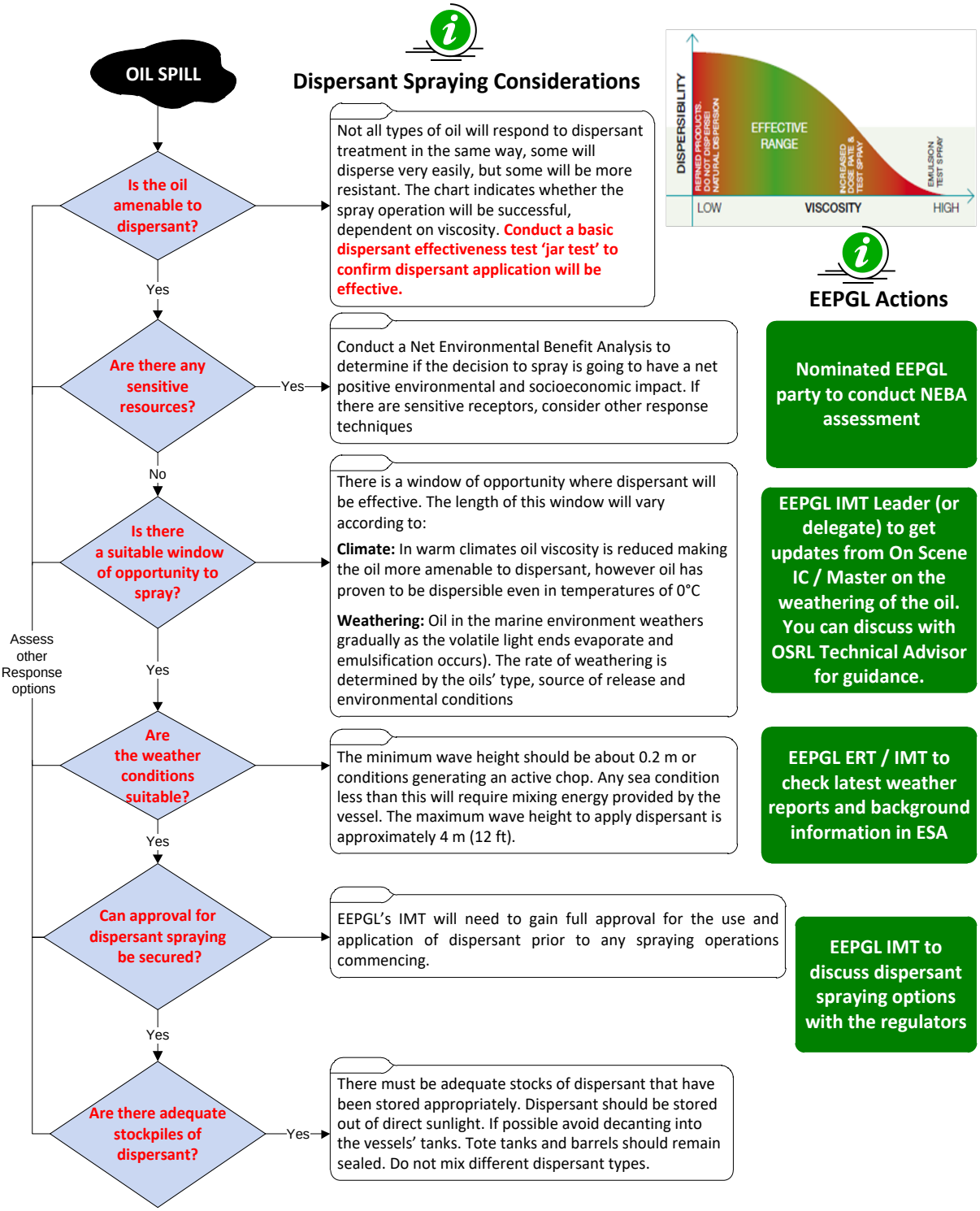
Figure A25: Wellbore Fluids Summer (June through November) – 20,000 Barrel per Day Scenario for 30 Days



Mitigated area swept results for the 95th percentile shoreline area oiled 20,000 bbl per day release for 21 days during summer months. Area swept is displayed in grey, no shoreline oiling occurred and no surface oil remains.

Figure A26: Crude Oil Summer (June through November) – 20,000 Barrel per Day Scenario for 21 Days – Mitigated

Appendix B DISPERSANT SPRAYING CONSIDERATIONS



Appendix C FORMS

C.1 Initial Spill Report Form

Complete prior to conversation with Guyana Authorities and other agencies.

Contact Details				
Reportee		Company		
Contact Number		Position		
Alt. Contact Number				
Spill Details				
Date / Time				
Installation	Name			
	Operator			
	Licence Holder			
	Response Primacy			
Hydrocarbon Spilled	Type			
	Name of Product			
Location of Spill	Latitude		Block	
	Longitude		Field	
Any Casualties / Damage to Installation			HSE been Advised?	YES I NO
Source of Spill (If Known)				
Cause of Spill (If Known)				
Spill Quantity / Potential (If Known)	Quantity		Is it on going?	YES I NO
	Potential			
Has Installation been Shut down and / or will Incident affect Production				
Appearance of Oil		Travel Direction of Spill (If Known)		
Possibility of Pollution reaching Shoreline / crossing Median Lines?	Where			
	Time			
Current Weather at Spill Location				
Wind Direction & Speed				
Sea State & Wave Height				

C.2 Dispersant Notification and Application Request Form and Safety Data Sheets

Dispersant Notification and Application Request Form		
Request from		
Name and Position	Contact Details	Date and Time of Request
Request made to		
Name and Position	Contact Details	Date and Time Request Received
Reason for Dispersant Use Request		
Use of dispersants provides the important advantage of removing oil from the surface of the water thereby minimizing the effects of an oil spill by dispersing oil before it reaches shorelines or sensitive areas. Removing oil from the surface of the water can reduce the potential for impacts to wildlife including birds and marine mammals that could be found on or near the sea surface and limits the action of wind on spill movement. Dispersants can be applied and are effective across a wide range of environmental, metrological and oceanographic condition, where mechanical responses are limited. Dispersants can be applied rapidly over a greater area in a given time than other response options.		
Expected Dispersant Effectiveness		
Has a Dispersant Effectiveness Test or Test Spray Run been carried out? Yes/No (If yes attach results to request form).	In this section, discuss the type of oil product spilled and its relative dispersibility. Reference available technical information or describe whether experience suggests that the spilled product is dispersible and will still be dispersible in the time frame of anticipated application of dispersants.	
Based on the assessment of the Incident what is the estimated timeframe available for a dispersant spraying operation to be effective?		

Dispersant Use Request Form	
Overview of Incident	
Describe the location and extent of spill, and spill volume (known or estimated).	
State oil type, API gravity, viscosity and pour point. (Attach Safety Data Sheet (SDS) if available).	
State whether the spill is in a location approved for Dispersant use by Caribbean Island OPRC Plan 2012 or provide details of why use dispersant approval is required if outside of these parameters.	

Dispersant Use Request Form	
Overview of Incident	
State whether spill is instantaneous or continuous (include flow rate if known).	
Predicted oil spill movement (attach oil spill modeling trajectory if available).	
Predicted sub-surface dispersant plume flow (attach oil	

spill modeling trajectory if available).	
Distance from shoreline.	
Depth of water.	
Weather Conditions	
Are current weather conditions suitable for a dispersant application operation? Yes/No	In this section, include current and forecasted weather conditions and whether they are suitable for dispersant application
Wind (from) direction.	
Wind speed (knots).	
Current velocity (knots).	
Current (to) direction.	
Visibility (nautical miles).	
Sea state	
Dispersant Application Details	
Dispersant type (Attach SDS) What is the current Dispersant stockpile level available for the dispersant spraying operation?	In this section, describe the dispersant product to be used (name). Attach an SDS. Describe the dispersant application method, the expected amount of dispersant to be used and estimated timeline for the dispersant spaying operation.
Application Method. (Include proposed DOR, dosage rate (gpa /lpha) and maximum equipment application rate.	
Estimated Dispersant quantity to be used.	
Describe Dispersant Spraying Operational area. Include any environmental and socio-economic sensitivities in the region. Use maps / charts if available.	

Dispersant Use Request Form		
Dispersant Effectiveness Monitoring Program		
Describe the level of dispersant effectiveness monitoring to be applied during the dispersant spraying operations.	State how observations will be carried out and documented. Describe how the dispersant spraying operations results will be communicated to the regulatory approvers.	
Dispersant Spraying Operation Approval Decision		
Approved Provide Additional Comments as Required	Not Approved Provide Details on Why Approval was Not Granted	
Decision Makers Name and Position	Contact Details	Date and Time

C.3 Safety Data Sheets for Global Dispersants

NALCO

MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME : **COREXIT® 9500**

APPLICATION : OIL SPILL DISPERSANT

COMPANY IDENTIFICATION : Nalco Energy Services, L.P.
P.O. Box 87
Sugar Land, Texas
77487-0087

EMERGENCY TELEPHONE NUMBER(S) : (800) 424-9300 (24 Hours) CHEMTREC

NFPA 704M/HMIS RATING
HEALTH : 1 / 1 FLAMMABILITY : 1 / 1 INSTABILITY : 0 / 0 OTHER :
0 = Insignificant 1 = Slight 2 = Moderate 3 = High 4 = Extreme

2. COMPOSITION/INFORMATION ON INGREDIENTS

Our hazard evaluation has identified the following chemical substance(s) as hazardous. Consult Section 15 for the nature of the hazard(s).

Hazardous Substance(s)	CAS NO	% (w/w)
Distillates, petroleum, hydrotreated light	64742-47-8	10.0 - 30.0
Propylene Glycol	57-55-6	1.0 - 5.0
Organic sulfonic acid salt	Proprietary	10.0 - 30.0

3. HAZARDS IDENTIFICATION

"EMERGENCY OVERVIEW"

WARNING
Combustible.
Keep away from heat. Keep away from sources of ignition - No smoking. Keep container tightly closed. Do not get in eyes, on skin, on clothing. Do not take internally. Avoid breathing vapor. Use with adequate ventilation. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of soap and water.
Wear suitable protective clothing.
Low Fire Hazard; liquids may burn upon heating to temperatures at or above the flash point. May evolve oxides of carbon (COx) under fire conditions. May evolve oxides of sulfur (SOx) under fire conditions.

PRIMARY ROUTES OF EXPOSURE :
Eye, Skin

HUMAN HEALTH HAZARDS - ACUTE :

EYE CONTACT :
May cause irritation with prolonged contact.

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MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

SKIN CONTACT :
May cause irritation with prolonged contact.

INGESTION :
Not a likely route of exposure. Can cause chemical pneumonia if aspirated into lungs following ingestion.

INHALATION :
Repeated or prolonged exposure may irritate the respiratory tract.

SYMPTOMS OF EXPOSURE :
Acute :
A review of available data does not identify any symptoms from exposure not previously mentioned.
Chronic :
Frequent or prolonged contact with product may defat and dry the skin, leading to discomfort and dermatitis.

AGGRAVATION OF EXISTING CONDITIONS :
Skin contact may aggravate an existing dermatitis condition.

4. FIRST AID MEASURES

EYE CONTACT :
Immediately flush with plenty of water for at least 15 minutes. If symptoms develop, seek medical advice.

SKIN CONTACT :
Immediately wash with plenty of soap and water. If symptoms develop, seek medical advice.

INGESTION :
Do not induce vomiting: contains petroleum distillates and/or aromatic solvents. If conscious, washout mouth and give water to drink. Get medical attention.

INHALATION :
Remove to fresh air, treat symptomatically. Get medical attention.

NOTE TO PHYSICIAN :
Based on the individual reactions of the patient, the physician's judgement should be used to control symptoms and clinical condition.

5. FIRE FIGHTING MEASURES

FLASH POINT :	181.4 °F / 83 °C (PMCC)
LOWER EXPLOSION LIMIT :	Not flammable
UPPER EXPLOSION LIMIT :	Not flammable

NALCO

MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

EXTINGUISHING MEDIA :
Alcohol foam, Carbon dioxide, Foam, Dry powder, Other extinguishing agent suitable for Class B fires, For large fires, use water spray or fog, thoroughly drenching the burning material.
Water mist may be used to cool closed containers.

UNSUITABLE EXTINGUISHING MEDIA :
Do not use water unless flooding amounts are available.

FIRE AND EXPLOSION HAZARD :
Low Fire Hazard; liquids may burn upon heating to temperatures at or above the flash point. May evolve oxides of carbon (COx) under fire conditions. May evolve oxides of sulfur (SOx) under fire conditions.

SPECIAL PROTECTIVE EQUIPMENT FOR FIRE FIGHTING :
In case of fire, wear a full face positive-pressure self contained breathing apparatus and protective suit.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS :
Restrict access to area as appropriate until clean-up operations are complete. Stop or reduce any leaks if it is safe to do so. Ventilate spill area if possible. Do not touch spilled material. Remove sources of ignition. Have emergency equipment (for fires, spills, leaks, etc.) readily available. Use personal protective equipment recommended in Section 8 (Exposure Controls/Personal Protection). Notify appropriate government, occupational health and safety and environmental authorities.

METHODS FOR CLEANING UP :
SMALL SPILLS: Soak up spill with absorbent material. Place residues in a suitable, covered, properly labeled container. Wash affected area. LARGE SPILLS: Contain liquid using absorbent material, by digging trenches or by diking. Reclaim into recovery or salvage drums or tank truck for proper disposal. Clean contaminated surfaces with water or aqueous cleaning agents. Contact an approved waste hauler for disposal of contaminated recovered material. Dispose of material in compliance with regulations indicated in Section 13 (Disposal Considerations).

ENVIRONMENTAL PRECAUTIONS :
Do not contaminate surface water.

7. HANDLING AND STORAGE

HANDLING :
Use with adequate ventilation. Keep the containers closed when not in use. Do not take internally. Do not get in eyes, on skin, on clothing. Have emergency equipment (for fires, spills, leaks, etc.) readily available.

STORAGE CONDITIONS :
Store away from heat and sources of ignition. Store separately from oxidizers. Store the containers tightly closed.

SUITABLE CONSTRUCTION MATERIAL :
Compatibility with Plastic Materials can vary; we therefore recommend that compatibility is tested prior to use.

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3 / 10

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MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE LIMITS :
Exposure guidelines have not been established for this product. Available exposure limits for the substance(s) are shown below.

ACGIH/TLV :
Substance(s)
Oil Mist — TWA: 5 mg/m3
STEL: 10 mg/m3

Propylene Glycol
OSHA/PEL :
Substance(s)
Oil Mist — TWA: 5 mg/m3
STEL: 10 mg/m3

Propylene Glycol
AIHA/WEEL :
Substance(s)

ENGINEERING MEASURES :
General ventilation is recommended.

RESPIRATORY PROTECTION :
Where concentrations in air may exceed the limits given in this section, the use of a half face filter mask or air supplied breathing apparatus is recommended. A suitable filter material depends on the amount and type of chemicals being handled. Consider the use of filter type: Multi-contaminant cartridge. with a Particulate pre-filter. In event of emergency or planned entry into unknown concentrations a positive pressure, full-facepiece SCBA should be used. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection.

HAND PROTECTION :
Nitrile gloves, PVC gloves

SKIN PROTECTION :
Wear standard protective clothing.

EYE PROTECTION :
Wear chemical splash goggles.

HYGIENE RECOMMENDATIONS :
Keep an eye wash fountain available. Keep a safety shower available. If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

HUMAN EXPOSURE CHARACTERIZATION :
Based on our recommended product application and personal protective equipment, the potential human exposure is: Low

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4 / 10

NALCO

MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE	Liquid
APPEARANCE	Clear Hazy Amber
ODOR	Hydrocarbon
SPECIFIC GRAVITY	0.95 @ 60 °F / 15.6 °C
DENSITY	7.91 lb/gal
SOLUBILITY IN WATER	Miscible
pH (100 %)	6.2
VISCOSITY	177 cps @ 32 °F / 0 °C 70 cps @ 60 °F / 15.6 °C @ 104 °F / 40 °C
VISCOSITY	@ 32 °F / 0 °C @ 60 °F / 15.6 °C 22.5 cst @ 104 °F / 40 °C
POUR POINT	< -71 °F / < -57 °C
BOILING POINT	296 °F / 147 °C
VAPOR PRESSURE	15.5 mm Hg @ 100 °F / 37.8 °C

Note: These physical properties are typical values for this product and are subject to change.

10. STABILITY AND REACTIVITY

STABILITY :
Stable under normal conditions.

HAZARDOUS POLYMERIZATION :
Hazardous polymerization will not occur.

CONDITIONS TO AVOID :
Heat

MATERIALS TO AVOID :
Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors.

HAZARDOUS DECOMPOSITION PRODUCTS :
Under fire conditions: Oxides of carbon, Oxides of sulfur

11. TOXICOLOGICAL INFORMATION

No toxicity studies have been conducted on this product.

SENSITIZATION :
This product is not expected to be a sensitizer.

NALCO

MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

CARCINOGENICITY :
None of the substances in this product are listed as carcinogens by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP) or the American Conference of Governmental Industrial Hygienists (ACGIH).

HUMAN HAZARD CHARACTERIZATION :
Based on our hazard characterization, the potential human hazard is: Moderate

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL EFFECTS :

The following results are for the product.

ACUTE INVERTEBRATE RESULTS :

Species	Exposure	LC50	EC50	Test Descriptor
Acartia tonsa	48 hrs	34 mg/l		Product
Artemia	48 hrs	20.7 mg/l		Product

MOBILITY :
The environmental fate was estimated using a level III fugacity model embedded in the EPI (estimation program interface) Suite TM , provided by the US EPA. The model assumes a steady state condition between the total input and output. The level III model does not require equilibrium between the defined media. The information provided is intended to give the user a general estimate of the environmental fate of this product under the defined conditions of the models. If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages;

Air	Water	Soil/Sediment
<5%	10 - 30%	50 - 70%

The portion in water is expected to float on the surface.

BIOACCUMULATION POTENTIAL
Component substances have a potential to biooconcentrate.

ENVIRONMENTAL HAZARD AND EXPOSURE CHARACTERIZATION
Based on our hazard characterization, the potential environmental hazard is: Low
Based on our recommended product application and the product's characteristics, the potential environmental exposure is: Low

If released into the environment, see CERCLA/SUPERFUND in Section 15.

13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it could meet the criteria of a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Before disposal, it should be determined if the waste meets the criteria of a hazardous waste.

NALCO

MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

Hazardous Waste: D018

Hazardous wastes must be transported by a licensed hazardous waste transporter and disposed of or treated in a properly licensed hazardous waste treatment, storage, disposal or recycling facility. Consult local, state, and federal regulations for specific requirements.

14. TRANSPORT INFORMATION

The information in this section is for reference only and should not take the place of a shipping paper (bill of lading) specific to an order. Please note that the proper Shipping Name / Hazard Class may vary by packaging, properties, and mode of transportation. Typical Proper Shipping Names for this product are as follows.

LAND TRANSPORT :

For Packages Less Than Or Equal To 119 Gallons:

Proper Shipping Name :	PRODUCT IS NOT REGULATED DURING TRANSPORTATION

For Packages Greater Than 119 Gallons:

Proper Shipping Name :	COMBUSTIBLE LIQUID, N.O.S.
Technical Name(s) :	PETROLEUM DISTILLATES
UN/ID No :	NA 1993
Hazard Class - Primary :	COMBUSTIBLE
Packing Group :	III
Flash Point :	83 °C / 181.4 °F

AIR TRANSPORT (ICAO/IATA) :

Proper Shipping Name :	PRODUCT IS NOT REGULATED DURING TRANSPORTATION

MARINE TRANSPORT (IMDG/IMO) :

Proper Shipping Name :	PRODUCT IS NOT REGULATED DURING TRANSPORTATION

15. REGULATORY INFORMATION

NATIONAL REGULATIONS, USA :

OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200 :
Based on our hazard evaluation, the following substance(s) in this product is/are hazardous and the reason(s) is/are shown below.

Distillates, petroleum, hydrotreated light : Irritant
Propylene Glycol : Exposure Limit, Eye irritant
Organic sulfonic acid salt : Irritant

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MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

CERCLA/SUPERFUND, 40 CFR 117, 302 :
Notification of spills of this product is not required.

SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (TITLE III) - SECTIONS 302, 311, 312, AND 313 :

SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355) :
This product does not contain substances listed in Appendix A and B as an Extremely Hazardous Substance.

SECTIONS 311 AND 312 - MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR 370) :
Our hazard evaluation has found this product to be hazardous. The product should be reported under the following indicated EPA hazard categories:

X	Immediate (Acute) Health Hazard
-	Delayed (Chronic) Health Hazard
-	Fire Hazard
-	Sudden Release of Pressure Hazard
-	Reactive Hazard

Under SARA 311 and 312, the EPA has established threshold quantities for the reporting of hazardous chemicals. The current thresholds are: 500 pounds or the threshold planning quantity (TPQ), whichever is lower, for extremely hazardous substances and 10,000 pounds for all other hazardous chemicals.

SECTION 313 - LIST OF TOXIC CHEMICALS (40 CFR 372) :
This product does not contain substances on the List of Toxic Chemicals.

TOXIC SUBSTANCES CONTROL ACT (TSCA) :
The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

FEDERAL WATER POLLUTION CONTROL ACT, CLEAN WATER ACT, 40 CFR 401.15 / formerly Sec. 307, 40 CFR 116.4 / formerly Sec. 311 :
None of the substances are specifically listed in the regulation.

CLEAN AIR ACT, Sec. 111 (40 CFR 60, Volatile Organic Compounds), Sec. 112 (40 CFR 61, Hazardous Air Pollutants), Sec. 602 (40 CFR 82, Class I and II Ozone Depleting Substances) :
None of the substances are specifically listed in the regulation.

Substance(s)	Citations
• Propylene Glycol	Sec. 111

CALIFORNIA PROPOSITION 65 :
This product does not contain substances which require warning under California Proposition 65.

MICHIGAN CRITICAL MATERIALS :
None of the substances are specifically listed in the regulation.

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8 / 10

NALCO

MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

STATE RIGHT TO KNOW LAWS :
The following substances are disclosed for compliance with State Right to Know Laws:

Propylene Glycol 57-55-6

NATIONAL REGULATIONS, CANADA :

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) :
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS CLASSIFICATION :
Not considered a WHMIS controlled product.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) :
The substances in this preparation are listed on the Domestic Substances List (DSL), are exempt, or have been reported in accordance with the New Substances Notification Regulations.

16. OTHER INFORMATION

Due to our commitment to Product Stewardship, we have evaluated the human and environmental hazards and exposures of this product. Based on our recommended use of this product, we have characterized the product's general risk. This information should provide assistance for your own risk management practices. We have evaluated our product's risk as follows:

* The human risk is: Low

* The environmental risk is: Low

Any use inconsistent with our recommendations may affect the risk characterization. Our sales representative will assist you to determine if your product application is consistent with our recommendations. Together we can implement an appropriate risk management process.

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to insure safe workplace operations. Please consult your local sales representative for any further information.

REFERENCES

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, OH., (Ariel Insight# CD-ROM Version), Ariel Research Corp., Bethesda, MD.

Hazardous Substances Data Bank, National Library of Medicine, Bethesda, Maryland (TOMES CPS# CD-ROM Version), Micromedex, Inc., Englewood, CO.

NALCO

MATERIAL SAFETY DATA SHEET

PRODUCT

COREXIT® 9500

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Geneva: World Health Organization, International Agency for Research on Cancer.

Integrated Risk Information System, U.S. Environmental Protection Agency, Washington, D.C. (TOMES CPS# CD-ROM Version), Micromedex, Inc., Englewood, CO.

Annual Report on Carcinogens, National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service.

Title 29 Code of Federal Regulations, Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA), (Ariel Insight# CD-ROM Version), Ariel Research Corp., Bethesda, MD.

Registry of Toxic Effects of Chemical Substances, National Institute for Occupational Safety and Health, Cincinnati, OH, (TOMES CPS# CD-ROM Version), Micromedex, Inc., Englewood, CO.

Ariel Insight# (An integrated guide to industrial chemicals covered under major regulatory and advisory programs), North American Module, Western European Module, Chemical Inventories Module and the Generics Module (Ariel Insight# CD-ROM Version), Ariel Research Corp., Bethesda, MD.

The Teratogen Information System, University of Washington, Seattle, WA (TOMES CPS# CD-ROM Version), Micromedex, Inc., Englewood, CO.

Prepared By : Product Safety Department
Date issued : 06/14/2005
Version Number : 1.6

TOTAL

MATERIAL SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

SDS # : 30033

FINASOL OSR 51

Date of the previous version: 2012-09-12*** Revision Date: 2012-02-22 Version 1.01

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

Product name	FINASOL OSR 51
Trade name	FINASOL OSR 51
Pure substance/mixture	Mixture

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses	dispersant.

1.3. Details of the supplier of the safety data sheet

Supplier	TOTAL FLUIDES 24, cours Michelet. 92800 PUTEAUX. FRANCE Tel: +33 (0)1 41 35 40 00 Fax: +33 (0)1 41 35 82 88

For further information, please contact

Contact Point	Service QSE : Tel : 01 41 35 33 64 / Fax : 01 41 35 33 50 Emergency number 24h/24h: +33 (0)1 41 35 65 00
E-mail Address	rmfs.fds@total.com

1.4. Emergency telephone number

+33 1 49 00 00 49 (24h/24, 7d/7)
Official National Emergency Telephone Number or Poison Control Center Number
In France : - PARIS : Hôpital Fernand Widal 200, rue du Faubourg Saint-Denis 75475 Paris Cédex 10 , Tel : 01.40.05.48.48. - MARSEILLE : Hopital Salvator, 249 bd Ste Marguerite 13274 Marseille cedex 5, Tel : 04.91.75.25.25. - LYON : Hopital Hédouard Herriot, 5 place d'Arsonvil, 69437 Lyon cedex 3, Tel : 04.72.11.69.11. - NANCY : Hopital central, 29 Av du Mal De Lattre de Tassigny, 54000 Nancy, Tel : 03.83.32.36.36 ou le SAMU : Tel (15)

2. HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

REGULATION (EC) No 1272/2008
For the full text of the H-Statements mentioned in this Section, see Section 2.2.

Classification

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

Aspiration toxicity - Category 1 - H304
Serious eye damage/eye irritation - Category 1 - H318

DIRECTIVE 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Symbol(s)
Xn - Harmful
Classification
Xn;R65 - Xi;R41 - R66

2.2. Label elements

Labelled according to: REGULATION (EC) No 1272/2008

Signal Word
DANGER

Hazard Statements
H304 - May be fatal if swallowed and enters airways
H318 - Causes serious eye damage

Precautionary Statements
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P337 + P313 - If eye irritation persists: Get medical advice/attention
P280 - Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310 - IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
P331 - Do NOT induce vomiting

Supplemental Hazard Statements
EUH066 - Repeated exposure may cause skin dryness or cracking

2.3. Other hazards

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

Physical-Chemical Properties Alkaline.
Combustible liquid.
Vapors may form explosive mixtures with air, at high temperatures.

Properties Affecting Health If swallowed accidentally, the product may enter the lungs due to its low viscosity and lead to the rapid development of very serious pulmonary lesions (medical survey during 48 hours) .

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2. Mixture

Chemical Name	EC-No	REACH registration No:	CAS-No	Weight %	Classification (Dir. 67/548)	Classification (Reg. 1272/2008)
Hydrocarbons, C11-C14, n-alkanes, isoalkanes, cyclics, <2% aromatics	926-141-6	01-2119456620-43	^	60-70	Xn;R65 R66 ***	Asp. Tox. 1 (H304)
docusate sodium***	209-406-4	no data available	577-11-7	0.2-5	Xi;R38-41***	Skin Irrit. 2 (H315) Eye Dam. 1 (H318)

Additional Information 15%-30% : Non-Ionic surfactants
0.2%-5% : Anionic surfactants

For the full text of the R-phrases mentioned in this Section, see Section 16
For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1. Description of first-aid measures

General advice IN CASE OF SERIOUS OR PERSISTENT CONDITIONS, CALL A DOCTOR OR EMERGENCY MEDICAL CARE.

Eye contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Skin contact Remove contaminated clothing and shoes. Wash off immediately with plenty of water for at least 15 minutes.

Inhalation In case of exposure to intense concentrations of vapours, fumes or spray, transport the person away from the contaminated zone, keep warm and allow to rest.

Ingestion If swallowed, do not induce vomiting - seek medical advice.
Risk of product entering the lungs on vomiting after ingestion. In this case, the casualty should be sent immediately to hospital.

Protection of First-aiders Use personal protective equipment.

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

4.2. Most important symptoms and effects, both acute and delayed

Eye contact	Risk of serious damage to eyes.
Skin contact	Repeated exposure may cause skin dryness or cracking.
Inhalation	The inhalation of vapours or aerosols may be irritating for the respiratory tract and for mucous membranes.
Ingestion	Harmful: If swallowed accidentally, the product may enter the lungs due to its low viscosity and lead to the rapid development of very serious inhalation pulmonary lesions (medical survey during 48 hours). Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea. May cause central nervous system depression.

4.3. Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

5.1. Extinguishing media

Suitable Extinguishing Media	Foam. Dry powder. Carbon dioxide (CO_2). Water spray.
Unsuitable Extinguishing Media	Do not use a solid water stream as it may scatter and spread fire.

5.2. Special hazards arising from the substance or mixture

Special Hazard	Incomplete combustion and thermolysis may produce gases of varying toxicity such as carbon monoxide, carbon dioxide, various hydrocarbons, aldehydes and soot. These may be highly dangerous if inhaled in confined spaces or at high concentration.

5.3. Advice for fire-fighters

Special protective equipment for fire-fighters	In case of a large fire or in confined or poorly ventilated spaces, wear full fire resistant protective clothing and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.
Other information	Cool containers / tanks with water spray. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

6. ACCIDENTAL RELEASE MEASURES

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

6.1. Personal precautions, protective equipment and emergency procedures

General information	Use personal protective equipment. Evacuate non-essential personnel. Ensure adequate ventilation, especially in confined areas. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch or walk through spilled material.

6.2. Environmental precautions

General information	Prevent further leakage or spillage if safe to do so. Dike to collect large liquid spills. The product should not be allowed to enter drains, water courses or the soil. Local authorities should be advised if significant spillages cannot be contained.

6.3. Methods and materials for containment and cleaning up

Methods for cleaning up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Following product recovery, flush area with water.

6.4. Reference to other sections

Personal Protective Equipment	See Section 8 for more detail
Waste treatment	See section 13
Other information	Remove all sources of ignition.

7. HANDLING AND STORAGE

7.1. Precautions for safe handling

Advice on safe handling	For personal protection see section 8. Use only in well-ventilated areas. Do not breathe vapors or spray mist. Avoid contact with skin and eyes.
Technical measures	Ensure adequate ventilation.
Prevention of fire and explosion	Handle away from any source of ignition (open flame and sparks) and heat (hot manifolds or casings). Design installations (machinery and equipment) to prevent burning product from spreading (tanks, retention systems, interceptors (traps) in drainage systems). Take precautionary measures against static discharges.

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

Hygiene measures	Ensure the application of strict rules of hygiene by the personnel exposed to the risk of contact with the product. When using, do not eat, drink or smoke. Do not dry hands with rags that have been contaminated with product.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures/Storage conditions	Keep away from heat. Keep at temperatures between 5 and 35 °C. Use only containers, seals, pipes, etc... made in a material suitable for use with aromatic hydrocarbons.
Materials to Avoid	Strong acids. Oxidizing agents.
Packaging material	Keep only in the original container or in a suitable container for this kind of product: steel , Stainless steel.

7.3. Specific end uses

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Exposure limits Ingredients with workplace control parameters

Legend See section 16

DNEL Worker (Industrial/Professional)

Chemical Name	Short term, systemic effects	Short term, local effects	Long term, systemic effects	Long term, local effects
docusate sodium*** 577-11-7			31.3 mg/kg bw/day (dermal) 44.1 mg/m³ (inhalation)	

DNEL General population

Chemical Name	Short term, systemic effects	Short term, local effects	Long term, systemic effects	Long term, local effects
docusate sodium*** 577-11-7			18.8 mg/kg bw/day (dermal) 13 mg/m³ (inhalation) 18.8 mg/kg bw/day (oral)	

Predicted No Effect Concentration (PNEC)

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

Chemical Name	Water	Sediment	Soil	Air	STP	Oral
docusate sodium*** 577-11-7	0.0066 mg/l (fw) 0.00066 mg/l (mw) 0.066 mg/l (or)	0.653 mg/kg dw (fw) 0.0653 mg/kg dw (mw)	0.138 mg/kg dw		122 mg/l	

8.2. Exposure controls

Occupational Exposure Controls

Engineering Measures Apply technical measures to comply with the occupational exposure limits.

Personal Protective Equipment

General Information These recommendations apply to the product as supplied. If the product is used in mixtures, it is recommended that you contact the appropriate protective equipment suppliers.

Respiratory protection When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.

Eye Protection Safety glasses with side-shields. If splashes are likely to occur, wear:. Face-shield.

Skin and body protection Wear suitable protective clothing. Protective shoes or boots.

Hand Protection Hydrocarbon-proof gloves. Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. Also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion.

Environmental exposure controls

General Information None in normal conditions.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Color	dark brown To black
Physical State @20°C	liquid
Odor	Petroleum solvent

Property	Values	Remarks	Method
pH	6.5 - 8.5		ASTM D 1172
pH (as aqueous solution)	8	solution (10 %)	ASTM D 1172

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

Boiling point/boiling range	180 - 240 °C 356 - 464 °F		
Flash point	>= 65 °C >= 149 °F		ISO 2719 ISO 2719.
Evaporation rate		No information available	
Flammability Limits in Air		No information available	
Vapor Pressure		No information available	
Vapor density		No information available	
Density	865 - 885 kg/m³	@ 20 °C	ISO 12185
Water solubility		No information available	
Solubility in other solvents		No information available	
logPow		Not applicable	
Autoignition temperature		No information available	
Viscosity, kinematic	7 - mm2/s	@ 40 °C	ISO 3104

Explosive properties	Not explosive
Oxidizing Properties	No information available
Possibility of hazardous reactions	No data available

9.2. Other information

10. STABILITY AND REACTIVITY

10.1. Reactivity

10.2. Chemical stability

Stability: Stable under recommended storage conditions.

10.3. Possibility of hazardous reactions

Hazardous Reactions: None under normal processing.

10.4. Conditions to Avoid

Conditions to Avoid: Heat, flames and sparks. Take precautionary measures against static discharges.

10.5. Incompatible Materials

Materials to Avoid: Strong acids. Oxidizing agents.

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

10.6. Hazardous Decomposition Products

Hazardous Decomposition Products Incomplete combustion and thermolysis may produce gases of varying toxicity such as carbon monoxide, carbon dioxide, various hydrocarbons, aldehydes and soot.

11. TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Acute toxicity Local effects Product information***

Skin contact Repeated exposure may cause skin dryness or cracking.

Eye contact Risk of serious damage to eyes.

Inhalation Not classified.
The inhalation of vapours or aerosols may be irritating for the respiratory tract and for mucous membranes.

Ingestion Harmful: If swallowed accidentally, the product may enter the lungs due to its low viscosity and lead to the rapid development of very serious inhalation pulmonary lesions (medical survey during 48 hours).
Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.
May cause central nervous system depression.

Acute toxicity Component Information

Chemical Name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Hydrocarbons, C11-C14, n-alkanes, isoalkanes, cyclics, <2% aromatics	LD50 > 5000 mg/kg bw (rat - OECD 401)	LD50 (24h) > 5000 mg/kg bw (rabbit - OECD 402)	LC50 (8h) > 5000 mg/m³ (vapour) (rat - OECD 403)
docusate sodium***	> 2100 mg/kg (Rat)	> 10000 mg/kg (Rabbit)	

Sensitization

Sensitization Not classified as a sensitizer.

Specific effects

Carcinogenicity Contains no ingredient listed as a carcinogen.

Mutagenicity Contains no ingredient listed as a mutagen.

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 **Version** 1.01

Reproductive toxicity	Contains no ingredient listed as toxic to reproduction.

Repeated Dose Toxicity

Target Organ Effects (STOT)

Specific target organ systemic toxicity (single exposure)	No known effect based on information supplied.
Specific target organ systemic toxicity (repeated exposure)	No known effect based on information supplied.
Aspiration toxicity	The fluid can enter the lungs and cause damage (chemical pneumonitis, potentially fatal).

Other information

Other adverse effects	Frequent or prolonged skin contact destroys the lipoacid cutaneous layer and may cause dermatitis.

12. ECOLOGICAL INFORMATION

12.1. Toxicity

Acute aquatic toxicity Product Information

Acute aquatic toxicity Component Information

Chemical Name	Toxicity to algae	Toxicity to daphnia and other aquatic invertebrates	Toxicity to fish	Toxicity to microorganisms
Hydrocarbons, C11-C14, n-alkanes, isoalkanes, cyclics, <2% aromatics ^	ErL50 (72h) > 1000 mg/l (Pseudokirchneriella subcapitata - OECD 201) EbL50 (72h) > 1000 mg/l (Pseudokirchneriella subcapitata - OECD 201) NOELR (72h) = 1000 mg/l (Pseudokirchneriella subcapitata - biomass - OECD 201) NOELR (72h) = 1000 mg/l (Pseudokirchneriella subcapitata - growth rate - OECD 201)	EL50 (48h) > 1000 mg/l (Daphnia magna - OECD 202)	LL50 (96h) > 1000 mg/l (Oncorhynchus mykiss - OECD 203)	
docusate sodium*** 577-11-7		EC50 (48h) = 6.6 mg/l Daphnia magna	LC50 (96h) = 49 mg/l Brachydanio rerio (semi-static)	

Chronic aquatic toxicity Product Information

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

Chronic aquatic toxicity Component information

Chemical Name	Toxicity to algae	Toxicity to daphnia and other aquatic invertebrates	Toxicity to fish	Toxicity to microorganisms
Hydrocarbons, C11-C14, n-alkanes, Isoalkanes, cyclics, <2% aromatics		NOELR (21d) = 1,22 mg/l (Daphnia magna - QSAR Petrotox)	NOELR (28d) = 0,17 mg/l (Oncorhynchus mykiss - QSAR Petrotox)	

Effects on terrestrial organisms
No information available.

12.2. Persistence and degradability

General information
For : Hydrocarbons, C11-C14, n-alkanes, Isoalkanes, cyclics, <2% aromatics.

Biodegradation						
Type:	Method	Sampling time	Specific effects	Values	Unit	Biodegradability
	OECD 301 F	28, days		69	%	Readily biodegradable

12.3. Bioaccumulative potential

Product information The potential for bioaccumulation of the product in the environment is very low.

logPow Not applicable
Component information No information available.

12.4. Mobility in soil

Soil Given its physical and chemical characteristics, the product is generally mobile in the ground.

Air The product evaporates readily.

Water soluble.

12.5. Results of PBT and vPvB assessment

PBT and vPvB assessment This product contains no substance considered as PBT and/or vPvB according to REACH regulation annex XIII criteria.

12.6. Other adverse effects

Version EU

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

General Information	No information available.

13. DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from Residues / Unused Products	Dispose of in accordance with the European Directives on waste and hazardous waste.
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Empty containers may contain flammable or explosive vapors.
EWC Waste Disposal No.	According to the European Waste Catalogue, Waste Codes are not product specific, but application specific. Waste codes should be assigned by the user based on the application for which the product was used.

14. TRANSPORT INFORMATION

ADR/RID	Not regulated
IMDG/IMO	Not regulated
ICAO/IATA	Not regulated

ADN

UN/ID No	UN9003
Proper shipping name	Substances with a flash-point above 60 degrees C and not more than 100 degrees C
Proper shipping name	SUBSTANCES WITH A FLASH POINT ABOVE 60°C AND NOT MORE THAN 100°C
Hazard class	9
Description	UN9003, SUBSTANCES WITH A FLASH-POINT ABOVE 60 DEGREES C AND NOT MORE THAN 100 DEGREES C (Hydrocarbons, C11-C14, n-alkanes, Isoalkanes, cyclics, < 2% aromatics), 9, MIXTURE

15. REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

European Union

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

International Inventories

Related CAS	Hydrocarbons, C11-C14, n-alkanes, Isoalkanes, cyclics, <2% aromatics 64742-47-8
EINECS/ELINCS	-
TSCA	-
DSL	-
ENCS	-
IECSC	-
KECL	-
PICCS	-
AICS	-
NZIoC	-

Legend
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

Further information

15.2. Chemical Safety Assessment

Chemical Safety Assessment Not applicable

16. OTHER INFORMATION

Full text of R-phrases referred to under sections 2 and 3
R41 - Risk of serious damage to eyes
R65 - Harmful: may cause lung damage if swallowed

Full text of H-Statements referred to under section 2 and 3
H304 - May be fatal if swallowed and enters airways
H318 - Causes serious eye damage

TOTAL

SDS # : 30033

FINASOL OSR 51

Revision Date: 2012-02-22 Version 1.01

Abbreviations, acronyms
bw = body weight
bw/day = body weight/day
dw = dry weight
mw = marine water
fw = fresh water

Legend Section 8

*	Sensitizer	°	Skin designation
**	Hazard Designation	C:	Carcinogen
M:	Mutagen	R:	Toxic to reproduction

Revision Date: 2012-02-22
Revision Note (M)SDS sections updated: 3. ***
This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

This safety data sheet serves to complete but not to replace the technical product sheets. The information contained herein is given in good faith and is accurate to the best of knowledge at the date indicated above.It is understood by the user that any use of the product for purposes other than those for which it was designed entails potential risk.The information given herein in no way dispenses the user from knowing and applying all provisions regulating his activity.The user bears sole liability for the precautions required when using the product.The regulatory texts indicated herein are intended to aid the user to fulfil his obligations. This list is not to be considered complete and exhaustive.It is the user's responsibility to ensure that he is subject to no other obligations than those mentioned.

End of the safety data sheet

DASIC INTERNATIONAL LTD

SAFETY DATA SHEET

Slickgone NS

Revision 2
Revision date 16-Apr-2009

1. IDENTIFICATION OF THE SUBSTANCE / PREPARATION AND THE COMPANY

Product name	Slickgone NS
Description	Internationally approved dispersant for treating marine oil spills.
Company	Dasic International Ltd Winchester Hill Romsey Hampshire SO51 7YD UK www.dasicinter.com
Telephone	+44 (0)1794 512419
Fax	+44 (0)1794 522346
Emergency telephone number	+44 (0)1794 512419

2. HAZARDS IDENTIFICATION.

Main hazards	The product is classified as non hazardous. May cause degreasing of the skin. May cause irritation to eyes.

3. COMPOSITION / INFORMATION ON INGREDIENTS.

Hazardous Ingredients

	Conc.	CAS	EINECS	Symbols/Risk phrases
Kerosine - odourless - distillates (petroleum), hydrotreated light	60-70%	64742-47-8	265-149-8	Xn; R65
Sodium dioctylsulphosuccinate	1-10%	577-11-7		Xi;R36 Xi;R38

4. FIRST AID MEASURES

Skin contact	Remove contaminated clothing. Wash with water. Seek medical attention if irritation or symptoms persist. Wash all contaminated clothing before reuse.
Eye contact	Rinse immediately with plenty of water for 15 minutes holding the eyelids open. Contact lenses should be removed. Seek medical attention.
Inhalation	Move the exposed person to fresh air. Seek medical attention if irritation or symptoms persist.
Ingestion	DO NOT INDUCE VOMITING. Rinse mouth thoroughly. Drink 1 to 2 glasses of water. Seek medical attention.
General information	Potential for aspiration if swallowed.

5. FIRE FIGHTING MEASURES

Extinguishing media	Alcohol resistant foam. Carbon dioxide (CO2) Dry chemical. Do NOT use water jet. Cool fire exposed containers with waterspray.
Fire hazards	Burning produces irritating, toxic and obnoxious fumes.
Protective equipment	In case of fire and/or explosion do not breathe fumes. Self-contained breathing apparatus.

Slickgone NS

Revision 2
Revision date 16-Apr-2009

6. ACCIDENTAL RELEASE MEASURES

Personal precautions	Wear suitable protective equipment. See section 8 for further information.
Environmental precautions	Prevent further spillage if safe. Do not allow product to enter drains. Do not flush into surface water. Do not let product contaminate subsoil. Advise local authorities if large spills cannot be contained.
Clean up methods	Absorb with inert, absorbent material. Transfer to suitable, labelled containers for disposal. Contact a licensed waste disposal company. Clean spillage area thoroughly with plenty of water.

7. HANDLING AND STORAGE

Handling	Wear protective clothing. See section 8 for further information.
Storage	Keep out of the reach of children. Avoid contact with: strong oxidising agents. Keep in a cool, dry, well ventilated area.
Suitable packaging	Store in original container.
Specific use	Obtain special instructions from the supplier.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limits

Kerosine - odourless - distillates (petroleum), hydrotreated light	WEL 8-hr limit ppm: WEL 15 min limit ppm:	WEL 8-hr limit mg/m3: 1000 WEL 15 min limit mg/m3:

Engineering measures	Ensure adequate ventilation of the working area.
Respiratory protection	Not normally required. Wear suitable respiratory equipment when necessary. For short periods of work a combination of charcoal filter and particulate filter is suitable.
Hand protection	Chemical resistant gloves (PVC)
Eye protection	Approved safety goggles. Provide eye wash station.
Protective equipment	Apron (Plastic or rubber) Rubber boots.

9. PHYSICAL AND CHEMICAL PROPERTIES

Description	Viscous liquid.
Colour	Brown.
Odour	Mild.
Boiling point	192°C
Flash point	72°C
Relative density	0.87
Water solubility	slightly miscible in water.
Viscosity	Flow Time in 3mm ISO cup (ISO 2431) - 40

10. STABILITY AND REACTIVITY

Stability	Stable under normal conditions.
Conditions to avoid	Burning produces irritating, toxic and obnoxious fumes.
Materials to avoid	Strong oxidising agents.

Slickgone NS

Revision 2
Revision date 16-Apr-2009

11. TOXICOLOGICAL INFORMATION

Acute toxicity	Ingestion may cause nausea and vomiting.
Corrosivity	May cause irritation to eyes. May cause degreasing of the skin. Potential for aspiration if swallowed.
Repeated or prolonged exposure	Repeated or prolonged exposure may cause dermatitis.
Mutagenic effects	No mutagenic effects reported.
Carcinogenic effects	No carcinogenic effects reported.
Reproductive toxicity	No teratogenic effects reported.

12. ECOLOGICAL INFORMATION

Degradability	The surfactant(s) contained in this preparation complies(comply) with the biodegradability criteria as laid down in Regulation (EC) No.648/2004 on detergents. Data to support this assertion are held at the disposal of the competent authorities of the Member States and will be made available to them, at their direct request or at the request of a detergent manufacturer.
Bioaccumulation	Does not bioaccumulate.

13. DISPOSAL CONSIDERATIONS

General Information	Dispose of as special waste in compliance with local and national regulations.
Disposal of packaging	Dispose of in compliance with all local and national regulations.

14. TRANSPORT INFORMATION

Further information	The product is not classifed as dangerous for carriage.

15. REGULATORY INFORMATION

16. OTHER INFORMATION

Text of risk phrases in Section 3.	R36 - Irritating to eyes. R38 - Irritating to skin. R65 - Harmful: may cause lung damage if swallowed.

119

C.4 Oil Spill Response Notification Form

OSRL NOTIFICATION FORM			
WARNING! Ensure telephone contact has been established with OSRL's Duty Manager before using e-mail and fax communications.			
To	Duty Manager		
Southampton Emergency Fax	+44 (0)23 8072 4314	Fort Lauderdale Emergency Fax	+1 954 987 3001
Southampton Telephone	+44 (0)23 8033 1551	Fort Lauderdale Telephone	+1 954 983 9880
Email	dutymanagers@oilspillresponse.com		
Section 1	**Obligatory Information Required-Please Complete All Details**		
Name of person in charge			
Position			
Company			
Contact telephone number			
Contact Mobile number			
Contact fax number			
E-mail address			
Section 2	**Spill Details**		
Location of spill			
Description of slick (size, direction, appearance)			
Latitude / longitude			
Situation (cross box)	❑ Land ❑ River ❑ Estuary ❑ Coastal ❑ Offshore ❑ Port		
Date & time of spill	❑ GMT ❑ Local		
Source of spill			
Quantity (if known)	❑ Cross box if estimate		
Spill status (cross box)	❑ On-going ❑ Controlled ❑ Unknown		
Action taken so far			
Product name			
Viscosity			
API / SG			
Pour point			
Asphaltene			
Section 3	**Weather**		
Wind speed & direction			
Sea state			
Sea temperature			
Tides			
Forecast			

Section 4	Additional Information Required – Please Complete Details if Known
Resources at risk	
Clean-up resources	
On-site / Ordered	
Nearest airport (if known)	
Runway length	
Handling facilities	
Customs	
Handling agent	
Section 5	**Vessel Availability**
Equipment deployed	
Recovered oil storage	
Section 6	**Equipment Logistics**
Transport	
Secure storage	
Port of embarkation	
Location of command centre	
Other designated contacts	
Section 7	**Special Requirements of Country**
Security	
Visa	
Medical advice	
Vaccinations	
Others (specify)	
Section 8	**Climate Information**
Section 9	**Other Information**

C.5 Oil Spill Response Mobilization Form

OSRL MOBILIZATION FORM
WARNING! Ensure telephone contact has been established with OSRL's Duty Manager before using e-mail and fax communications.

To	Duty Manager
Southampton Emergency Fax	+44 (0)23 8072 4314
Southampton Telephone	+44 (0)23 8033 1551
Email	dutymanagers@oilspillresponse.com

Authorizer's Details	
Subject	Mobilization of OSRL
Date	
Name	
Company	
Position	
Contact Telephone Number	
Contact Mobile Number	
Contact Email Address	
Incident Name	
Invoice Address	
I, authorize the activation of Oil Spill Response Limited and its resources in connection with the above incident under the terms of the Agreement in place between above stated Company and Oil Spill Response Limited.	
Signature:	

If OSRL personnel are to work under another party's direction please complete details below:

Additional Details	
Name	
Company	
Position	
Contact Telephone Number	
Contact Mobile Number	
Contact Email Address	

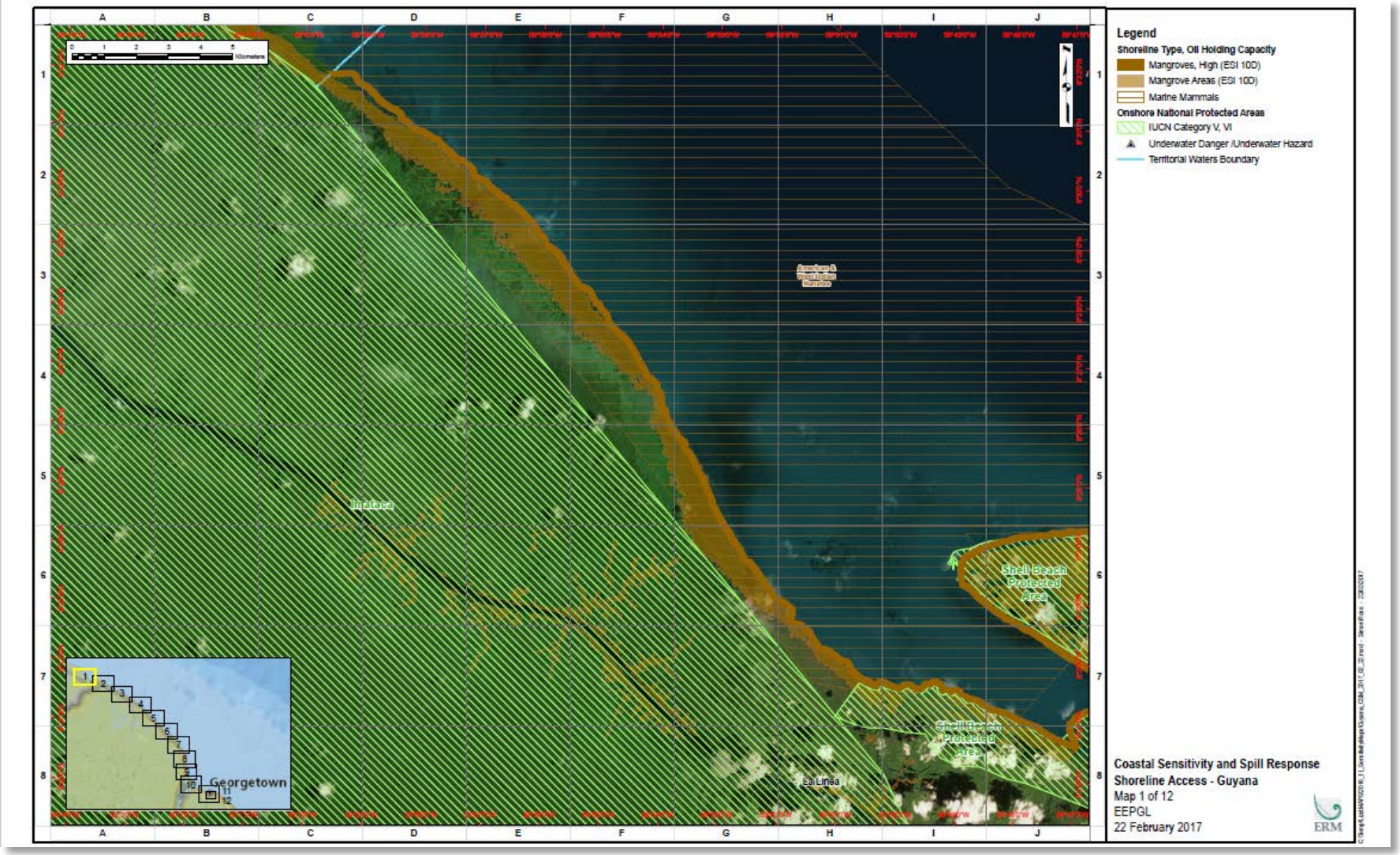
Appendix D COASTAL SENSITIVITY MAPS

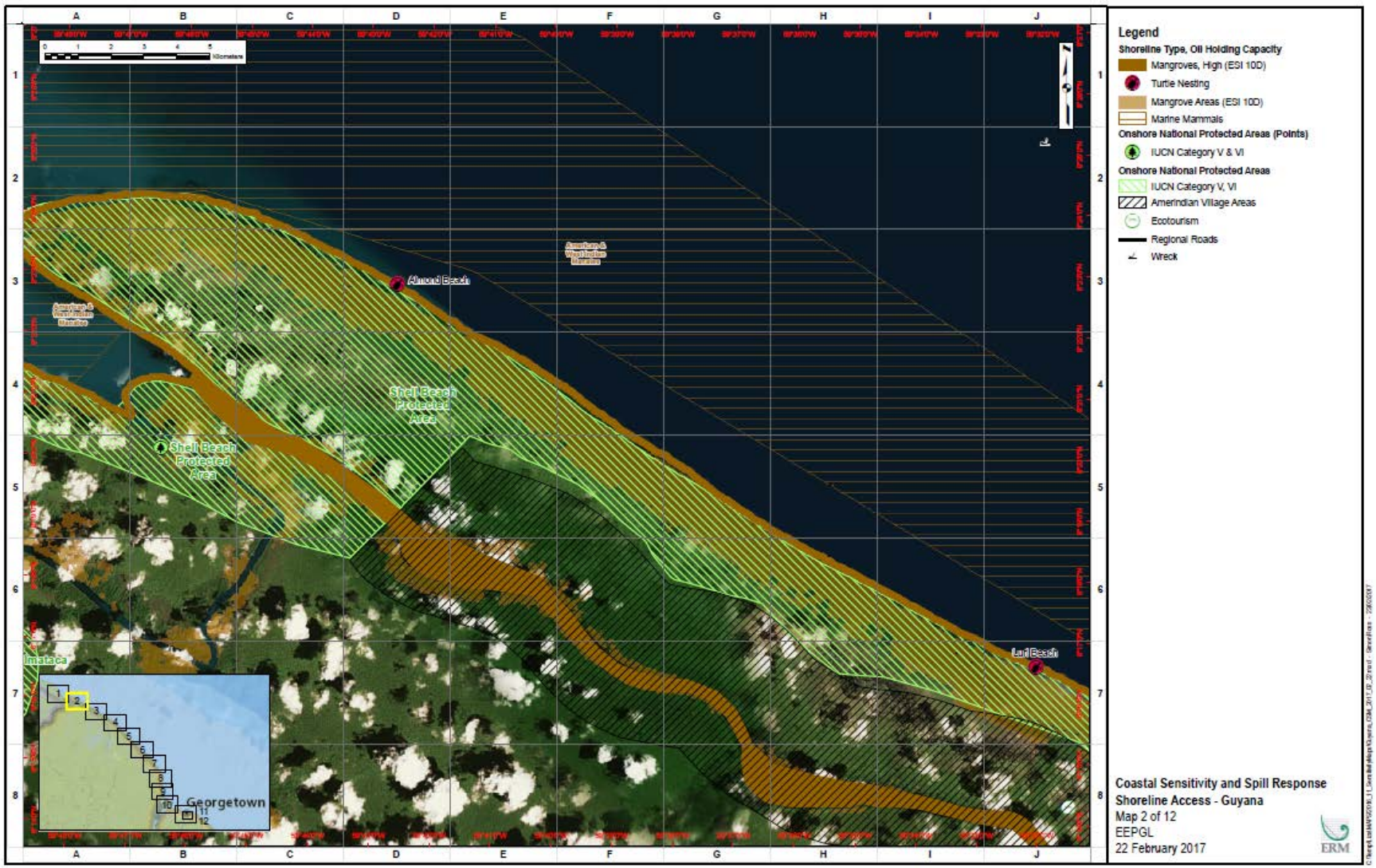
Coastal sensitivity mapping was conducted for the entire coastal area identified in the oil spill modeling as being potentially exposed to hydrocarbons as a result of a Tier III Marine Oil Spill (Scenario 9). The mapping included the following resources and receptors:

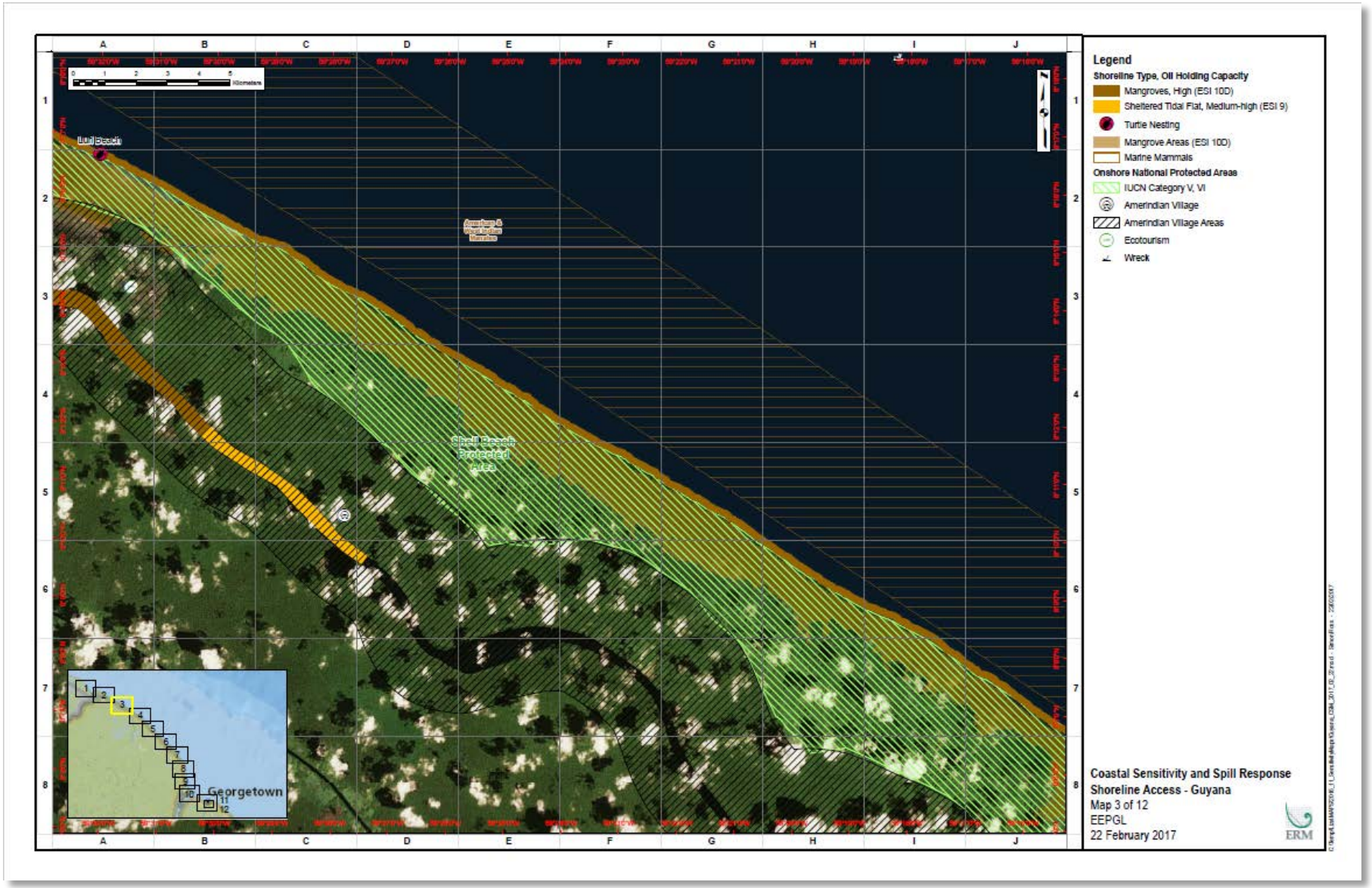
- Environmental – protected areas, wetlands, mangroves, beach types, seagrass beds, coral reefs, and other sensitive habitats; and
- Socioeconomic – coastal and/or indigenous people's communities (e.g., location and socioeconomic characteristics), coast-dependent commercial and artisanal activities (e.g., fishing, foraging, etc.), other industrial activities, and infrastructure (e.g., water intake facilities).

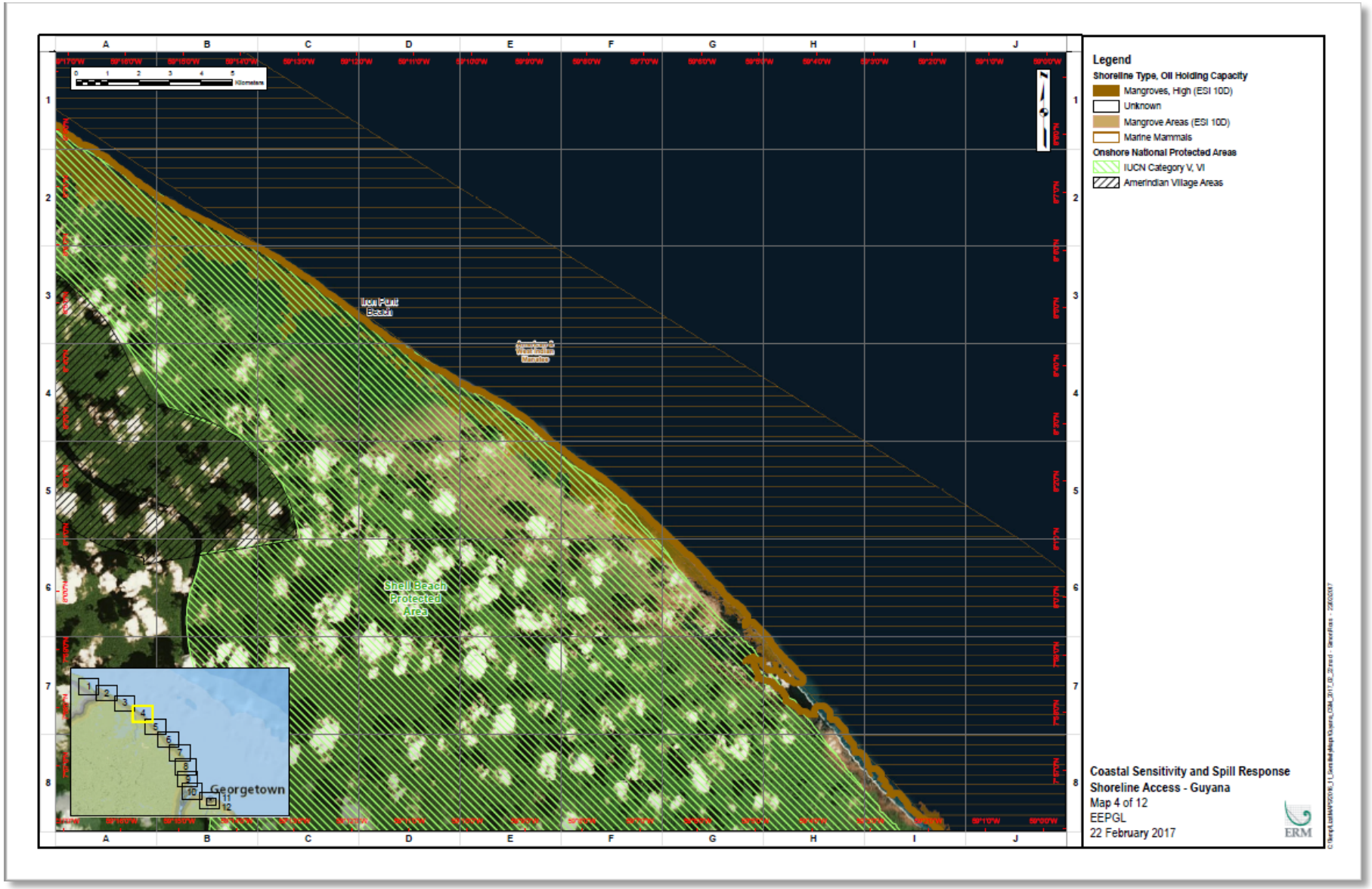
This information enabled EEPGL to prioritize the mobilization of emergency response resources (manpower and equipment) to those areas most sensitive to a spill. Unmitigated potential effects on the coastline of Guyana, portions of Venezuela, Trinidad and Tobago and several islands in the Lesser Antilles (e.g., Grenada, St. Vincent, the Grenadines, and St. Lucia) have been mapped. However, based on the multi-tiered emergency response actions that will be implemented and weathering and evaporative losses that occur for such hydrocarbons most of such coastal areas are not expected to be at risk. The results of this further environmental risk assessment and analysis will be incorporated into the oil spill planning and emergency response training and exercises that will be conducted during each stage of the Liza Phase 1 FPSO Project.

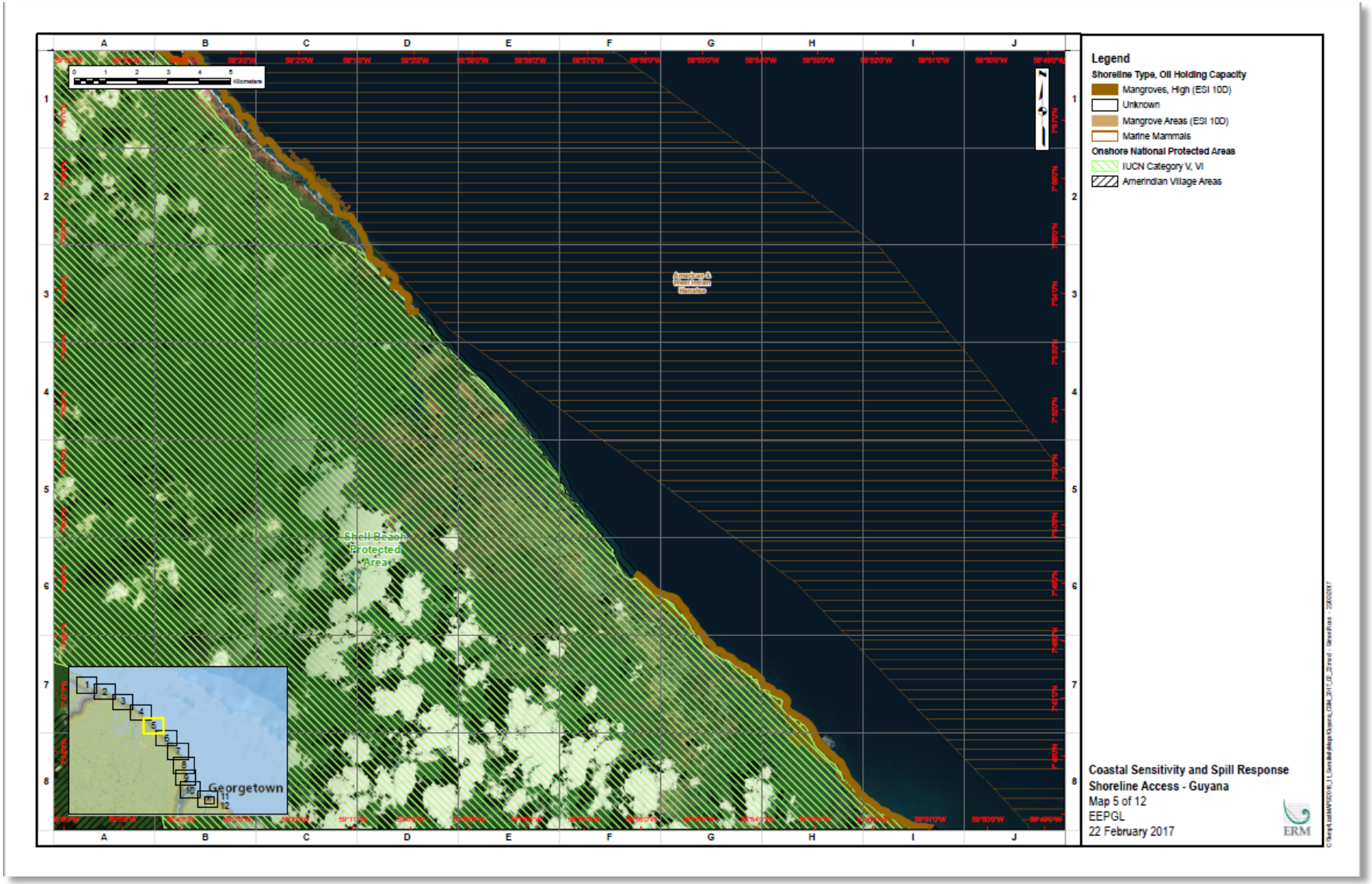
D.1 GUYANA Coastal Sensitivity Maps

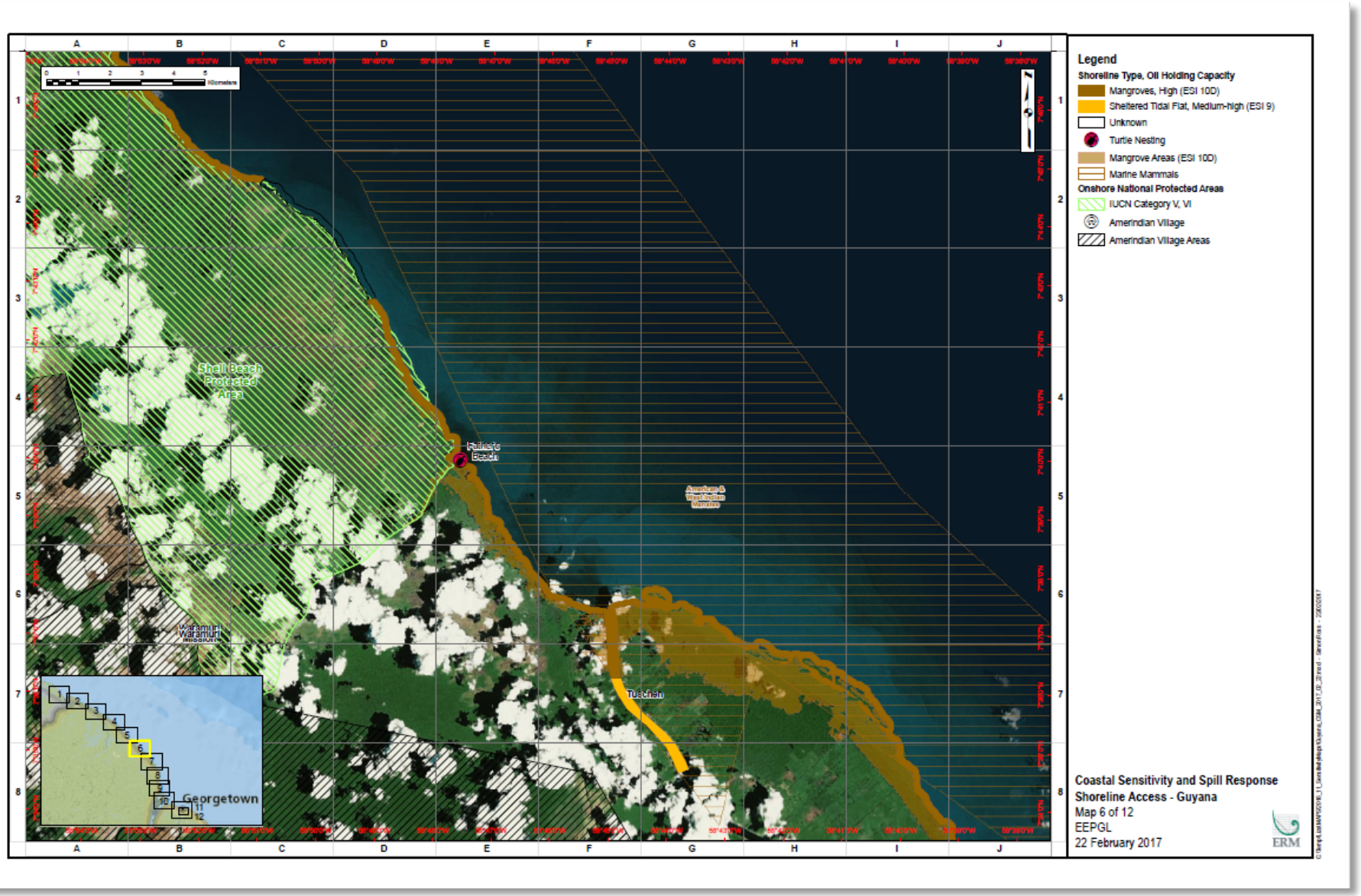



Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Turtle Nesting
Mangrove Areas (ESI 10D)
Marine Mammals
Onshore National Protected Areas (Points)
IUCN Category V & VI
Onshore National Protected Areas
IUCN Category V, VI
Amerindian Village Areas
Ecotourism
Regional Roads
Wreck
Almond Beach
Shell Beach Protected Area
Shell Beach Protected Area
Imataca
Georgetown
Ltd Beach
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 2 of 12
EEPGL
22 February 2017
ERM

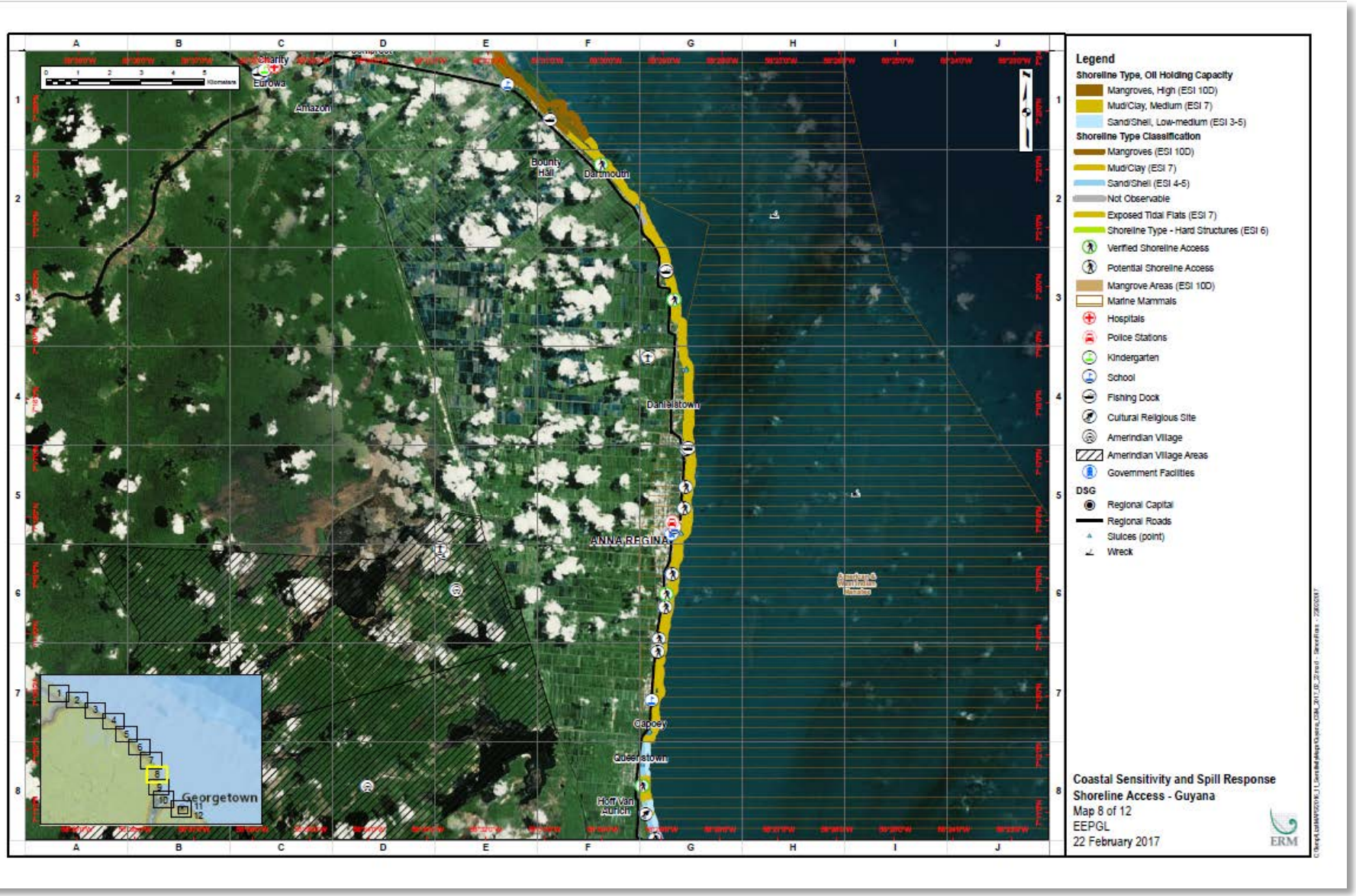

Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Sheltered Tidal Flat, Medium-high (ESI 9)
Turtle Nesting
Mangrove Areas (ESI 10D)
Marine Mammals
Onshore National Protected Areas
IUCN Category V, VI
Amerindian Village
Amerindian Village Areas
Ecotourism
Wreck
Shell Beach Protected Area
Georgetown
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 3 of 12
EEPGL
22 February 2017
ERM

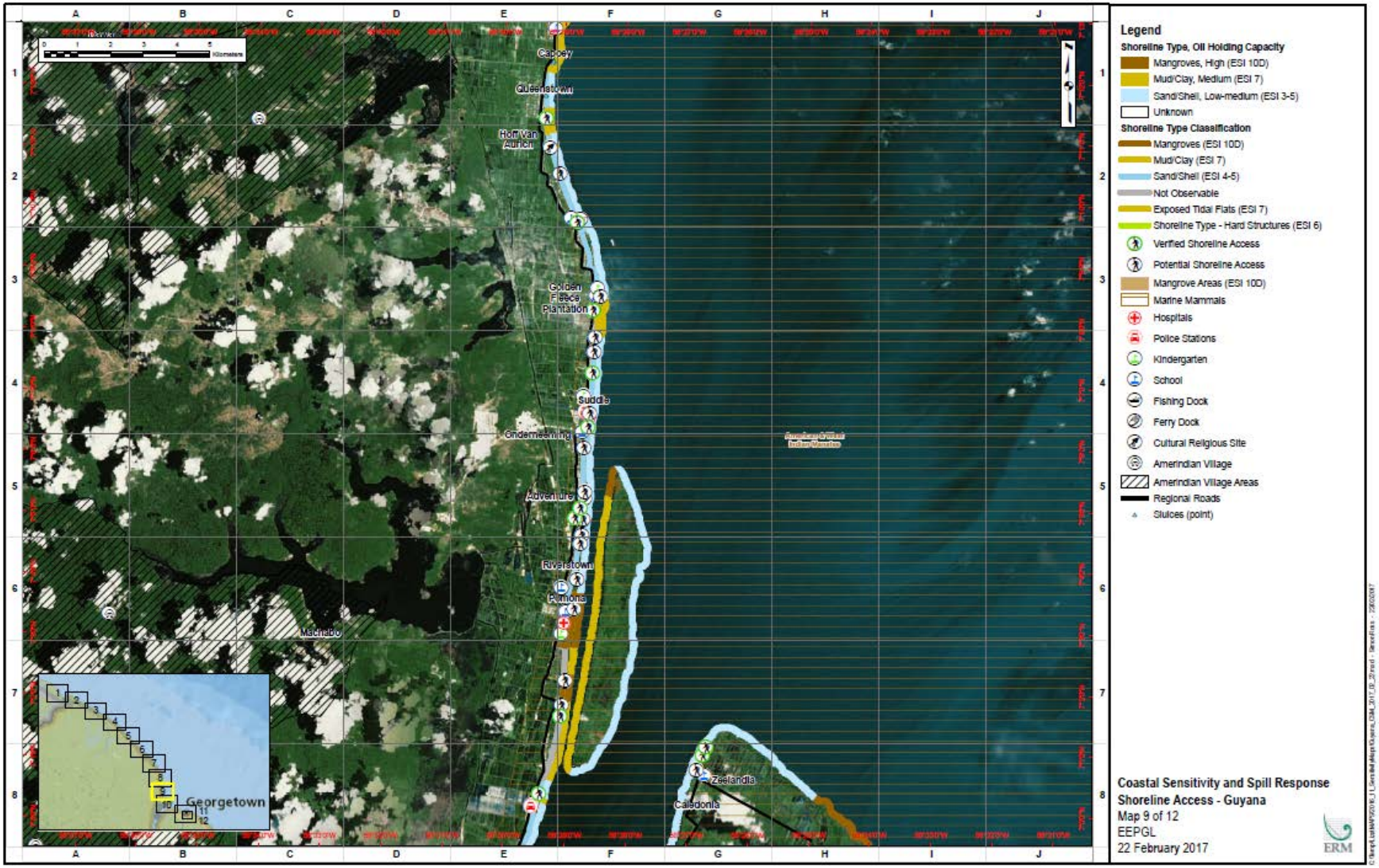

Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Unknown
Mangrove Areas (ESI 10D)
Marine Mammals
Onshore National Protected Areas
IUCN Category V, VI
Amerindian Village Areas
Iron Pole Beach
Shell Beach Protected Area
Georgetown
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 4 of 12
EEPGL
22 February 2017
ERM

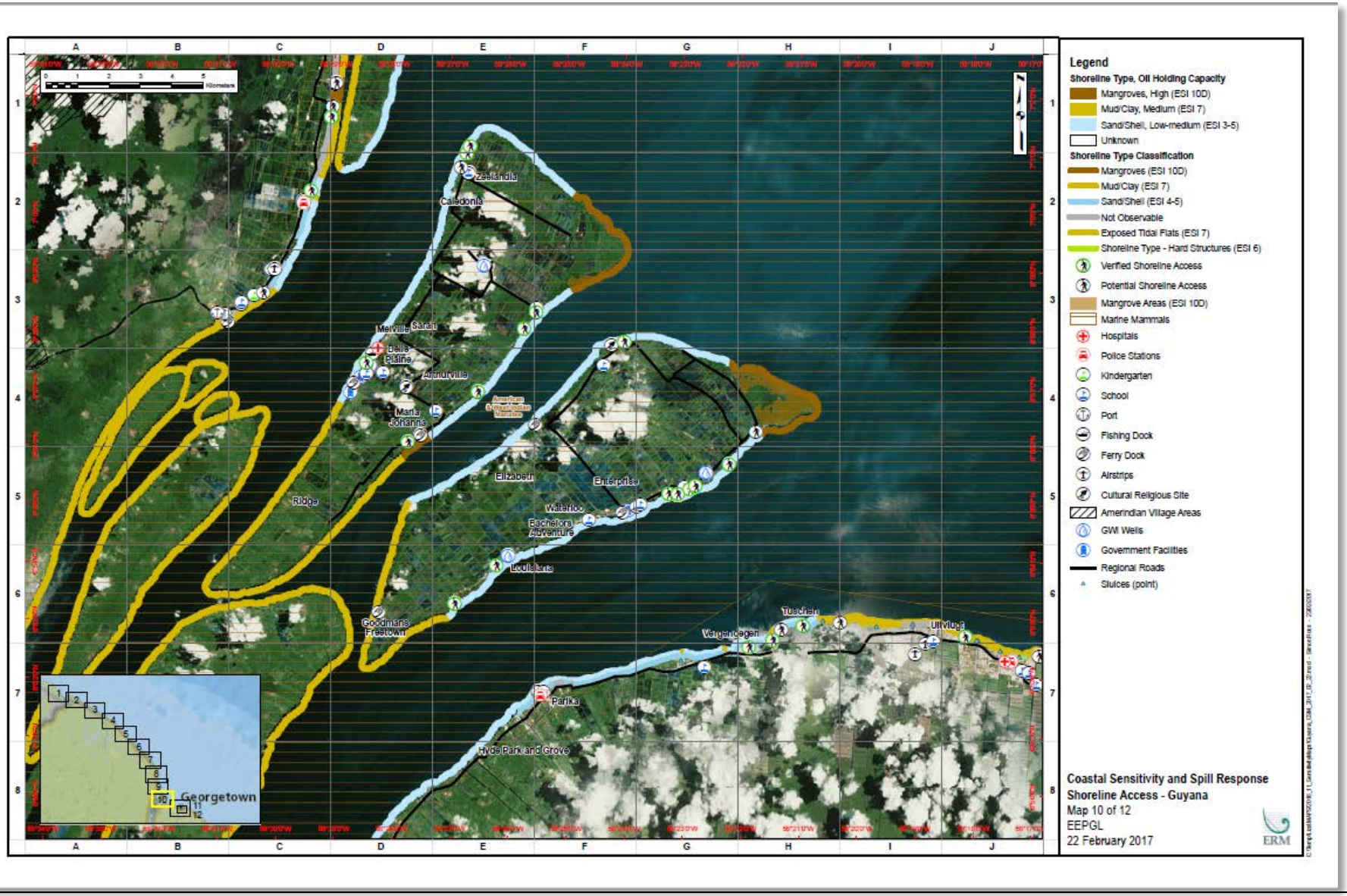

Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Unknown
Mangrove Areas (ESI 10D)
Marine Mammals
Onshore National Protected Areas
IUCN Category V, VI
Amerindian Village Areas
Shell Beach Protected Area
Georgetown
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 5 of 12
EEPGL
22 February 2017
ERM


Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Sheltered Tidal Flat, Medium-high (ESI 9)
Unknown
Turtle Nesting
Mangrove Areas (ESI 10D)
Marine Mammals
Onshore National Protected Areas
IUCN Category V, VI
Amerindian Village
Amerindian Village Areas
Shell Beach Protected Area
Georgetown
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 6 of 12
EEPGL
22 February 2017
ERM

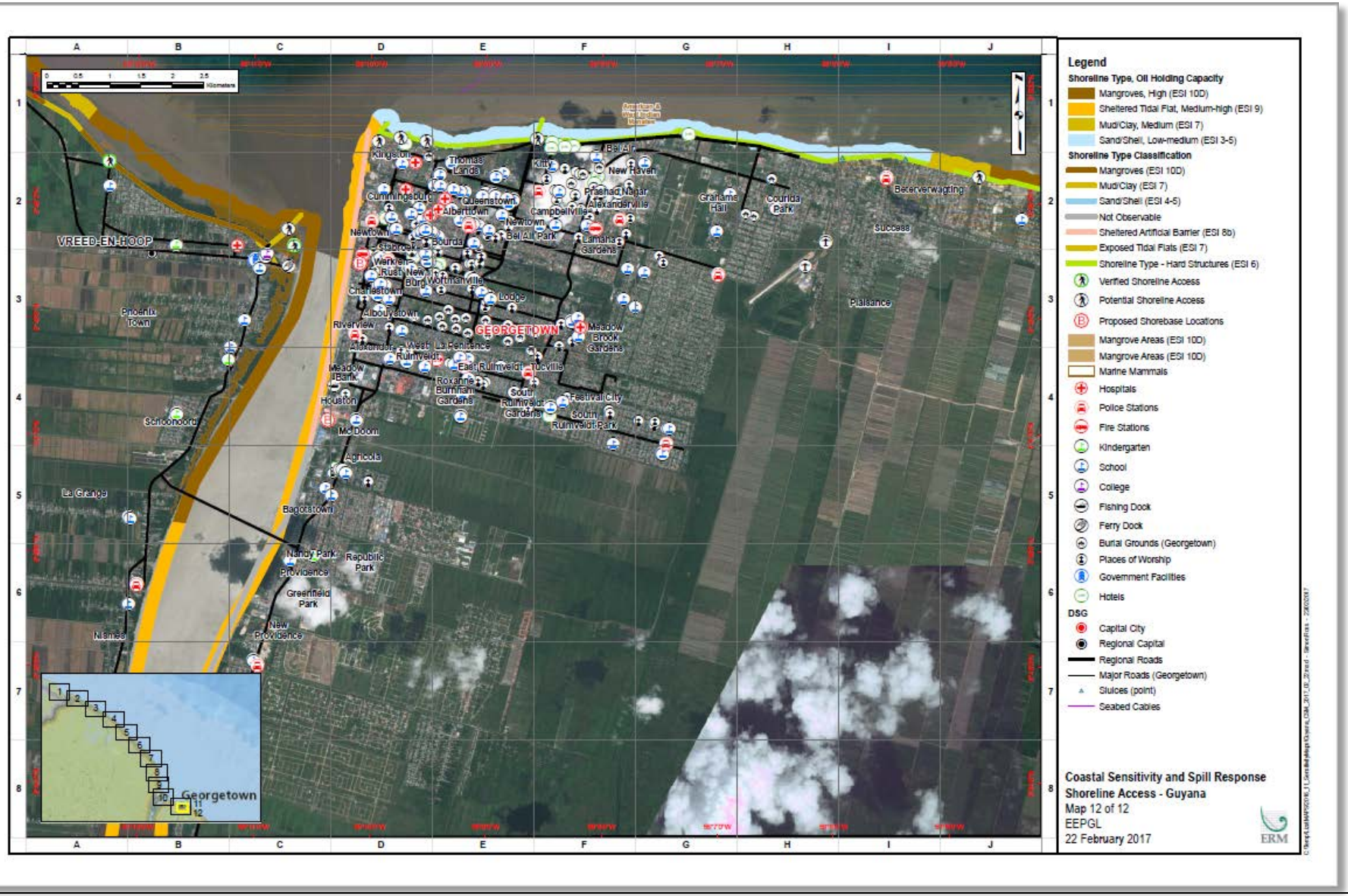

Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Sheltered Tidal Flat, Medium-High (ESI 9)
Mud/Clay, Medium (ESI 7)
Shoreline Type Classification
Mangroves (ESI 10D)
Mud/Clay (ESI 7)
Exposed Tidal Flats (ESI 7)
Shoreline Type - Hard Structures (ESI 6)
Verified Shoreline Access
Mangrove Areas (ESI 10D)
Marine Mammals
Hospitals
Kindergarten
School
Fishing Dock
Amerindian Village Areas
Government Facilities
Regional Roads
Sluices (point)
Kitty
Marlborough
Charity
Edrowa
Berks Somerset
Amazon
Georgetown
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 7 of 12
EEPGL
22 February 2017
ERM


Clarity
Eurowa
Amazon
Bounty Hall
Dartmouth
Danielstown
ANNA REGINA
Capoey
Queenstown
Hoff Van Aurich
Georgetown
Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Mud/Clay, Medium (ESI 7)
Sand/Shell, Low-medium (ESI 3-5)
Shoreline Type Classification
Mangroves (ESI 10D)
Mud/Clay (ESI 7)
Sand/Shell (ESI 4-5)
Not Observable
Exposed Tidal Flats (ESI 7)
Shoreline Type - Hard Structures (ESI 6)
Verified Shoreline Access
Potential Shoreline Access
Mangrove Areas (ESI 10D)
Marine Mammals
Hospitals
Police Stations
Kindergarten
School
Fishing Dock
Cultural Religious Site
Amerindian Village
Amerindian Village Areas
Government Facilities
DSG
Regional Capital
Regional Roads
Sluices (point)
Wreck
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 8 of 12
EEPGL
22 February 2017
ERM

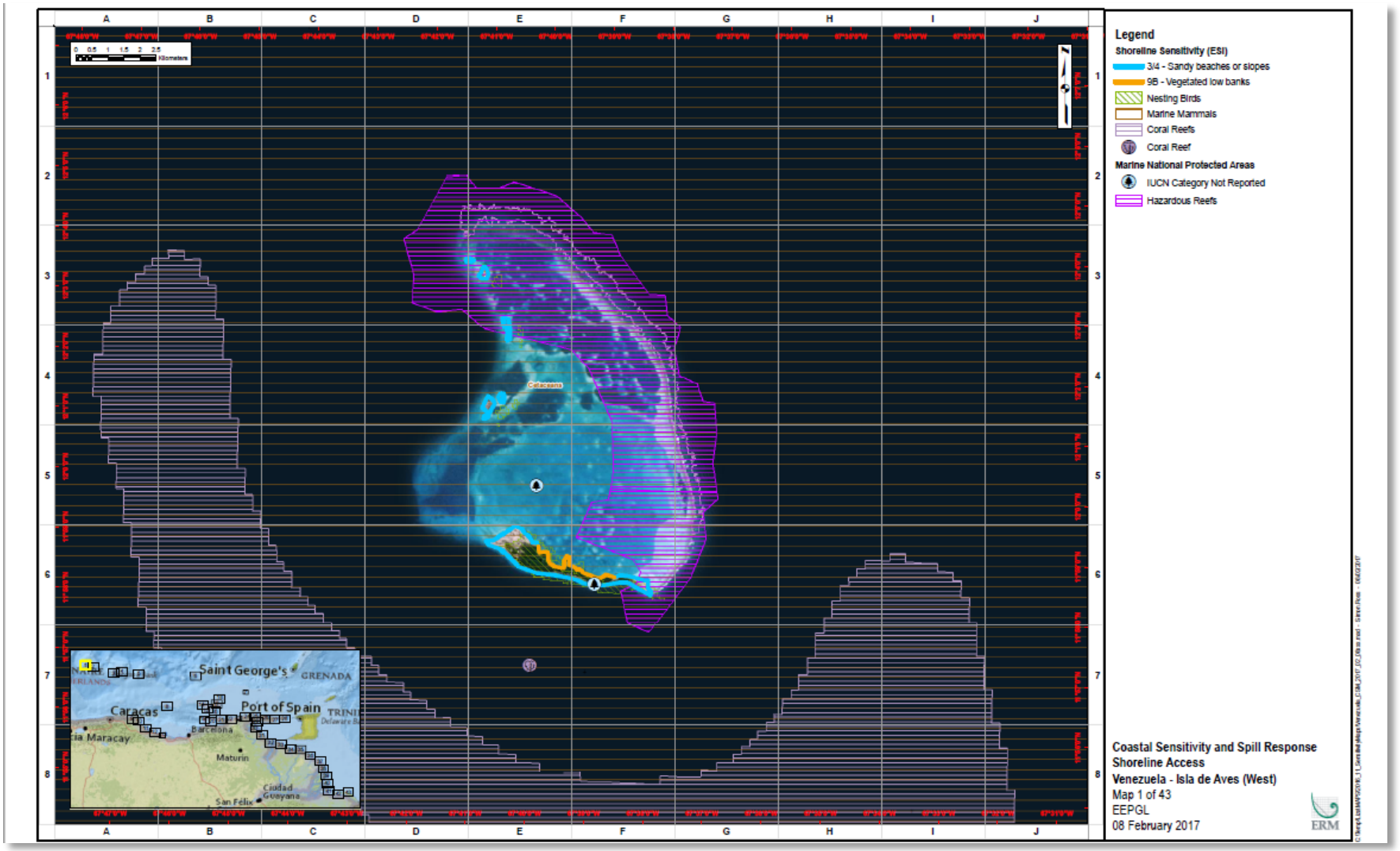

Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Mud/Clay, Medium (ESI 7)
Sand/Shell, Low-medium (ESI 3-5)
Unknown
Shoreline Type Classification
Mangroves (ESI 10D)
Mud/Clay (ESI 7)
Sand/Shell (ESI 4-5)
Not Observable
Exposed Tidal Flats (ESI 7)
Shoreline Type - Hard Structures (ESI 6)
Verified Shoreline Access
Potential Shoreline Access
Mangrove Areas (ESI 10D)
Marine Mammals
Hospitals
Police Stations
Kindergarten
School
Fishing Dock
Ferry Dock
Cultural Religious Site
Amerindian Village
Amerindian Village Areas
Regional Roads
Sluices (point)
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 9 of 12
EEPGL
22 February 2017
ERM
Cappey
Queenstown
Hoff Van Aurich
Golden Fleece Plantation
Suddie
Onderneeming
Adventure
Riverstown
Pumona
Machabo
Georgetown
Zeelandia
Caledonia

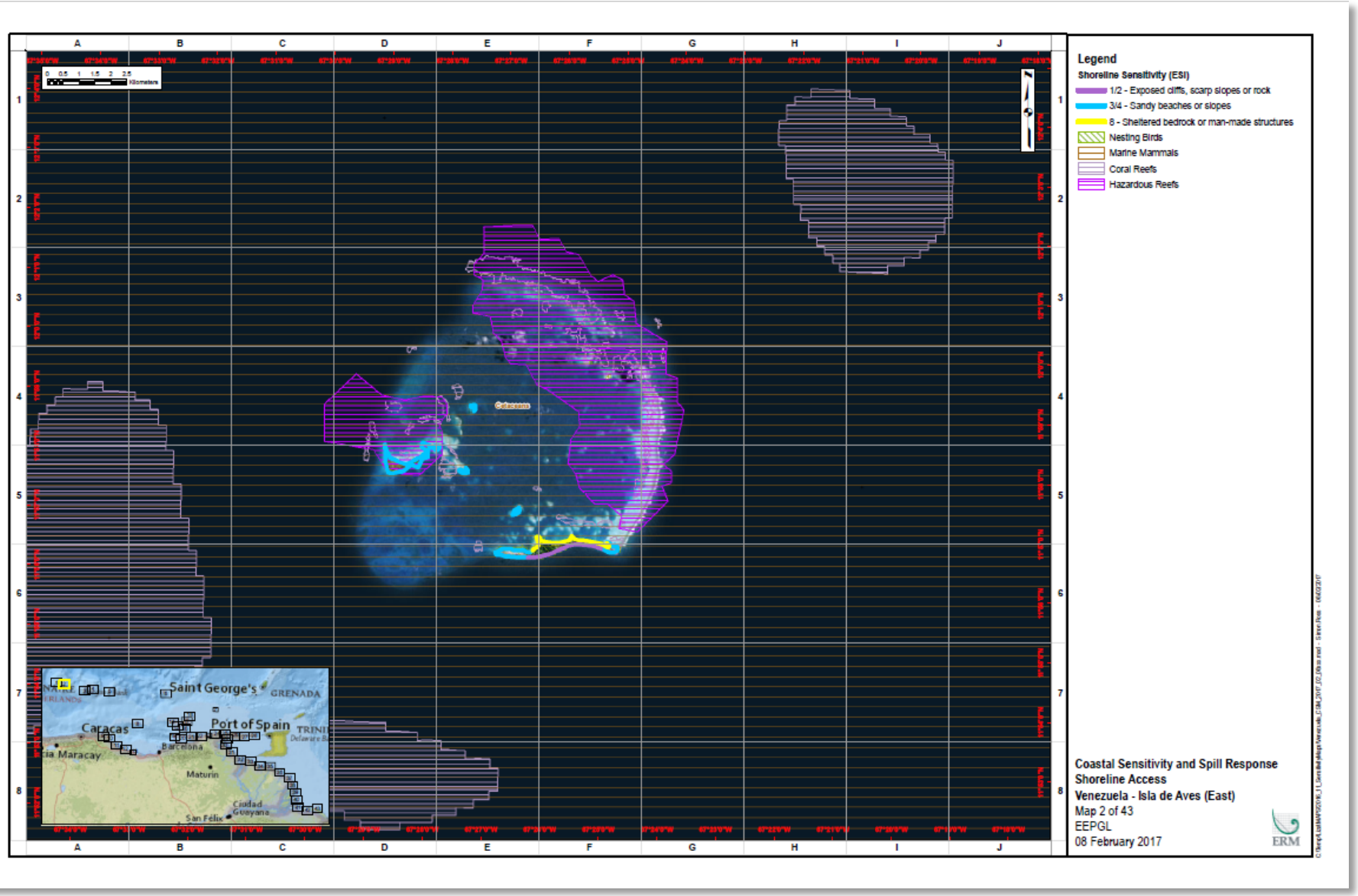

Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Mud/Clay, Medium (ESI 7)
Sand/Shell, Low-medium (ESI 3-5)
Unknown
Shoreline Type Classification
Mangroves (ESI 10D)
Mud/Clay (ESI 7)
Sand/Shell (ESI 4-5)
Not Observable
Exposed Tidal Flats (ESI 7)
Shoreline Type - Hard Structures (ESI 6)
Verified Shoreline Access
Potential Shoreline Access
Mangrove Areas (ESI 10D)
Marine Mammals
Hospitals
Police Stations
Kindergarten
School
Port
Fishing Dock
Ferry Dock
Airstrips
Cultural Religious Site
Amerindian Village Areas
GWI Wells
Government Facilities
Regional Roads
Sluices (point)
Zeelandia
Caledonia
Melville
Sarah
Belle Plaine
Adventville
Maria Johanna
Elizabeth
Enterprise
Waterloo
Bachelors Adventure
Louisiana
Ridge
Goodmans Freetown
Parika
Hyde Park and Grove
Vergenoegen
Tuschen
Uitvlugt
Georgetown
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 10 of 12
EEPGL
22 February 2017
ERM

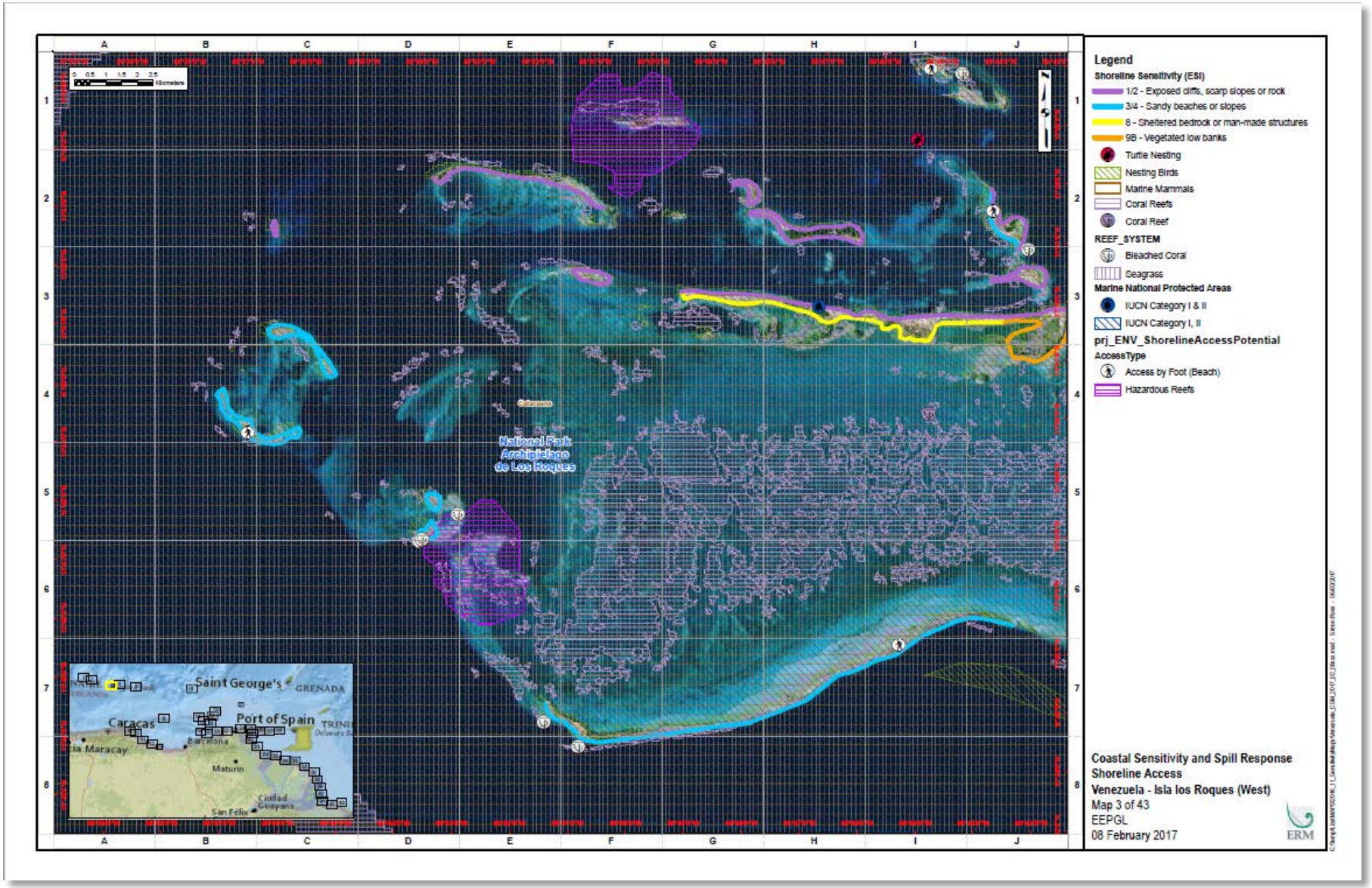

SEE MAP 12 FOR DETAIL
Uitvlugt
Anna Catherina
Den Amstel
La Jalousie
Windsor Forest
Harlem
VREED-EN-HOOP
Margot
Lusignan
Great Diamond
Good Intent
De Gezusters
Golden Grove
Lorenza Patentia
Good Success
Georgetown
Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Sheltered Tidal Flat, Medium-high (ESI 9)
Mud/Clay, Medium (ESI 7)
Sand/Shell, Low-medium (ESI 3-5)
Unknown
Shoreline Type Classification
Mangroves (ESI 10D)
Mud/Clay (ESI 7)
Sand/Shell (ESI 4-5)
Not Observable
Sheltered Artificial Barrier (ESI 8b)
Exposed Tidal Flats (ESI 7)
Shoreline Type - Hard Structures (ESI 6)
Verified Shoreline Access
Potential Shoreline Access
Proposed Shorebase Locations
Mangrove Areas (ESI 10D)
Mangrove Areas (ESI 10D)
Marine Mammals
Hospitals
Police Stations
Fire Stations
Kindergarten
School
College
Fishing Dock
Ferry Dock
Cultural Religious Site
Burial Grounds (Georgetown)
Places of Worship
Government Facilities
Hotels
DSG
Capital City
Regional Capital
Regional Roads
Major Roads (Georgetown)
Sluices (point)
Shipping Route
Seabed Cables
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 11 of 12
EEPGL
22 February 2017
ERM

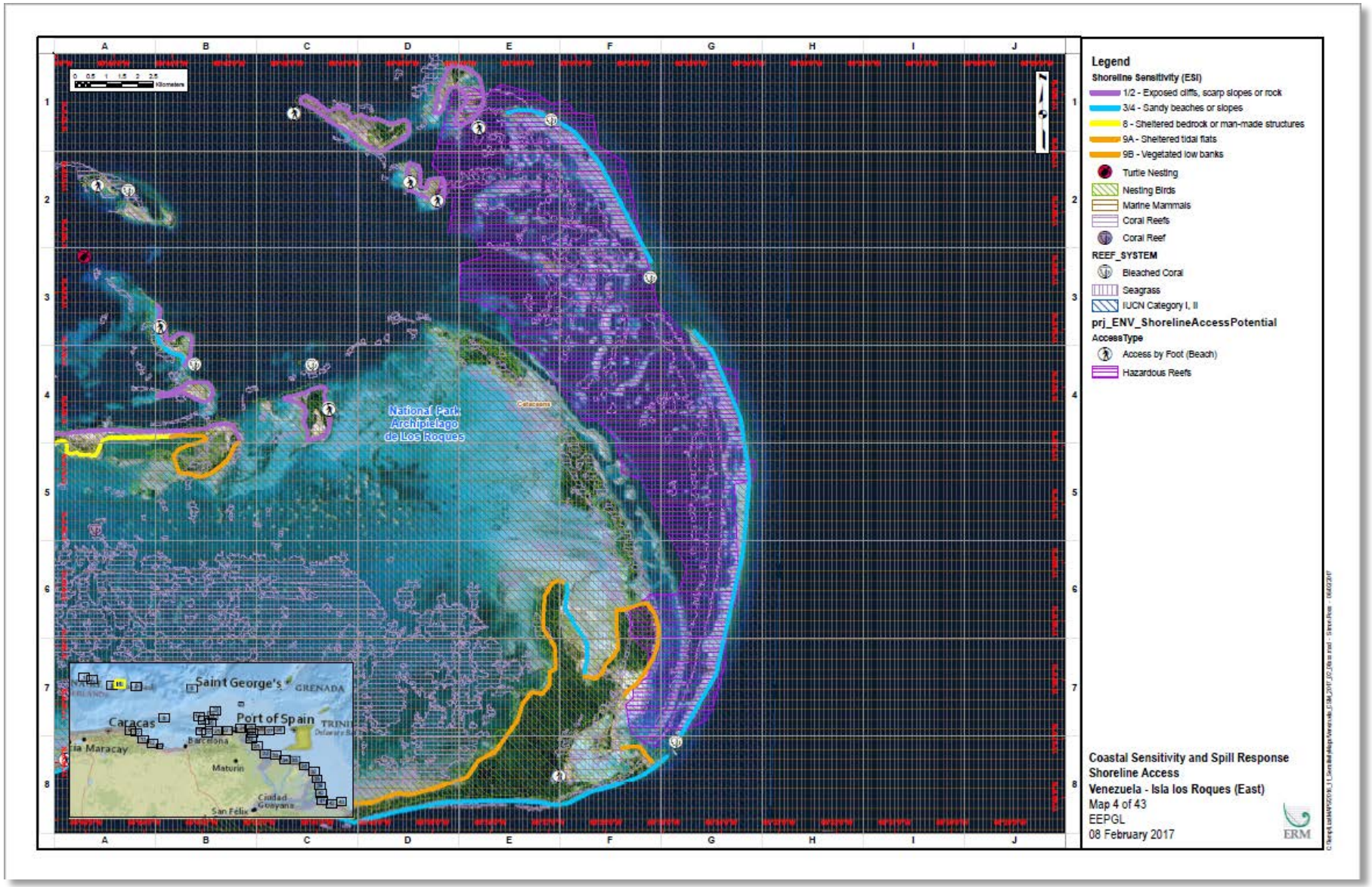

Legend
Shoreline Type, Oil Holding Capacity
Mangroves, High (ESI 10D)
Sheltered Tidal Flat, Medium-high (ESI 9)
Mud/Clay, Medium (ESI 7)
Sand/Shell, Low-medium (ESI 3-5)
Shoreline Type Classification
Mangroves (ESI 10D)
Mud/Clay (ESI 7)
Sand/Shell (ESI 4-5)
Not Observable
Sheltered Artificial Barrier (ESI 8b)
Exposed Tidal Flats (ESI 7)
Shoreline Type - Hard Structures (ESI 6)
Verified Shoreline Access
Potential Shoreline Access
Proposed Shorebase Locations
Mangrove Areas (ESI 10D)
Mangrove Areas (ESI 10D)
Marine Mammals
Hospitals
Police Stations
Fire Stations
Kindergarten
School
College
Fishing Dock
Ferry Dock
Burial Grounds (Georgetown)
Places of Worship
Government Facilities
Hotels
DSG
Capital City
Regional Capital
Regional Roads
Major Roads (Georgetown)
Sluices (point)
Seabed Cables
Coastal Sensitivity and Spill Response
Shoreline Access - Guyana
Map 12 of 12
EEPGL
22 February 2017
ERM
GEORGETOWN
VREED-EN-HOOP
Georgetown

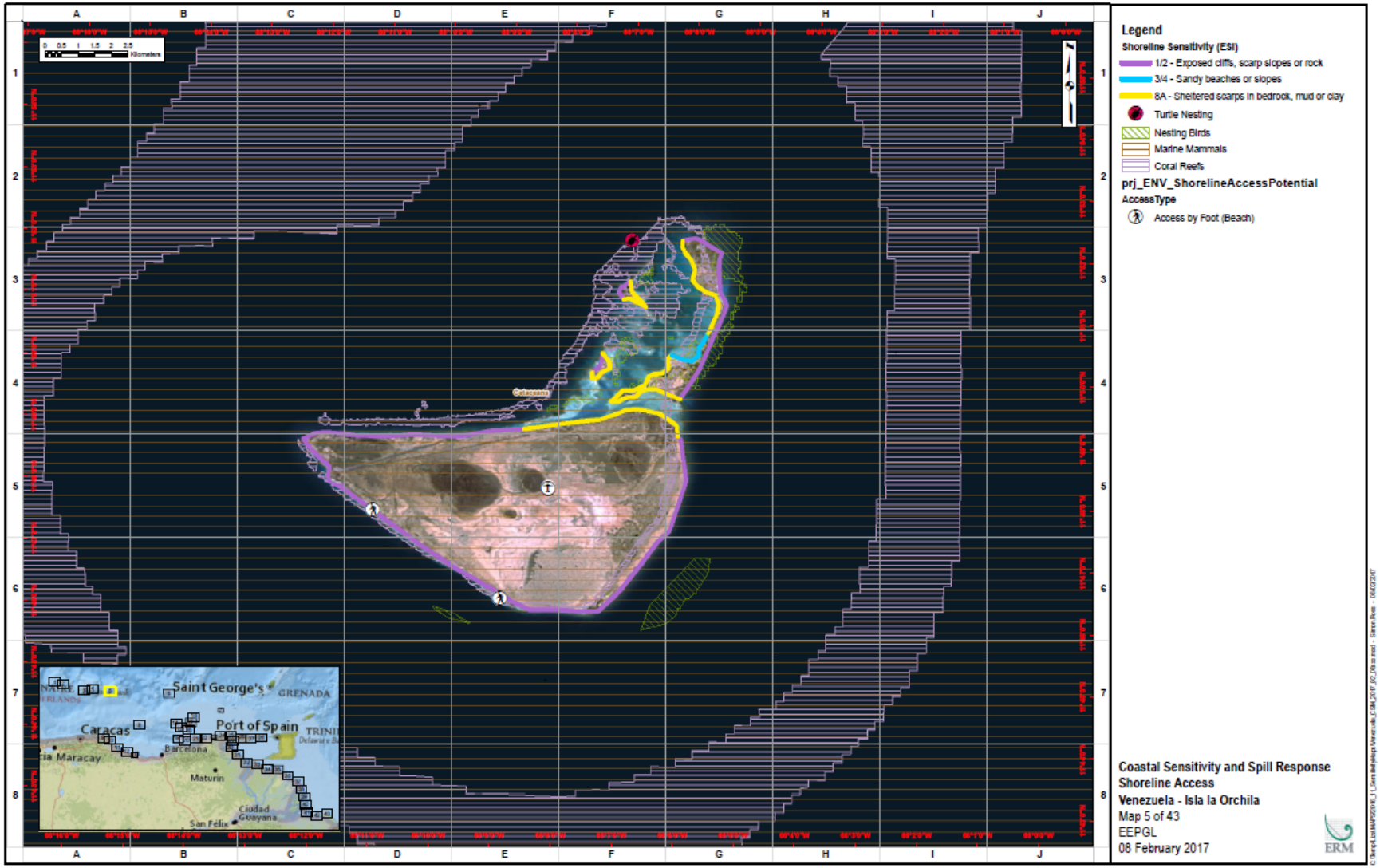
D.2 VENEZUELA Coastal Sensitivity Maps

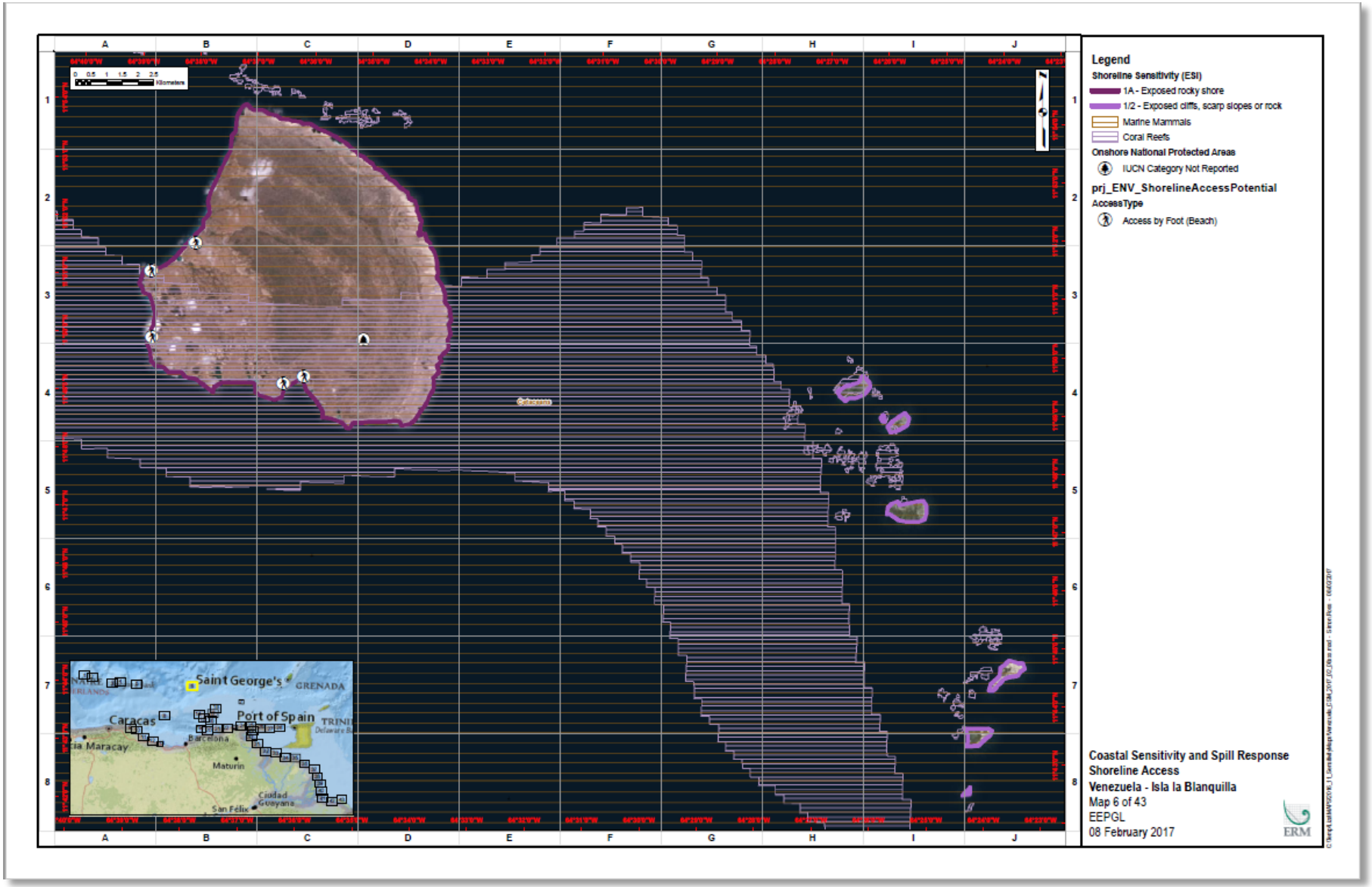


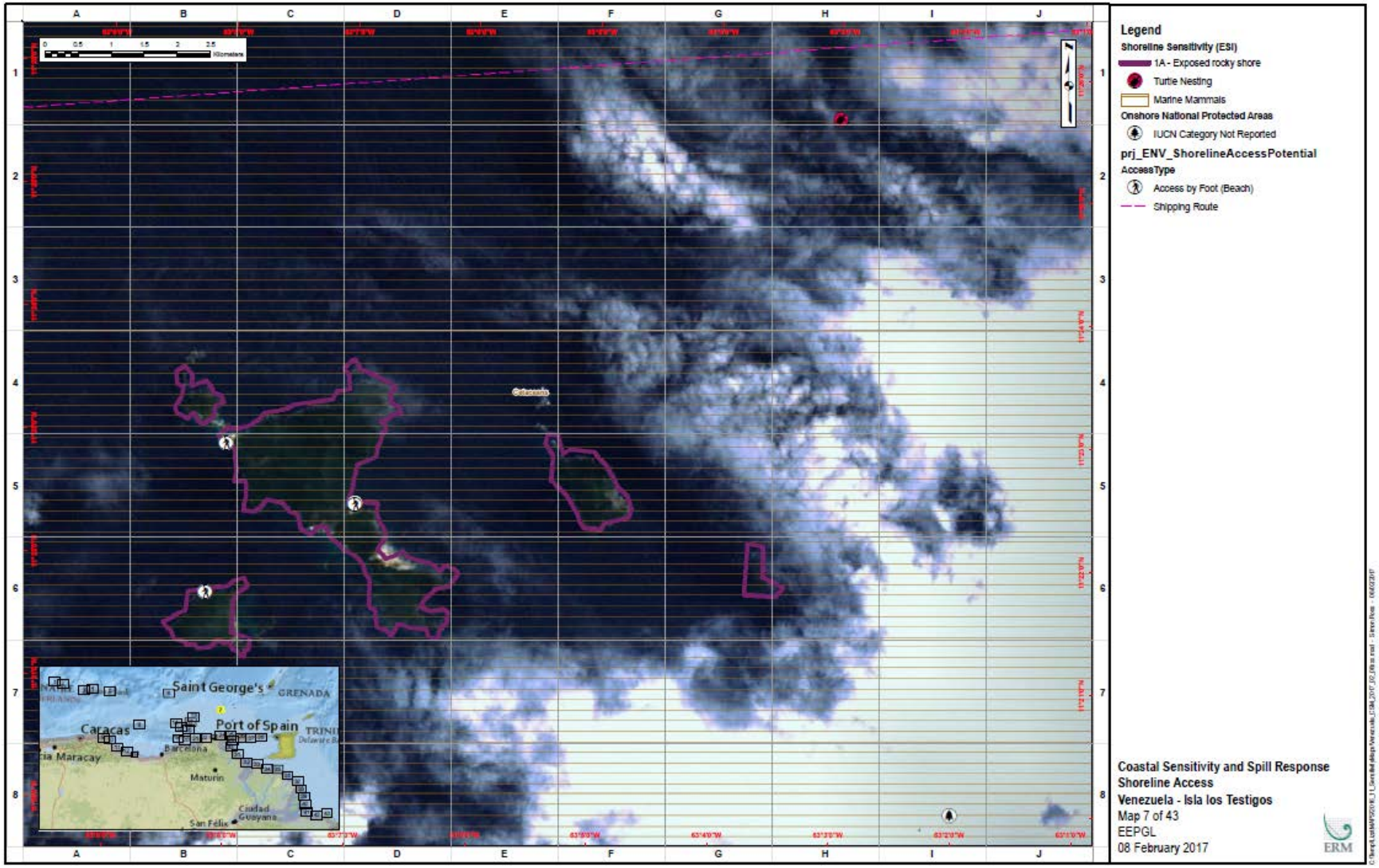

Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
3/4 - Sandy beaches or slopes
8 - Sheltered bedrock or man-made structures
Nesting Birds
Marine Mammals
Coral Reefs
Hazardous Reefs
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Isla de Aves (East)
Map 2 of 43
EEPGL
08 February 2017
ERM
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix

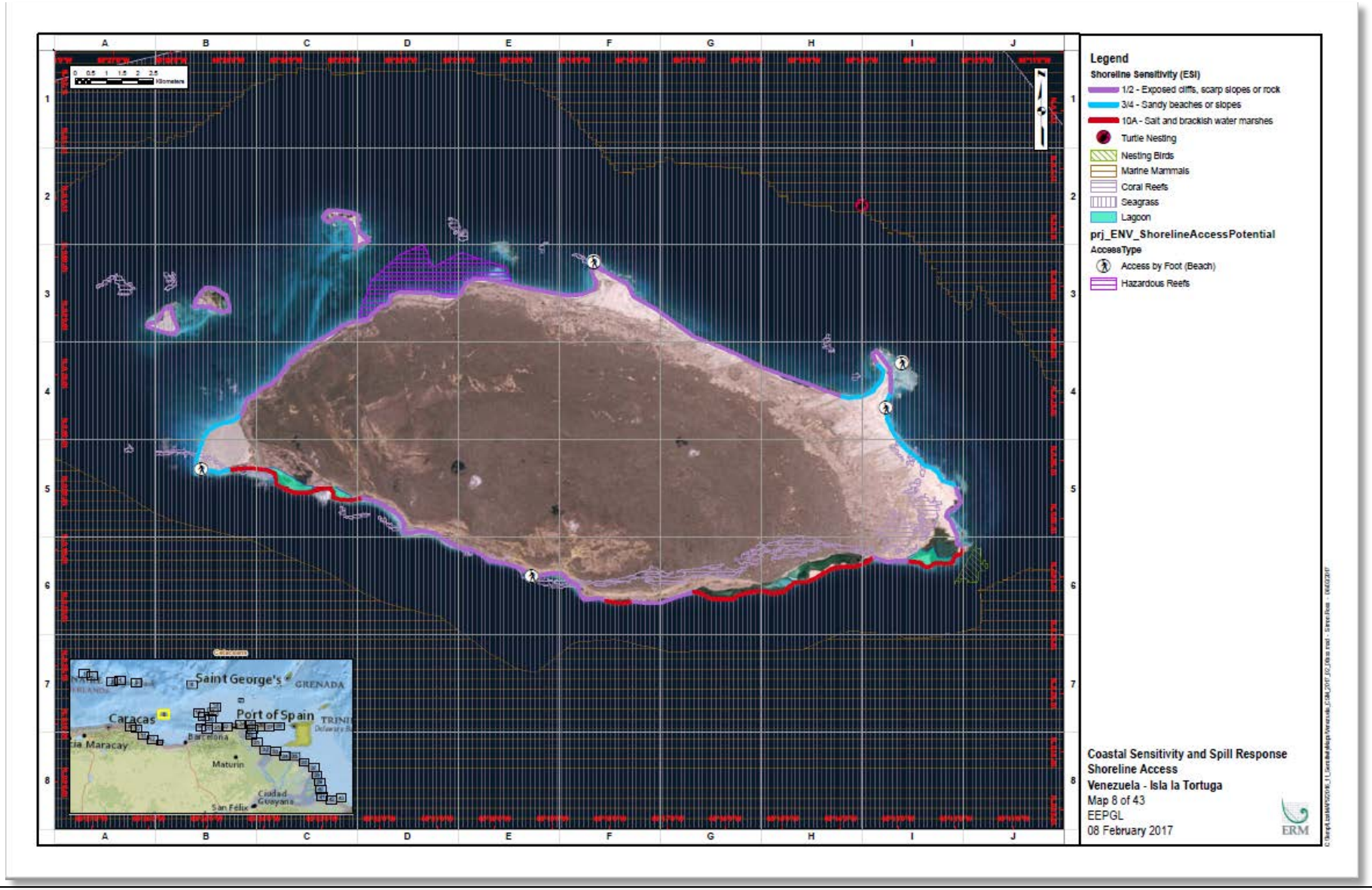

Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
3/4 - Sandy beaches or slopes
8 - Sheltered bedrock or man-made structures
9B - Vegetated low banks
Turtle Nesting
Nesting Birds
Marine Mammals
Coral Reefs
Coral Reef
REEF_SYSTEM
Bleached Coral
Seagrass
Marine National Protected Areas
IUCN Category I & II
IUCN Category I, II
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Hazardous Reefs
National Park Archipielago de Los Roques
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Isla los Roques (West)
Map 3 of 43
EEPGL
08 February 2017
ERM

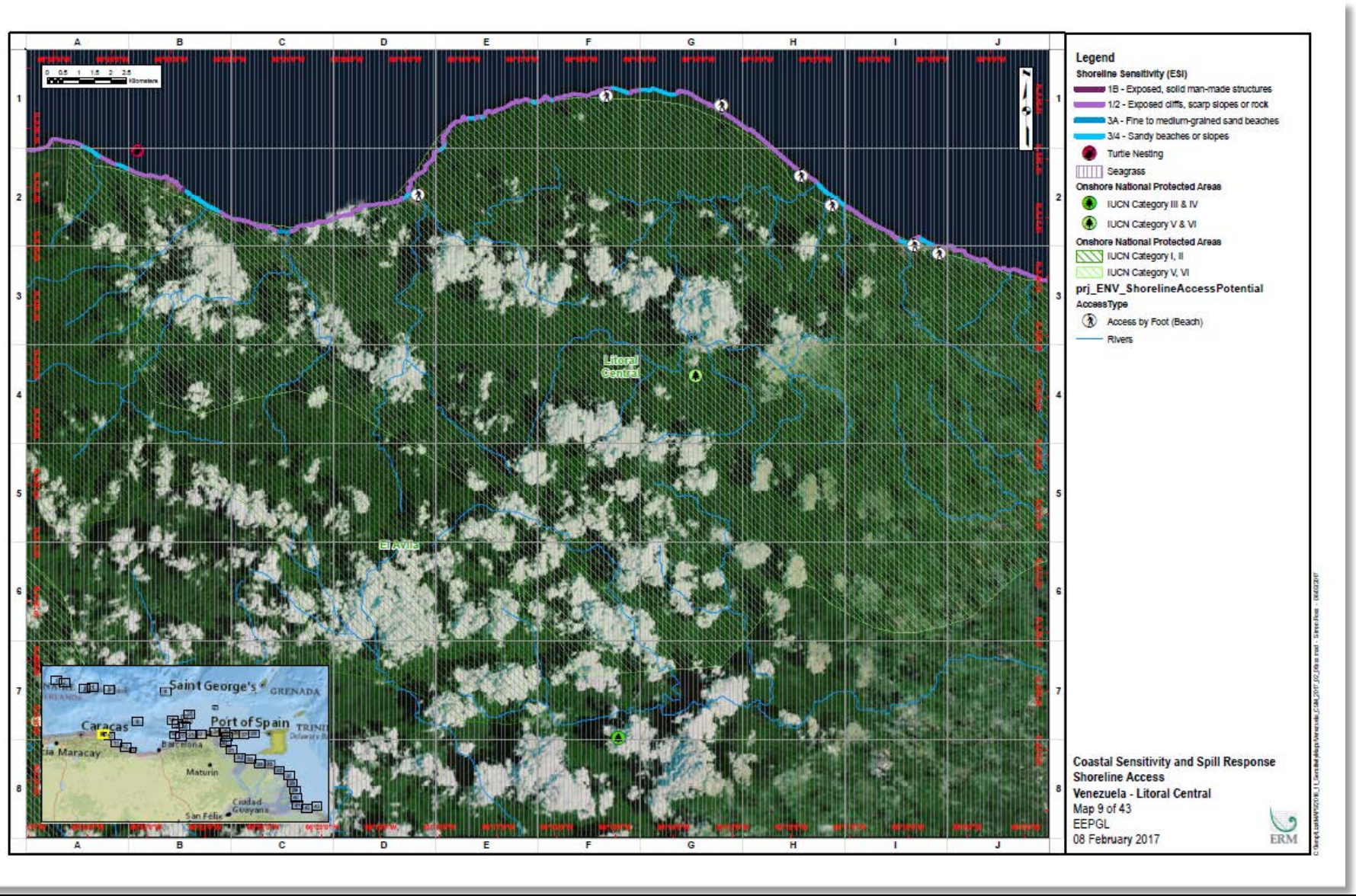

Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
3/4 - Sandy beaches or slopes
8 - Sheltered bedrock or man-made structures
9A - Sheltered tidal flats
9B - Vegetated low banks
Turtle Nesting
Nesting Birds
Marine Mammals
Coral Reefs
Coral Reef
REEF_SYSTEM
Bleached Coral
Seagrass
IUCN Category I, II
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Hazardous Reefs
National Park Archipielago de Los Roques
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Isla los Roques (East)
Map 4 of 43
EEPGL
08 February 2017
ERM

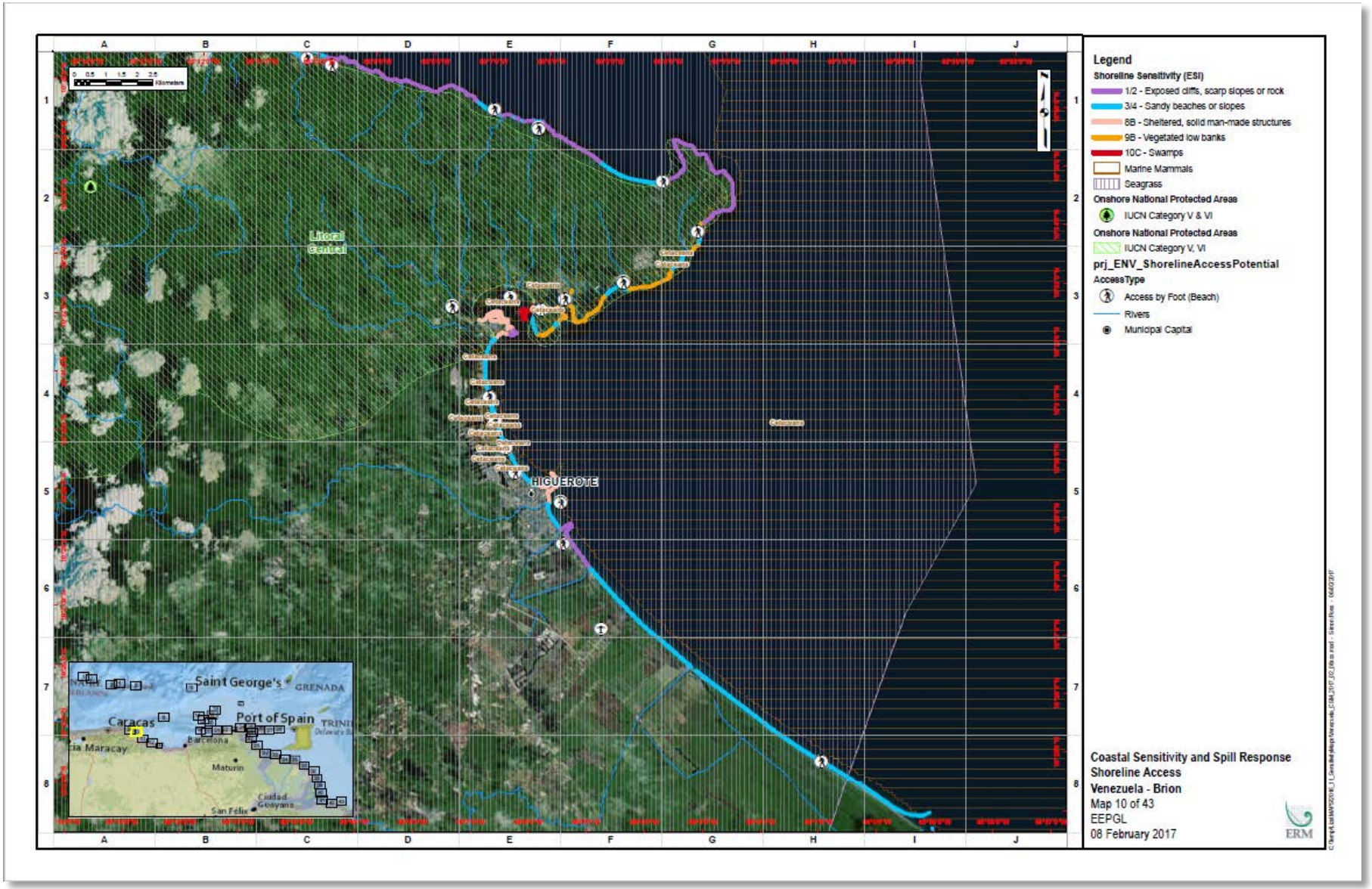

Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
3/4 - Sandy beaches or slopes
8A - Sheltered scarps in bedrock, mud or clay
Turtle Nesting
Nesting Birds
Marine Mammals
Coral Reefs
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Isla la Orchila
Map 5 of 43
EEPGL
08 February 2017
ERM
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Felix

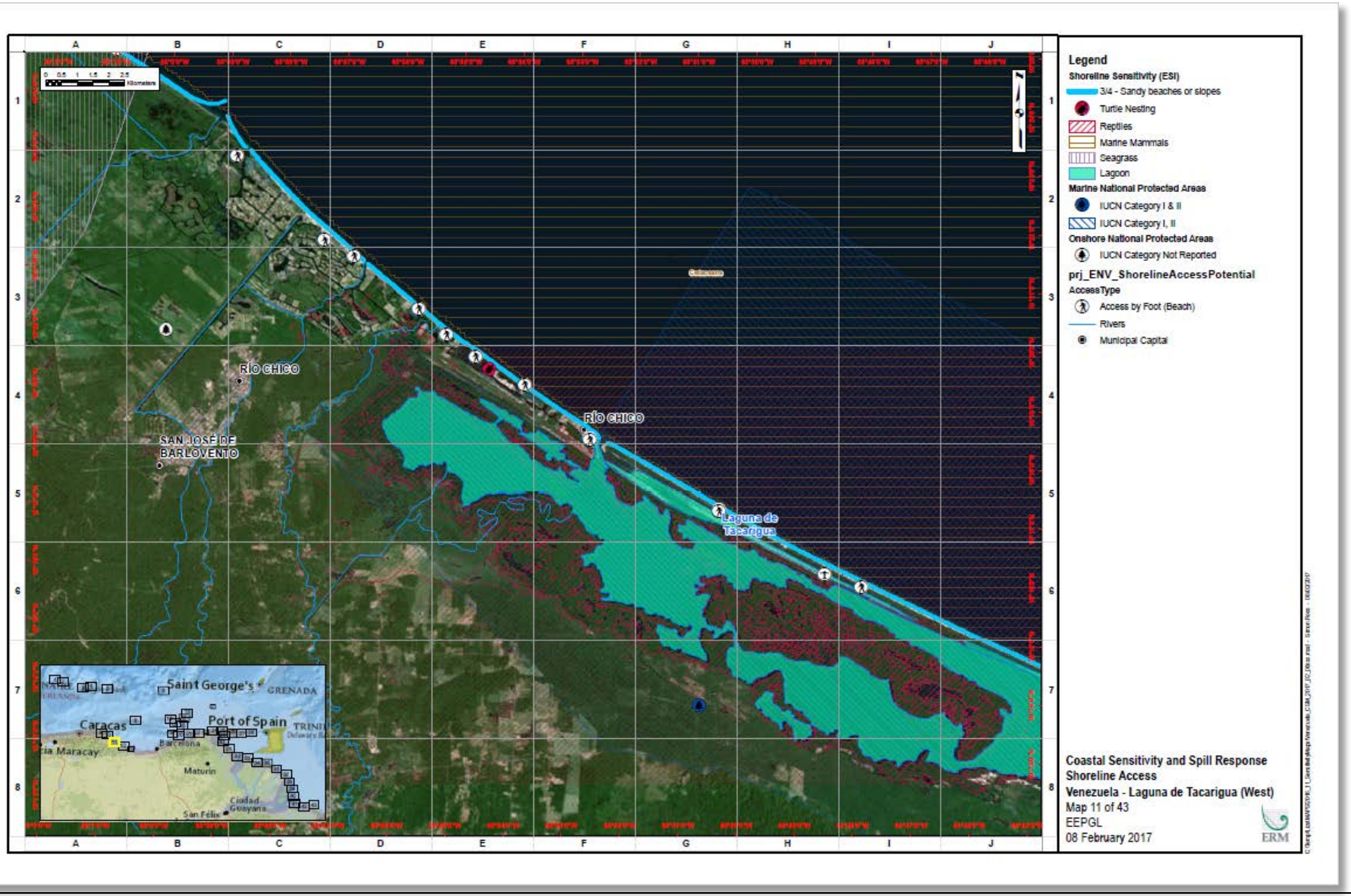

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1/2 - Exposed cliffs, scarp slopes or rock
Marine Mammals
Coral Reefs
Onshore National Protected Areas
IUCN Category Not Reported
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Isla la Blanquilla
Map 6 of 43
EEPGL
08 February 2017
ERM
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix

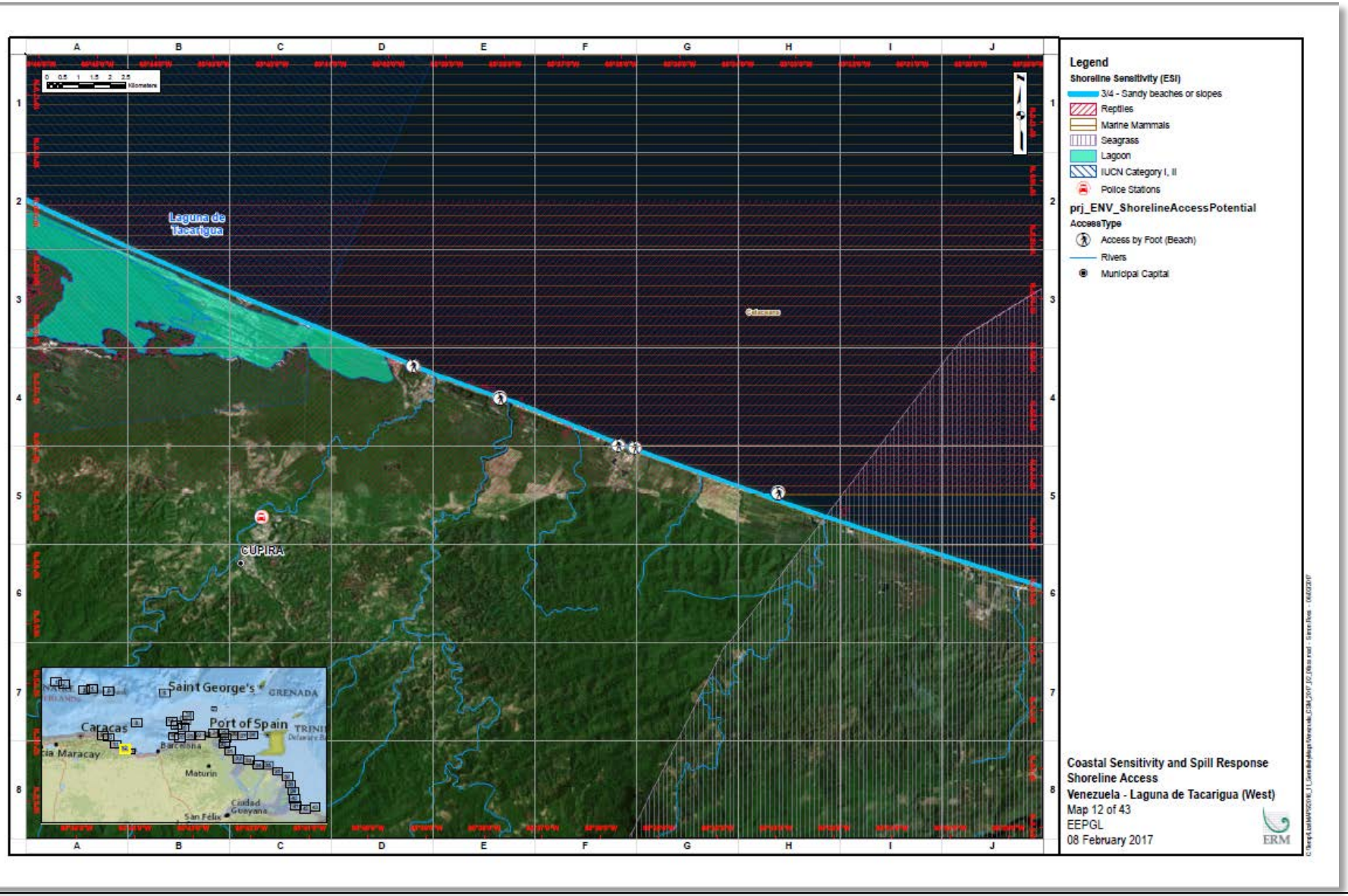

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
Turtle Nesting
Marine Mammals
Onshore National Protected Areas
IUCN Category Not Reported
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Isla los Testigos
Map 7 of 43
EEPGL
08 February 2017
ERM
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix

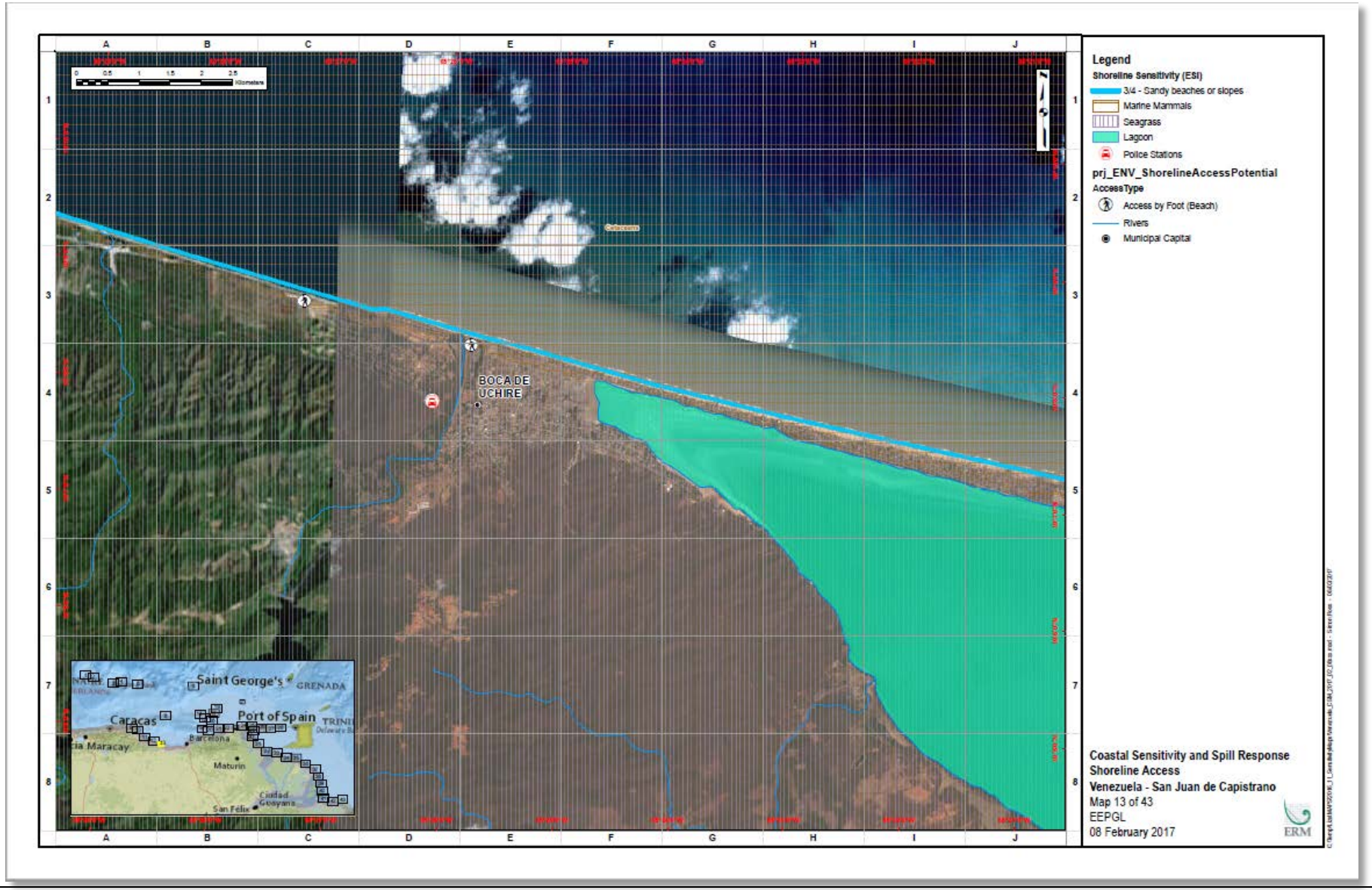

Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
3/4 - Sandy beaches or slopes
10A - Salt and brackish water marshes
Turtle Nesting
Nesting Birds
Marine Mammals
Coral Reefs
Seagrass
Lagoon
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Hazardous Reefs
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Isla la Tortuga
Map 8 of 43
EEPGL
08 February 2017
ERM
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix

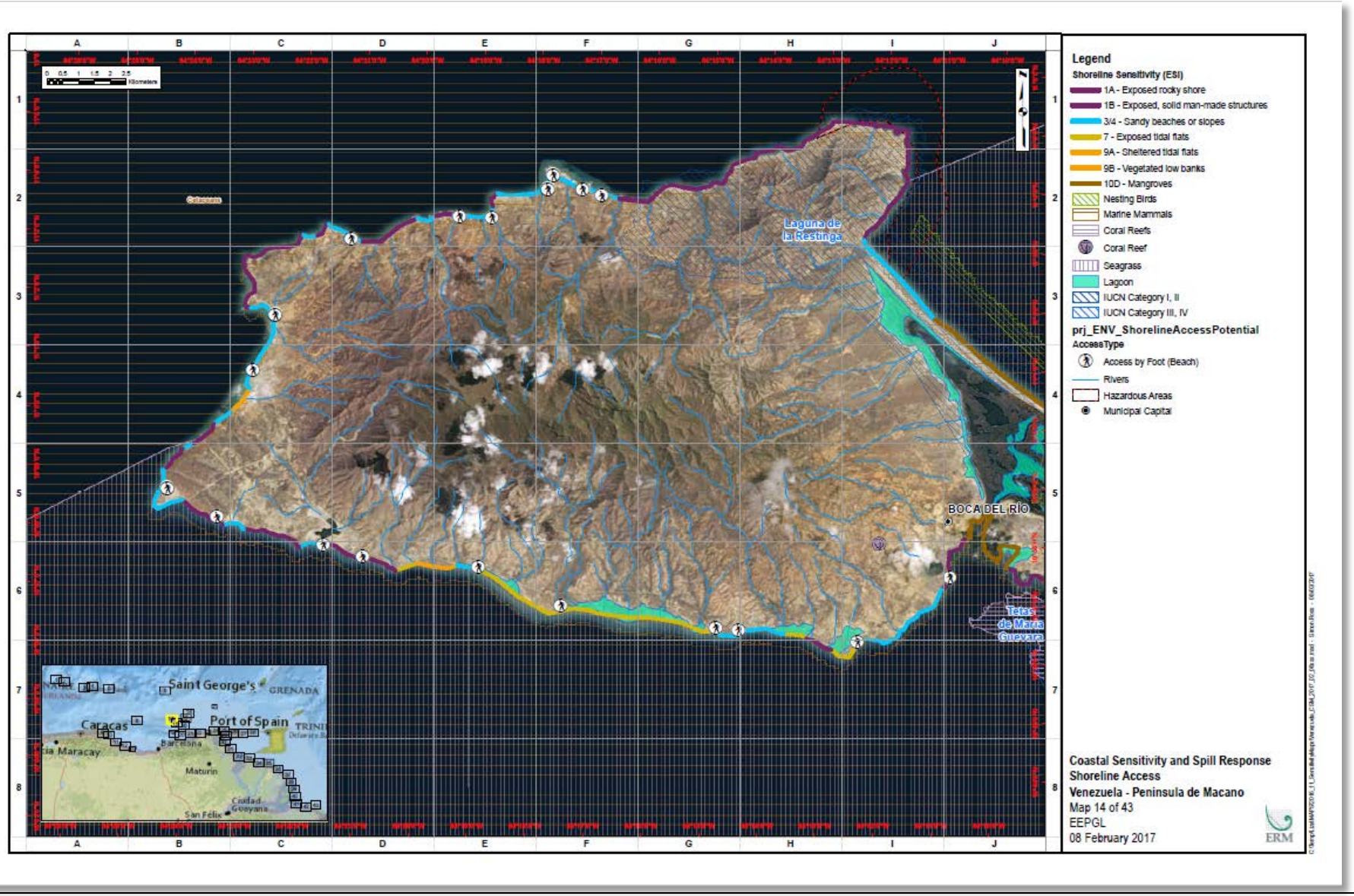

Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
3A - Fine to medium-grained sand beaches
3/4 - Sandy beaches or slopes
Turtle Nesting
Seagrass
Onshore National Protected Areas
IUCN Category III & IV
IUCN Category V & VI
Onshore National Protected Areas
IUCN Category I, II
IUCN Category V, VI
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Litoral Central
El Avila
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Litoral Central
Map 9 of 43
EEPGL
08 February 2017
ERM

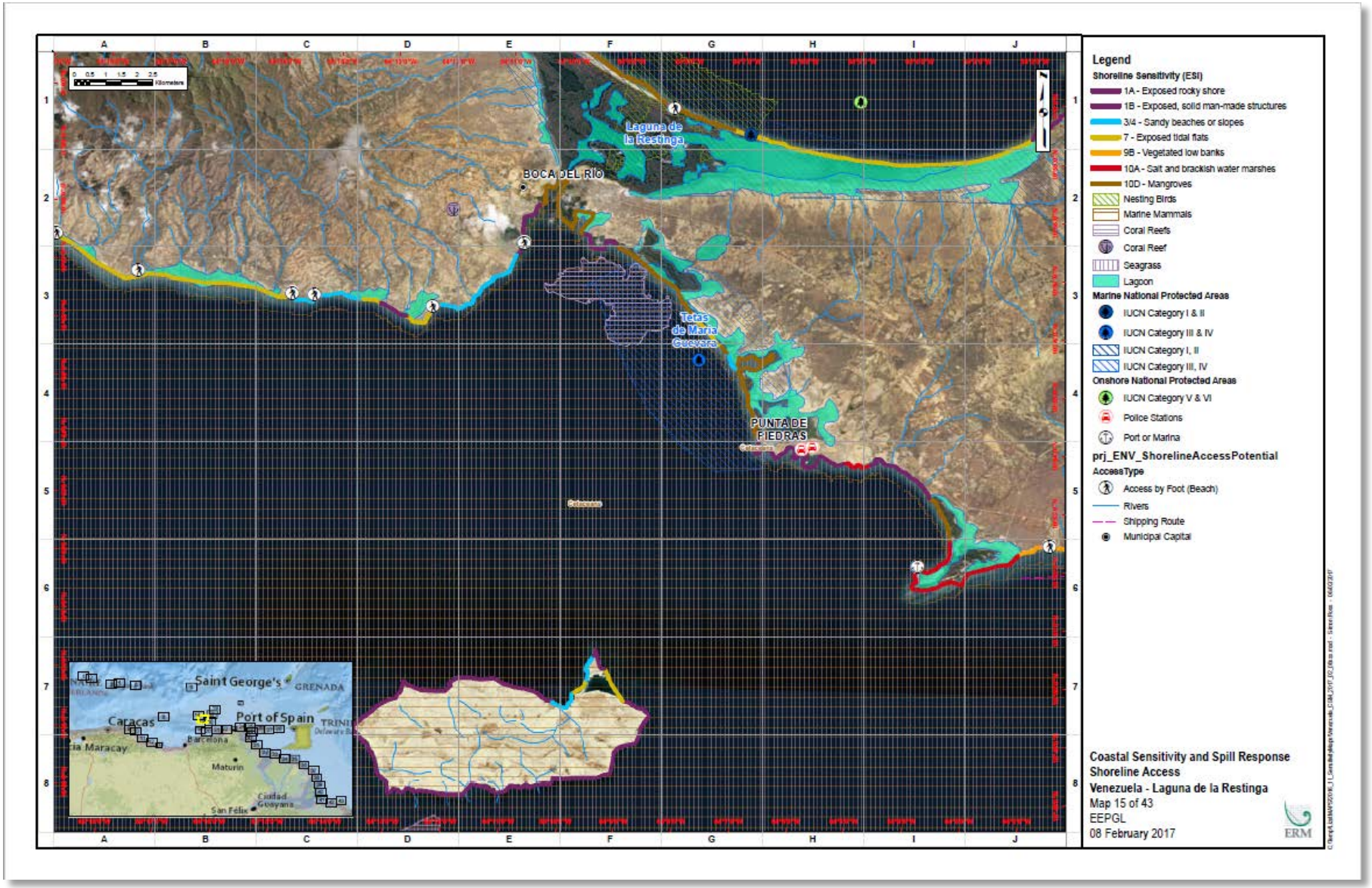

Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
3/4 - Sandy beaches or slopes
8B - Sheltered, solid man-made structures
9B - Vegetated low banks
10C - Swamps
Marine Mammals
Seagrass
Onshore National Protected Areas
IUCN Category V & VI
Onshore National Protected Areas
IUCN Category V, VI
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Municipal Capital
Litoral Central
HIGUEROTE
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Brion
Map 10 of 43
EEPGL
08 February 2017
ERM

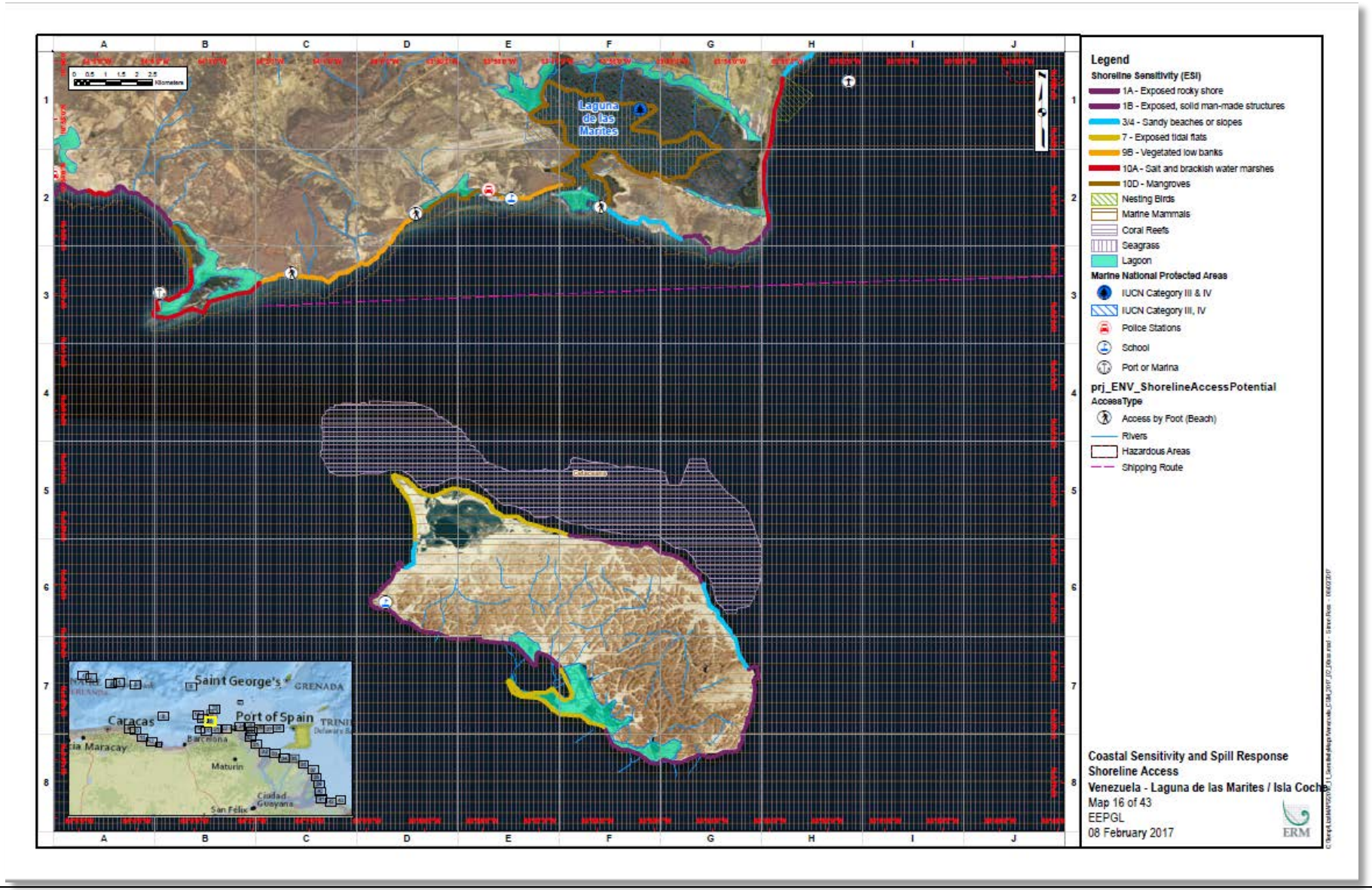

Legend
Shoreline Sensitivity (ESI)
3/4 - Sandy beaches or slopes
Turtle Nesting
Reptiles
Marine Mammals
Seagrass
Lagoon
Marine National Protected Areas
IUCN Category I & II
IUCN Category I, II
Onshore National Protected Areas
IUCN Category Not Reported
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Municipal Capital
RÍO CHICO
SAN JOSÉ DE BARLOVENTO
RÍO CHICO
Laguna de Tacarigua
Saint George's
GRENADA
Caracas
Port of Spain
Maturín
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Laguna de Tacarigua (West)
Map 11 of 43
EEPGL
08 February 2017
ERM

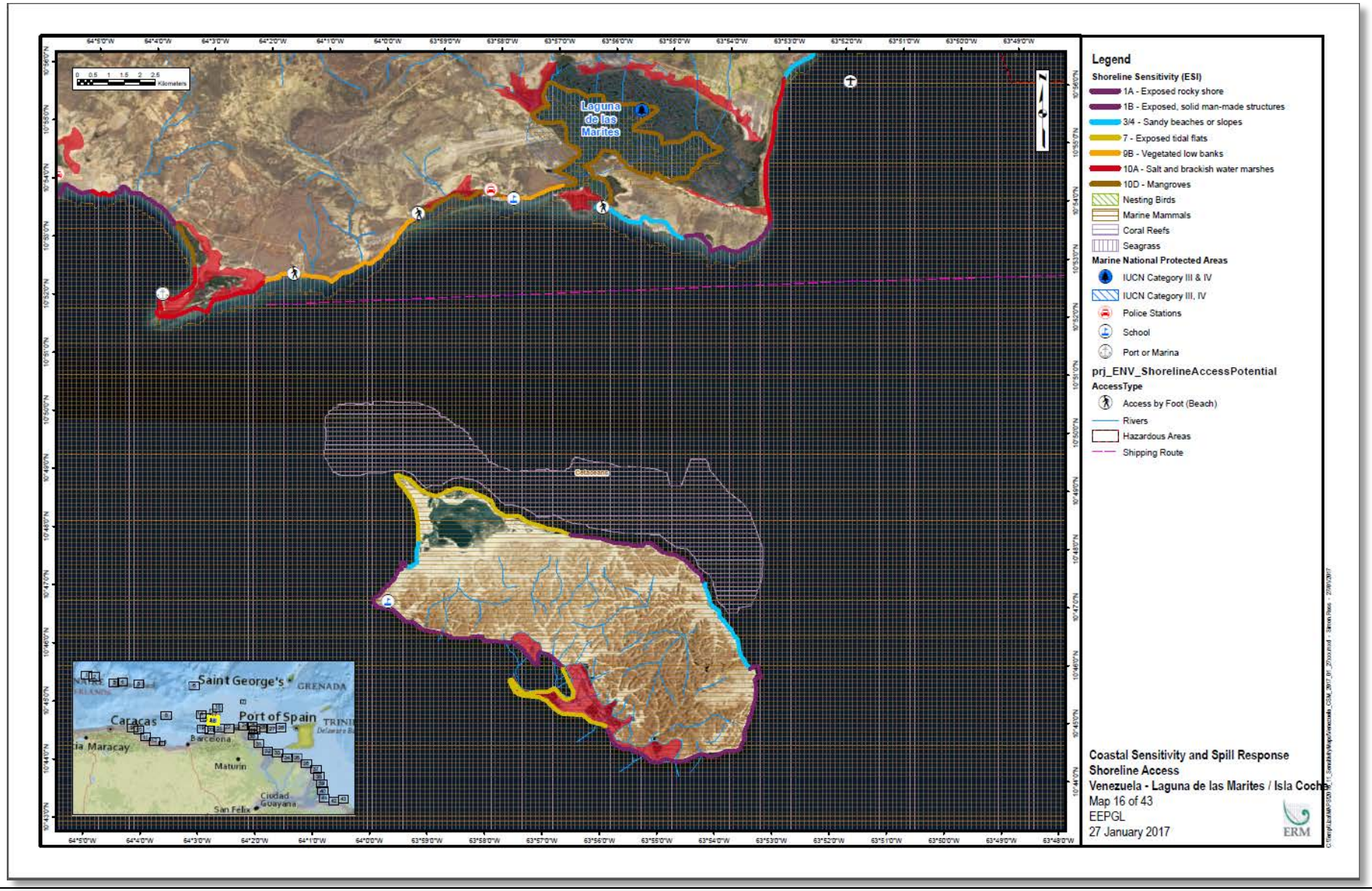

Laguna de Tacarigua
CUPIRA
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Legend
Shoreline Sensitivity (ESI)
3/4 - Sandy beaches or slopes
Reptiles
Marine Mammals
Seagrass
Lagoon
IUCN Category I, II
Police Stations
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Municipal Capital
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Laguna de Tacarigua (West)
Map 12 of 43
EEPGL
08 February 2017
ERM

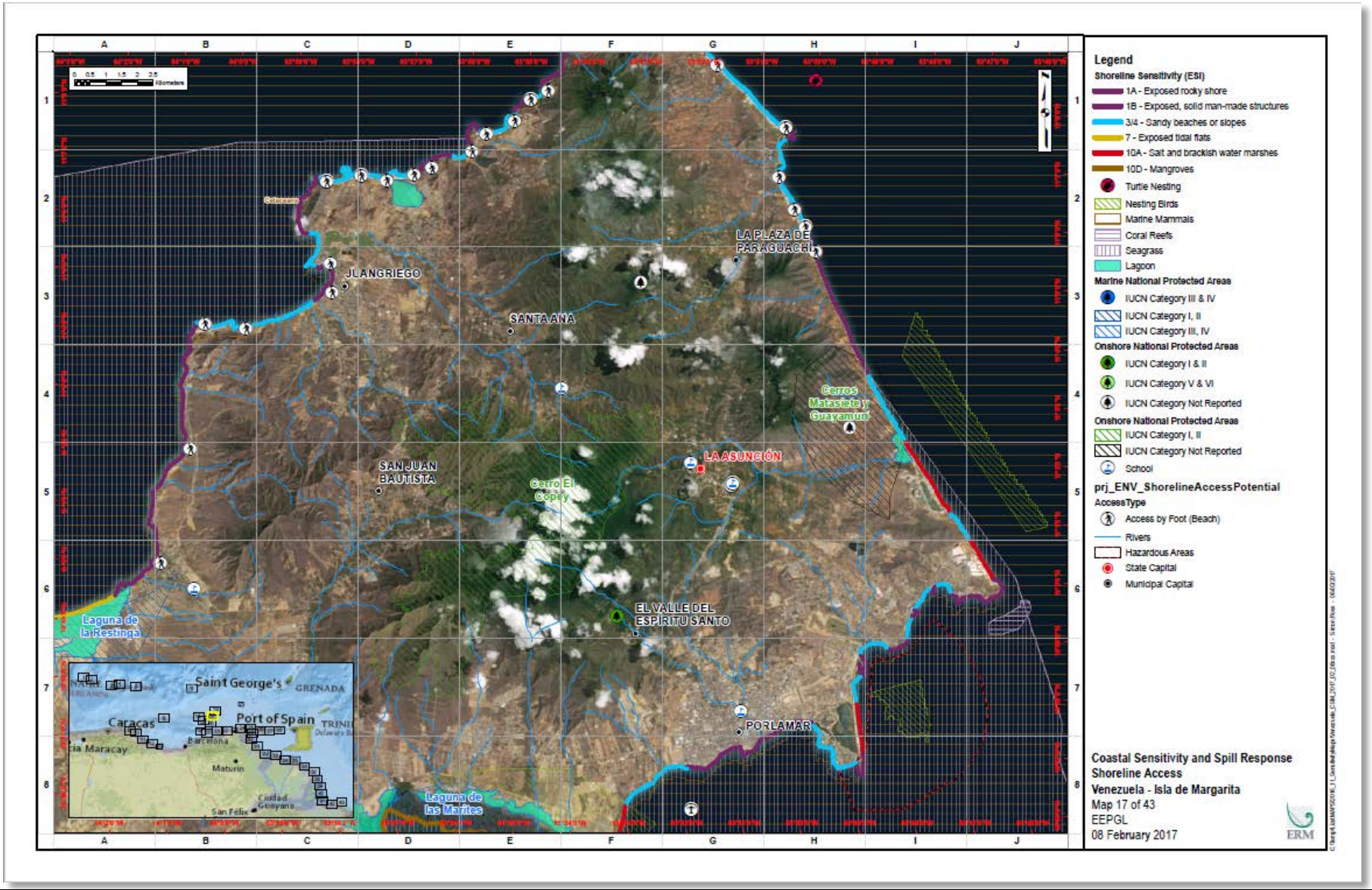

Legend
Shoreline Sensitivity (ESI)
3/4 - Sandy beaches or slopes
Marine Mammals
Seagrass
Lagoon
Police Stations
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Municipal Capital
BOCA DE UCHIRE
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - San Juan de Capistrano
Map 13 of 43
EEPGL
08 February 2017
ERM

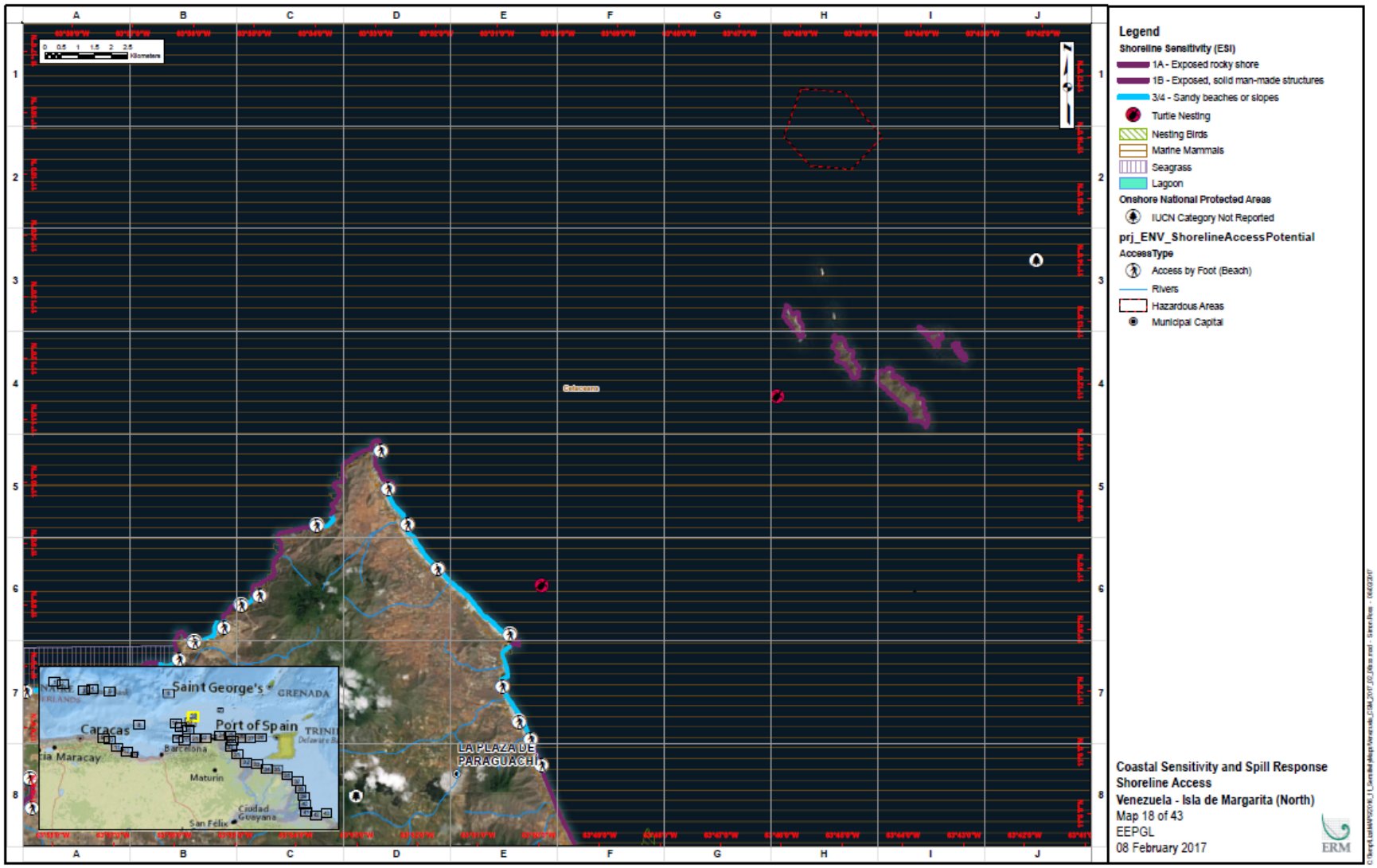

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
9A - Sheltered tidal flats
9B - Vegetated low banks
10D - Mangroves
Nesting Birds
Marine Mammals
Coral Reefs
Coral Reef
Seagrass
Lagoon
IUCN Category I, II
IUCN Category III, IV
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Hazardous Areas
Municipal Capital
Laguna de la Restinga
BOCA DEL RIO
Tetas de Maria Guevara
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Peninsula de Macano
Map 14 of 43
EEPGL
08 February 2017
ERM

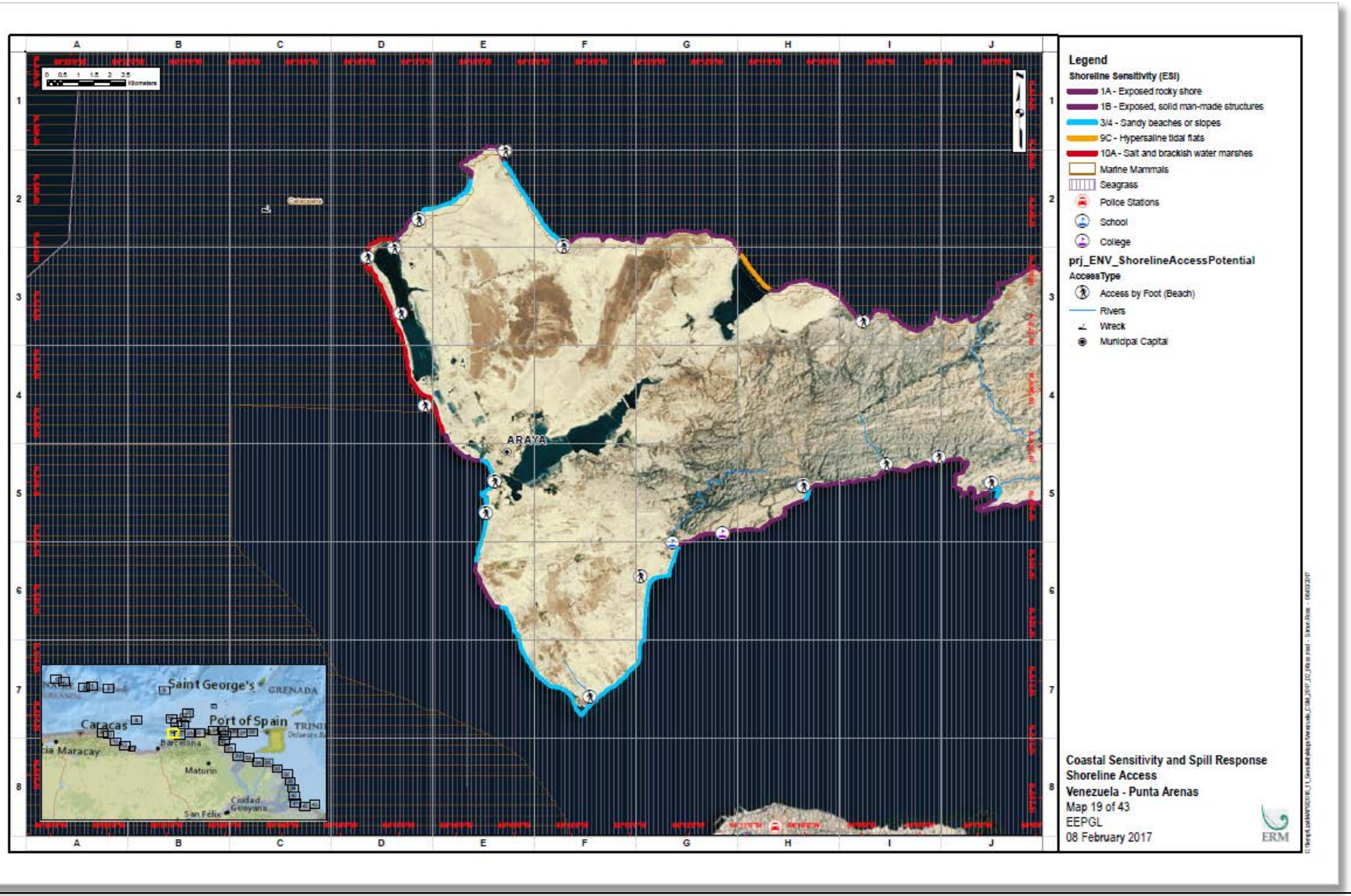

Laguna de la Restinga
BOCA DEL RÍO
Tetas de María Guevara
PUNTA DE PIEDRAS
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturín
Ciudad Guayana
San Félix
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
9B - Vegetated low banks
10A - Salt and brackish water marshes
10D - Mangroves
Nesting Birds
Marine Mammals
Coral Reefs
Coral Reef
Seagrass
Lagoon
Marine National Protected Areas
IUCN Category I & II
IUCN Category III & IV
IUCN Category I, II
IUCN Category III, IV
Onshore National Protected Areas
IUCN Category V & VI
Police Stations
Port or Marina
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Shipping Route
Municipal Capital
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Laguna de la Restinga
Map 15 of 43
EEPGL
08 February 2017
ERM

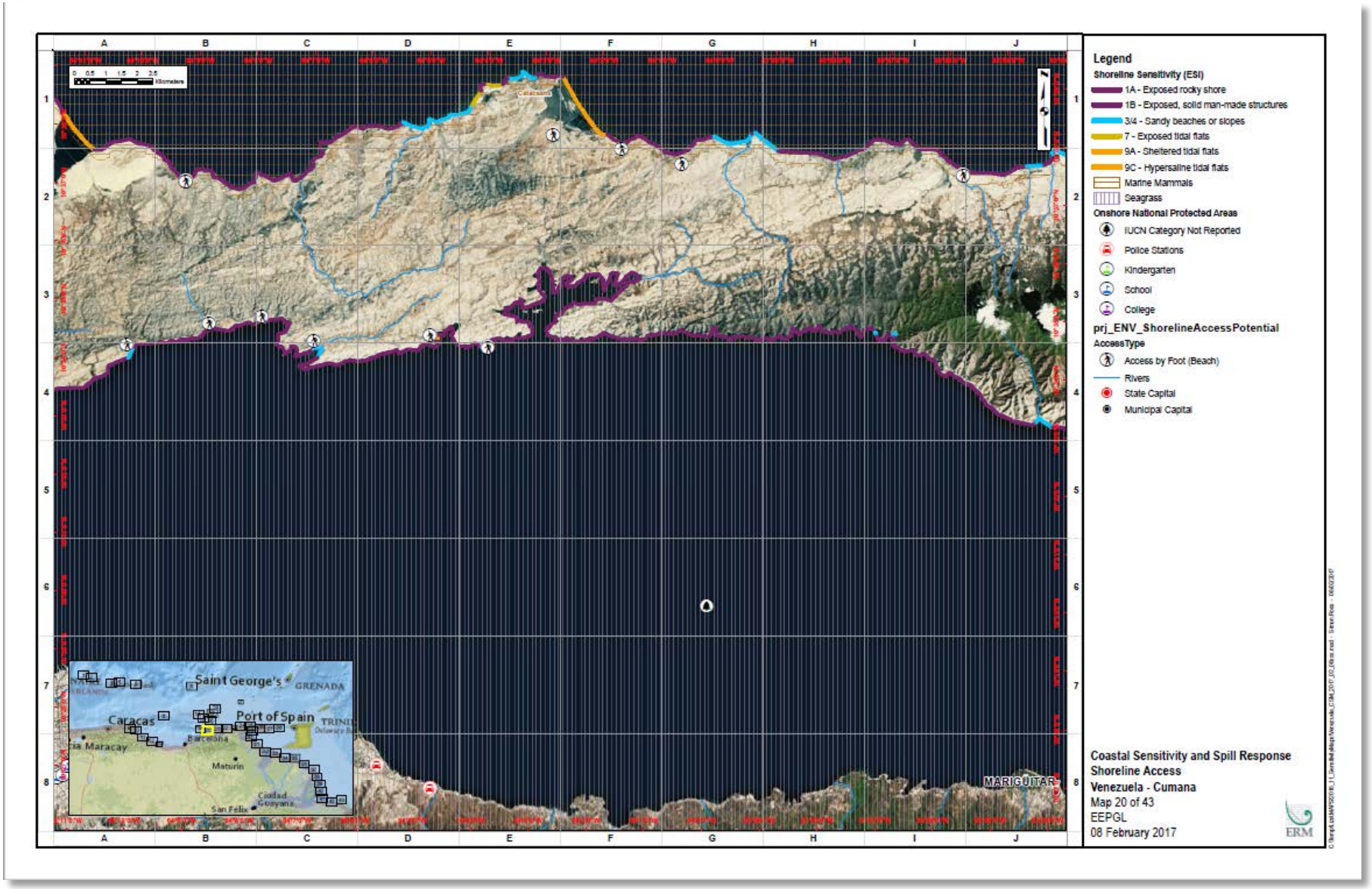

Laguna de las Marites
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
9B - Vegetated low banks
10A - Salt and brackish water marshes
10D - Mangroves
Nesting Birds
Marine Mammals
Coral Reefs
Seagrass
Lagoon
Marine National Protected Areas
IUCN Category III & IV
IUCN Category III, IV
Police Stations
School
Port or Marina
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Hazardous Areas
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Laguna de las Marites / Isla Coche
Map 16 of 43
EEPGL
08 February 2017
ERM

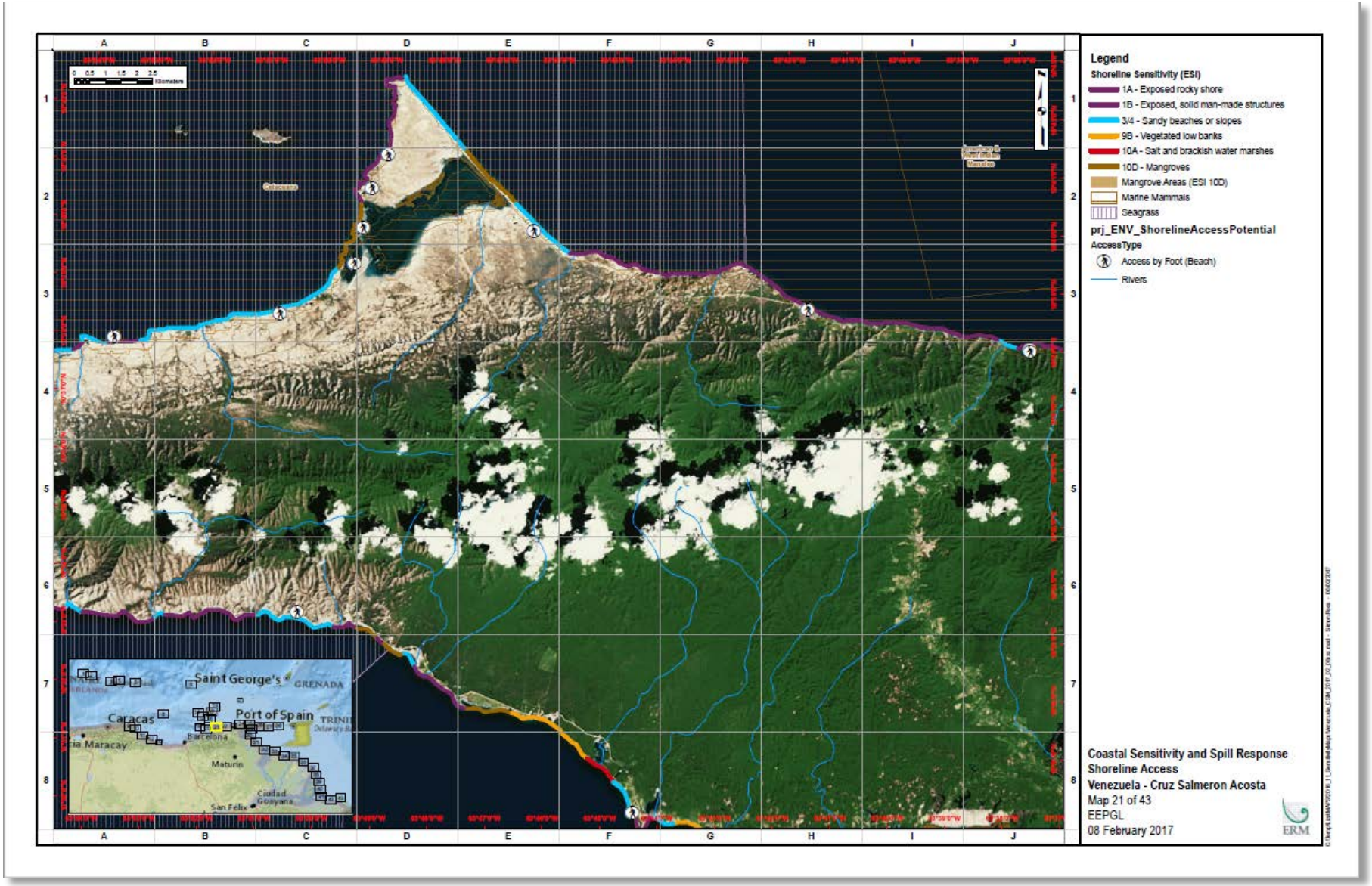

Laguna de las Marites
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
9B - Vegetated low banks
10A - Salt and brackish water marshes
10D - Mangroves
Nesting Birds
Marine Mammals
Coral Reefs
Seagrass
Marine National Protected Areas
IUCN Category III & IV
IUCN Category III, IV
Police Stations
School
Port or Marina
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Hazardous Areas
Shipping Route
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Felix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Laguna de las Marites / Isla Coche
Map 16 of 43
EEPGL
27 January 2017
ERM

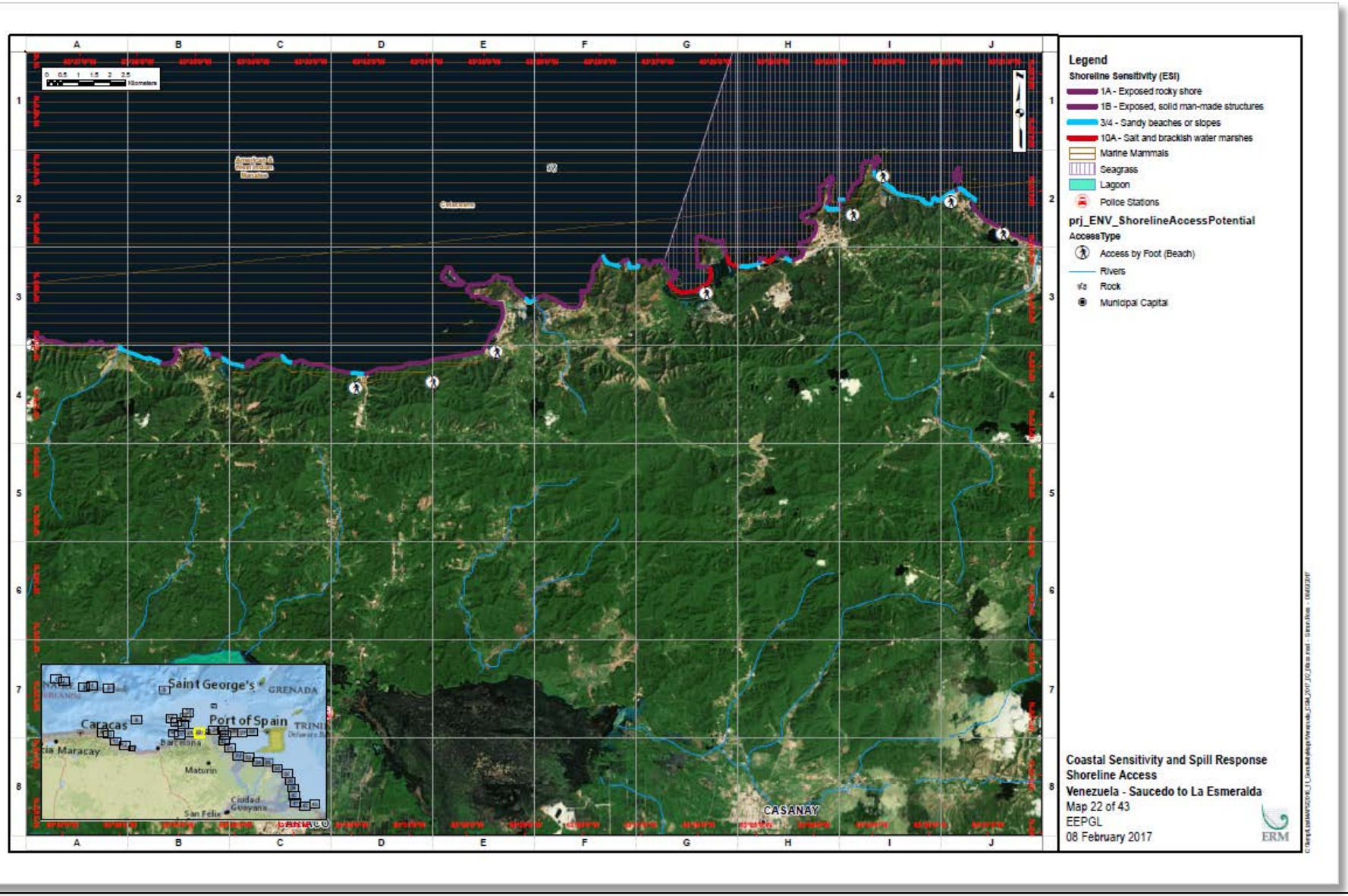

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
10A - Salt and brackish water marshes
10D - Mangroves
Turtle Nesting
Nesting Birds
Marine Mammals
Coral Reefs
Seagrass
Lagoon
Marine National Protected Areas
IUCN Category III & IV
IUCN Category I, II
IUCN Category III, IV
Onshore National Protected Areas
IUCN Category I & II
IUCN Category V & VI
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category I, II
IUCN Category Not Reported
School
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Hazardous Areas
State Capital
Municipal Capital
JUANGRIEGO
SANTA ANA
LA PLAZA DE PARAGUACHI
Cerros Matasiete y Guayamuri
SAN JUAN BAUTISTA
Cerro El Copey
LA ASUNCIÓN
EL VALLE DEL ESPIRITU SANTO
PORLAMAR
Laguna de la Restinga
Laguna de las Marites
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Isla de Margarita
Map 17 of 43
EEPGL
08 February 2017
ERM

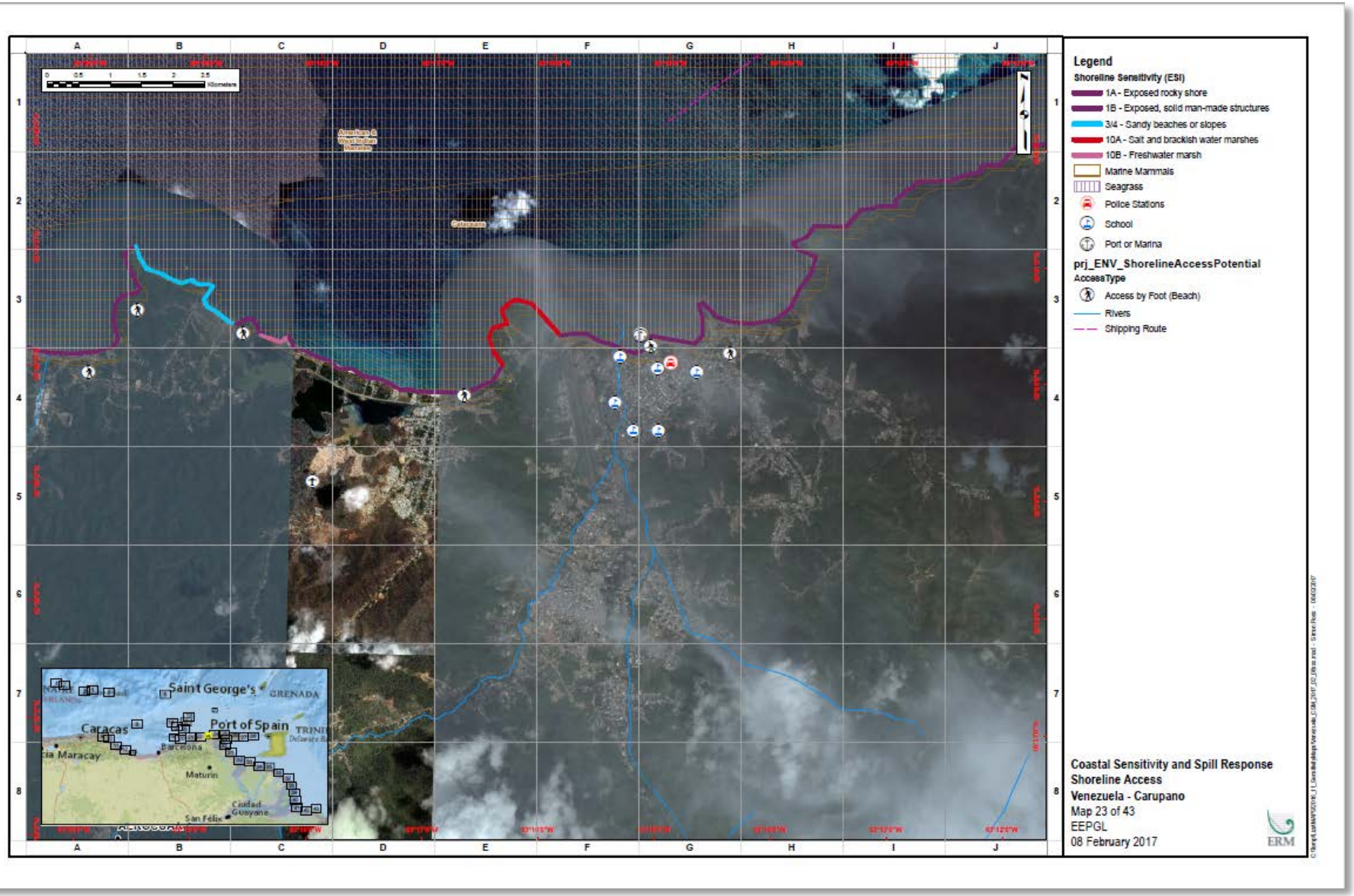

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
Turtle Nesting
Nesting Birds
Marine Mammals
Seagrass
Lagoon
Onshore National Protected Areas
IUCN Category Not Reported
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Hazardous Areas
Municipal Capital
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix
LA PLAZA DE PARAGUACHÍ
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Isla de Margarita (North)
Map 18 of 43
EEPGL
08 February 2017
ERM

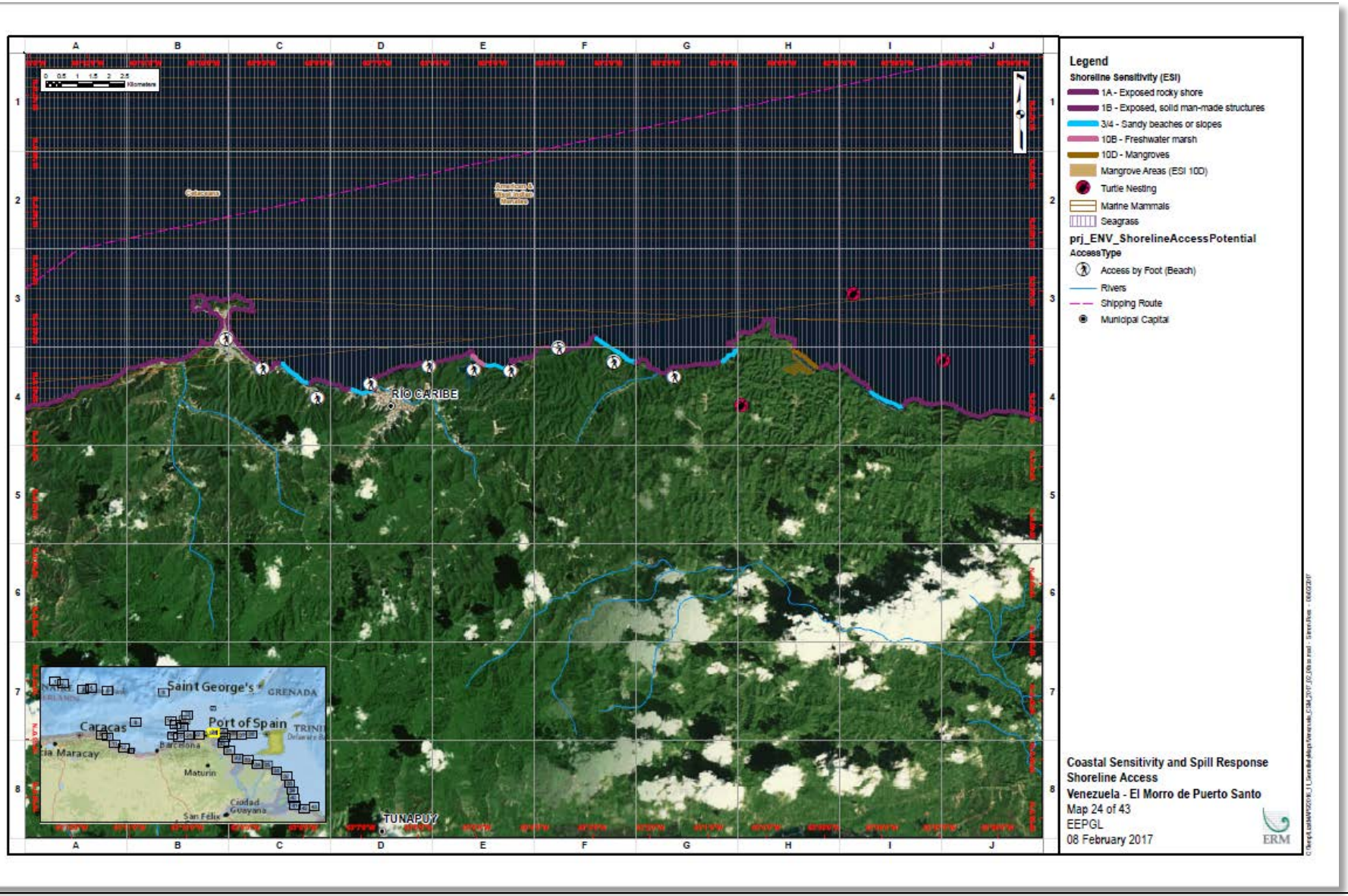

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
9C - Hypersaline tidal flats
10A - Salt and brackish water marshes
Marine Mammals
Seagrass
Police Stations
School
College
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Wreck
Municipal Capital
ARAYA
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Felix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Punta Arenas
Map 19 of 43
EEPGL
08 February 2017
ERM

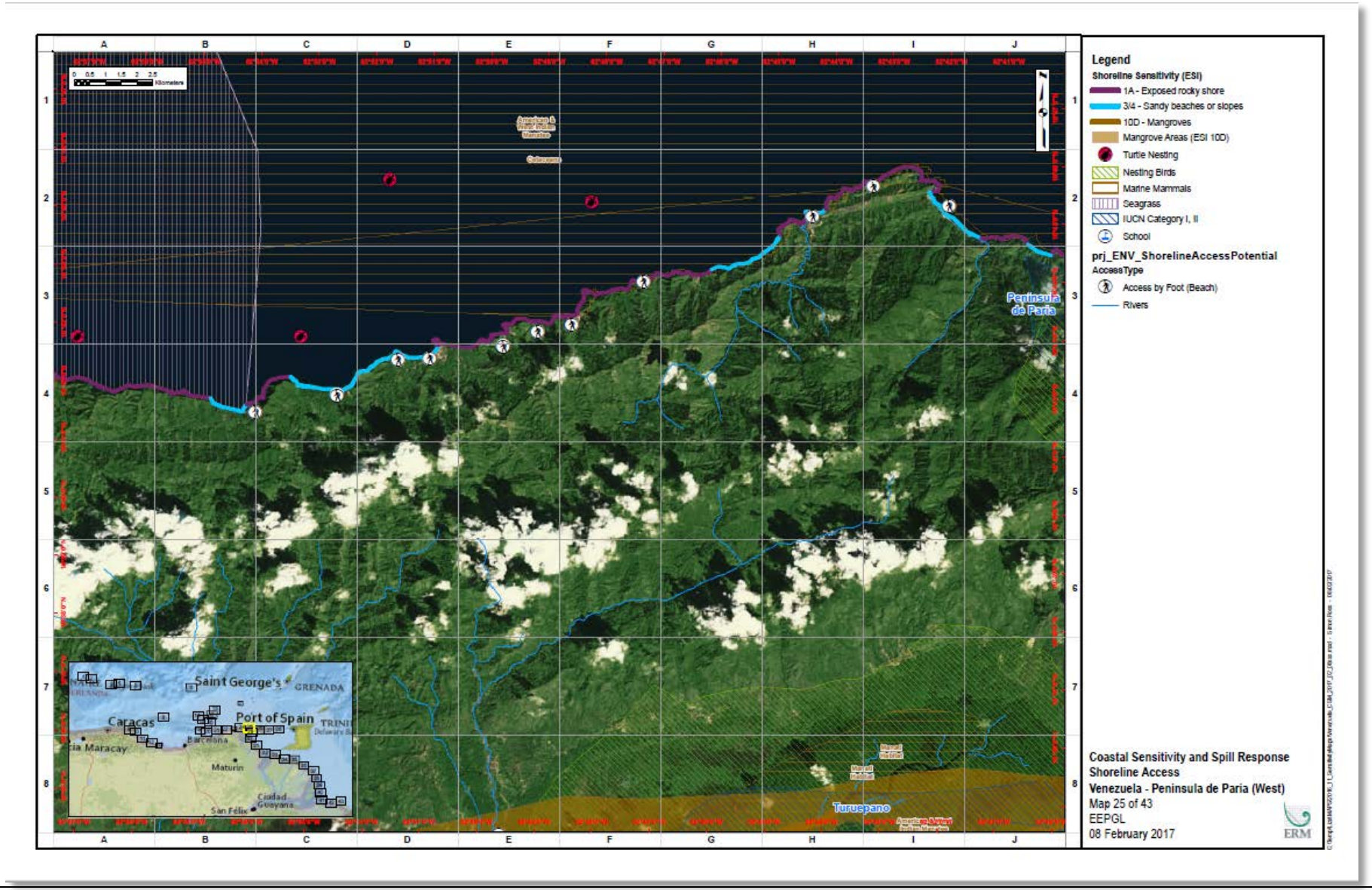

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
9A - Sheltered tidal flats
9C - Hypersaline tidal flats
Marine Mammals
Seagrass
Onshore National Protected Areas
IUCN Category Not Reported
Police Stations
Kindergarten
School
College
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
State Capital
Municipal Capital
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Felix
MARIGUITAR
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Cumana
Map 20 of 43
EEPGL
08 February 2017
ERM

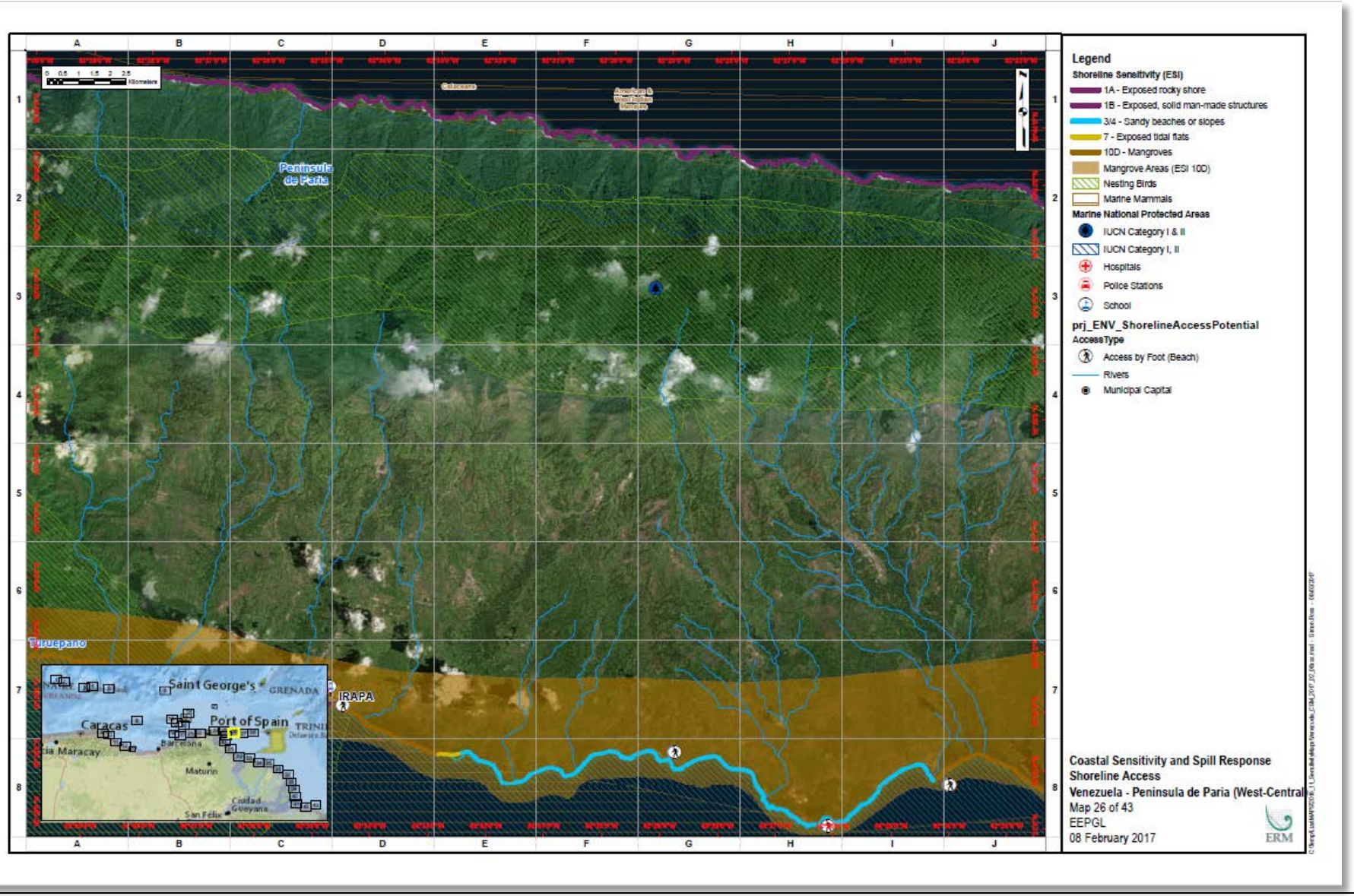

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
9B - Vegetated low banks
10A - Salt and brackish water marshes
10D - Mangroves
Mangrove Areas (ESI 10D)
Marine Mammals
Seagrass
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Cruz Salmeron Acosta
Map 21 of 43
EEPGL
08 February 2017
ERM
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix

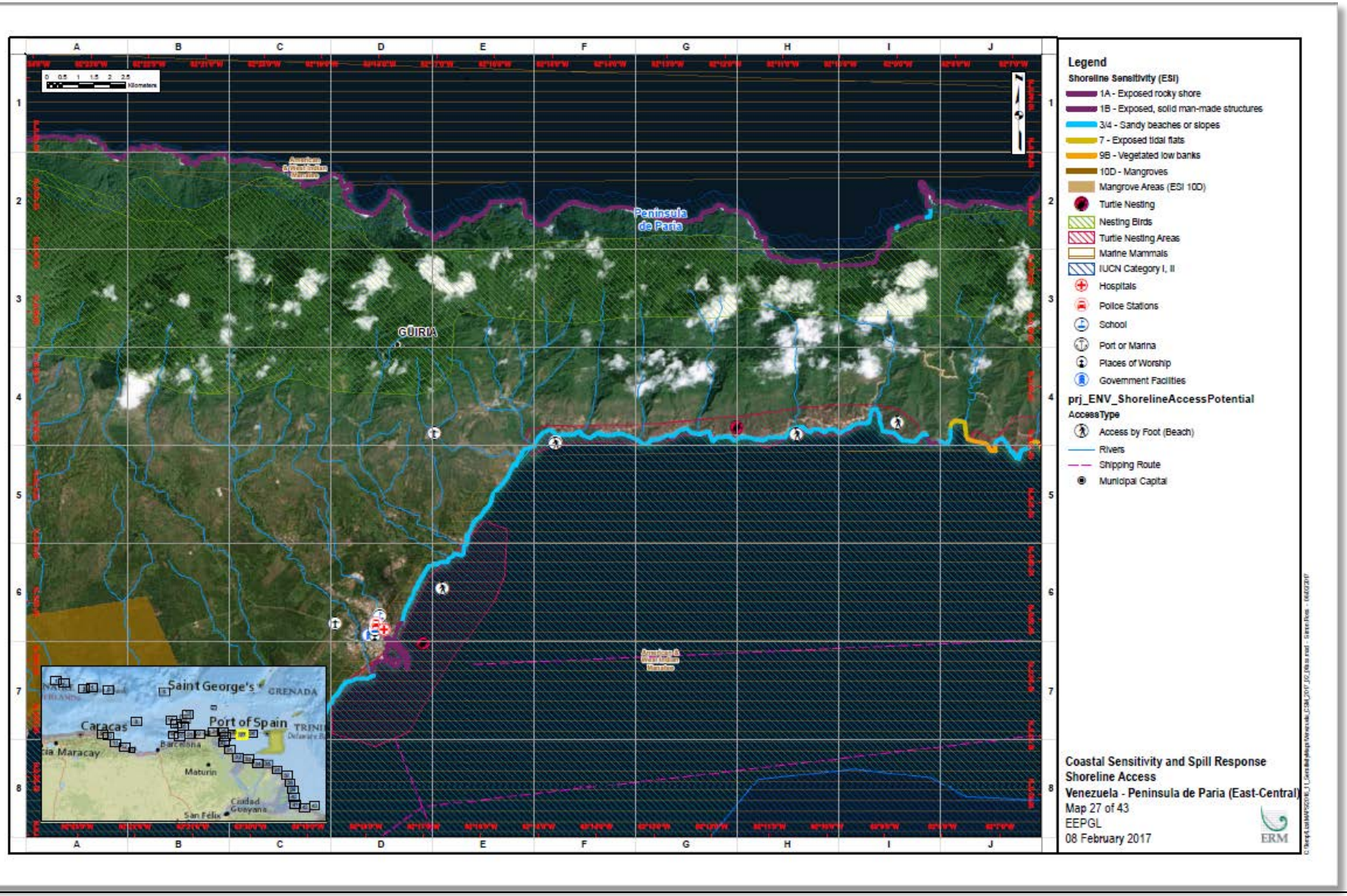

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
10A - Salt and brackish water marshes
Marine Mammals
Seagrass
Lagoon
Police Stations
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Rock
Municipal Capital
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Saucedo to La Esmeralda
Map 22 of 43
EEPGL
08 February 2017
ERM
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Felix
CASANAY

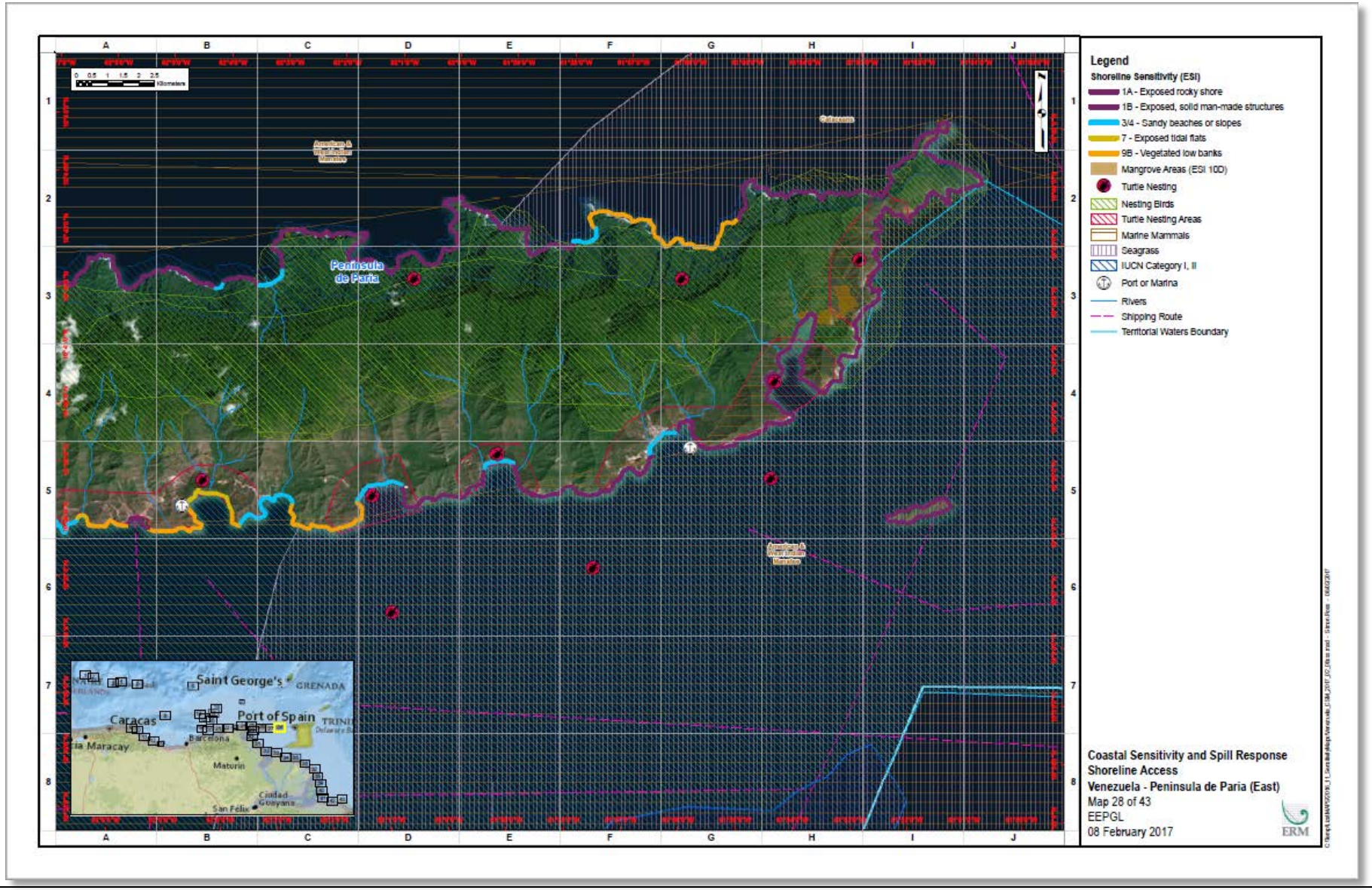

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
10A - Salt and brackish water marshes
10B - Freshwater marsh
Marine Mammals
Seagrass
Police Stations
School
Port or Marina
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Carupano
Map 23 of 43
EEPGL
08 February 2017
ERM
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix

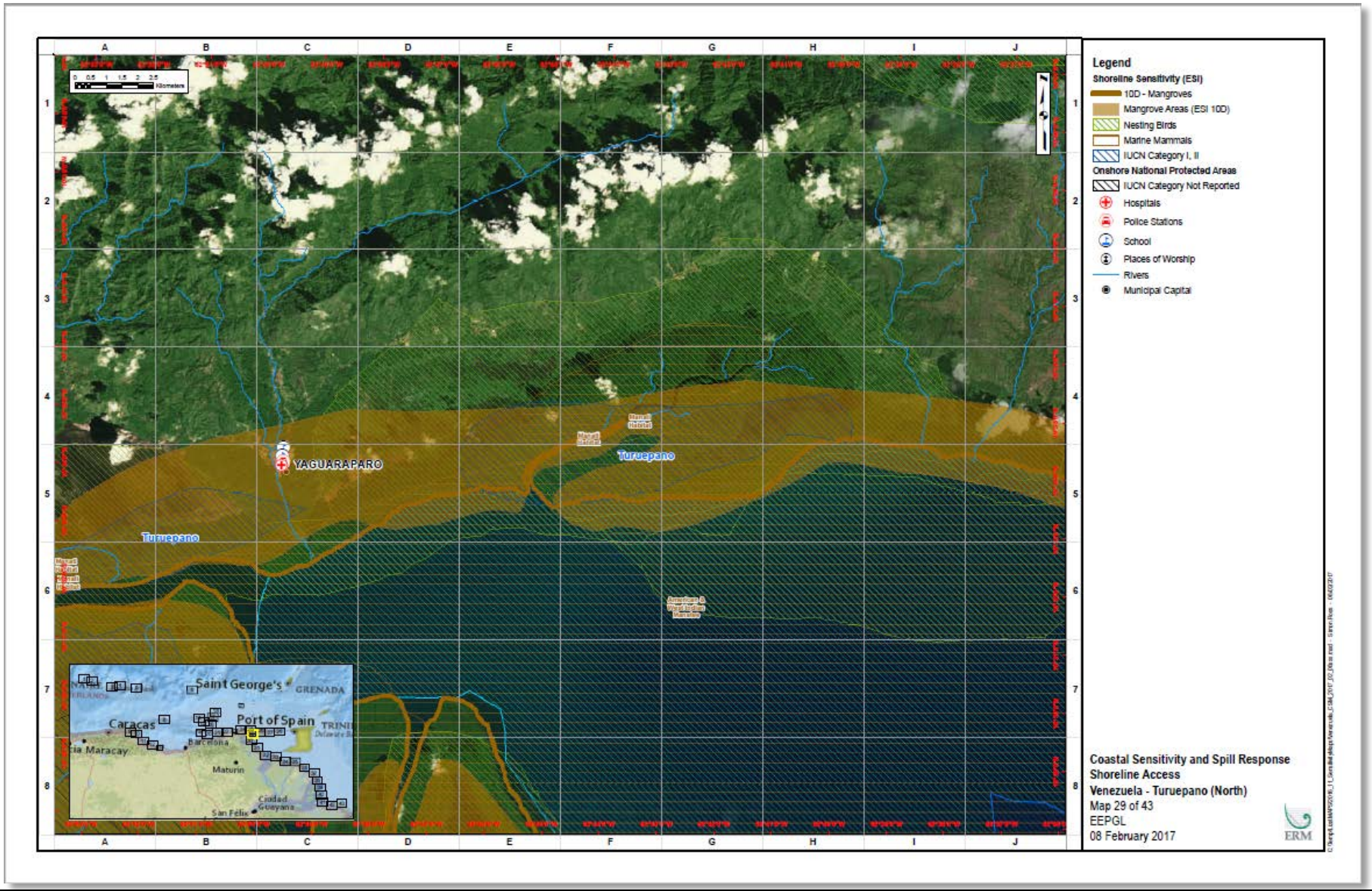

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
10B - Freshwater marsh
10D - Mangroves
Mangrove Areas (ESI 10D)
Turtle Nesting
Marine Mammals
Seagrass
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Shipping Route
Municipal Capital
RIO CARIBE
TUNAPUY
Saint George's
GRENADA
Port of Spain
Caracas
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - El Morro de Puerto Santo
Map 24 of 43
EEPGL
08 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
3/4 - Sandy beaches or slopes
10D - Mangroves
Mangrove Areas (ESI 10D)
Turtle Nesting
Nesting Birds
Marine Mammals
Seagrass
IUCN Category I, II
School
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Peninsula de Paria
Turuepano
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Peninsula de Paria (West)
Map 25 of 43
EEPGL
08 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
Marine National Protected Areas
IUCN Category I & II
IUCN Category I, II
Hospitals
Police Stations
School
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Municipal Capital
Peninsula de Paria
Güiria
IRAPA
Caracas
Port of Spain
Saint George's
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Peninsula de Paria (West-Central)
Map 26 of 43
EEPGL
08 February 2017
ERM

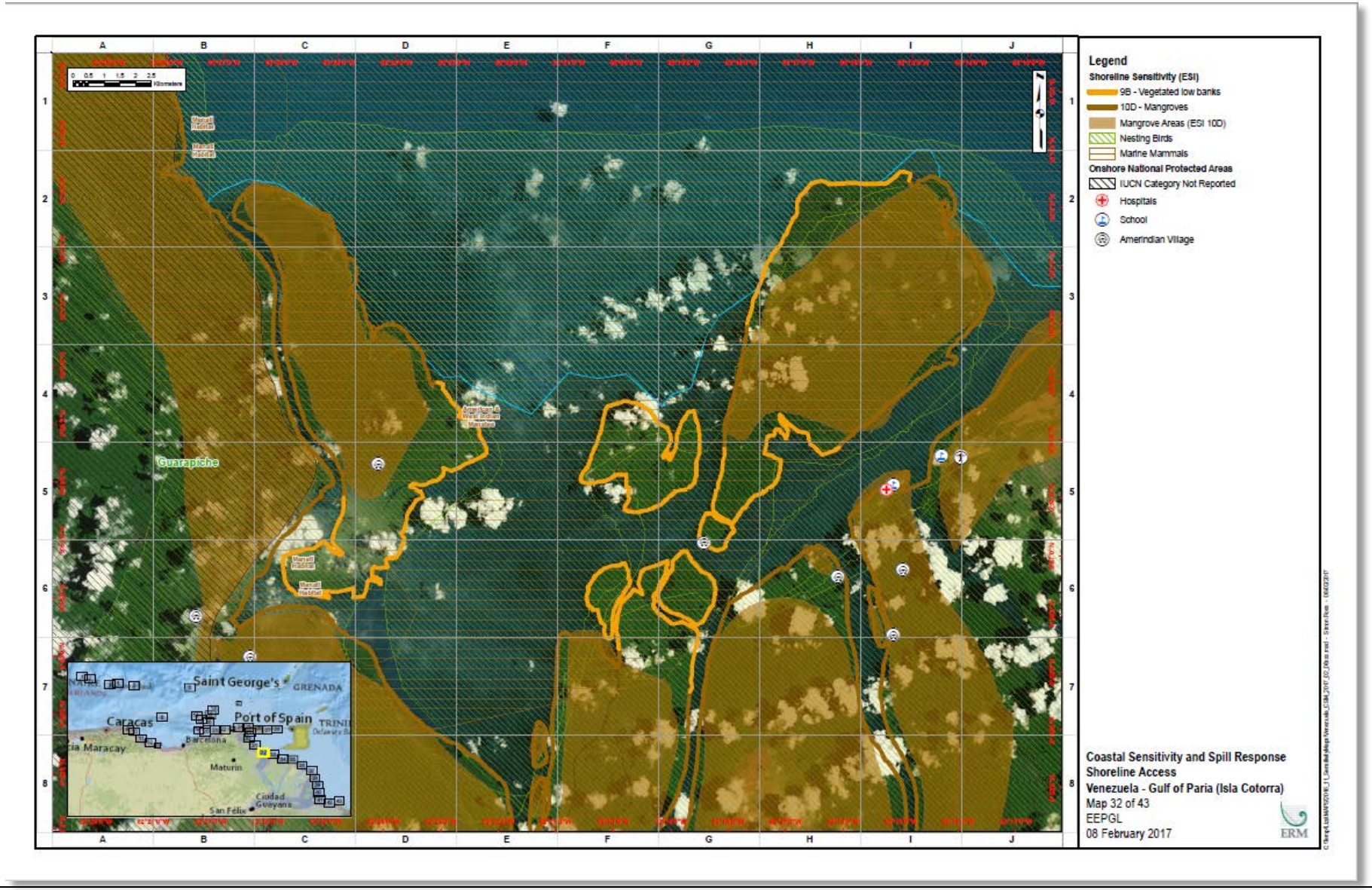

Peninsula de Paria
GÜIRIA
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Turtle Nesting
Nesting Birds
Turtle Nesting Areas
Marine Mammals
IUCN Category I, II
Hospitals
Police Stations
School
Port or Marina
Places of Worship
Government Facilities
prj_ENV_ShorelineAccessPotential
AccessType
Access by Foot (Beach)
Rivers
Shipping Route
Municipal Capital
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Peninsula de Paria (East-Central)
Map 27 of 43
EEPGL
08 February 2017
ERM

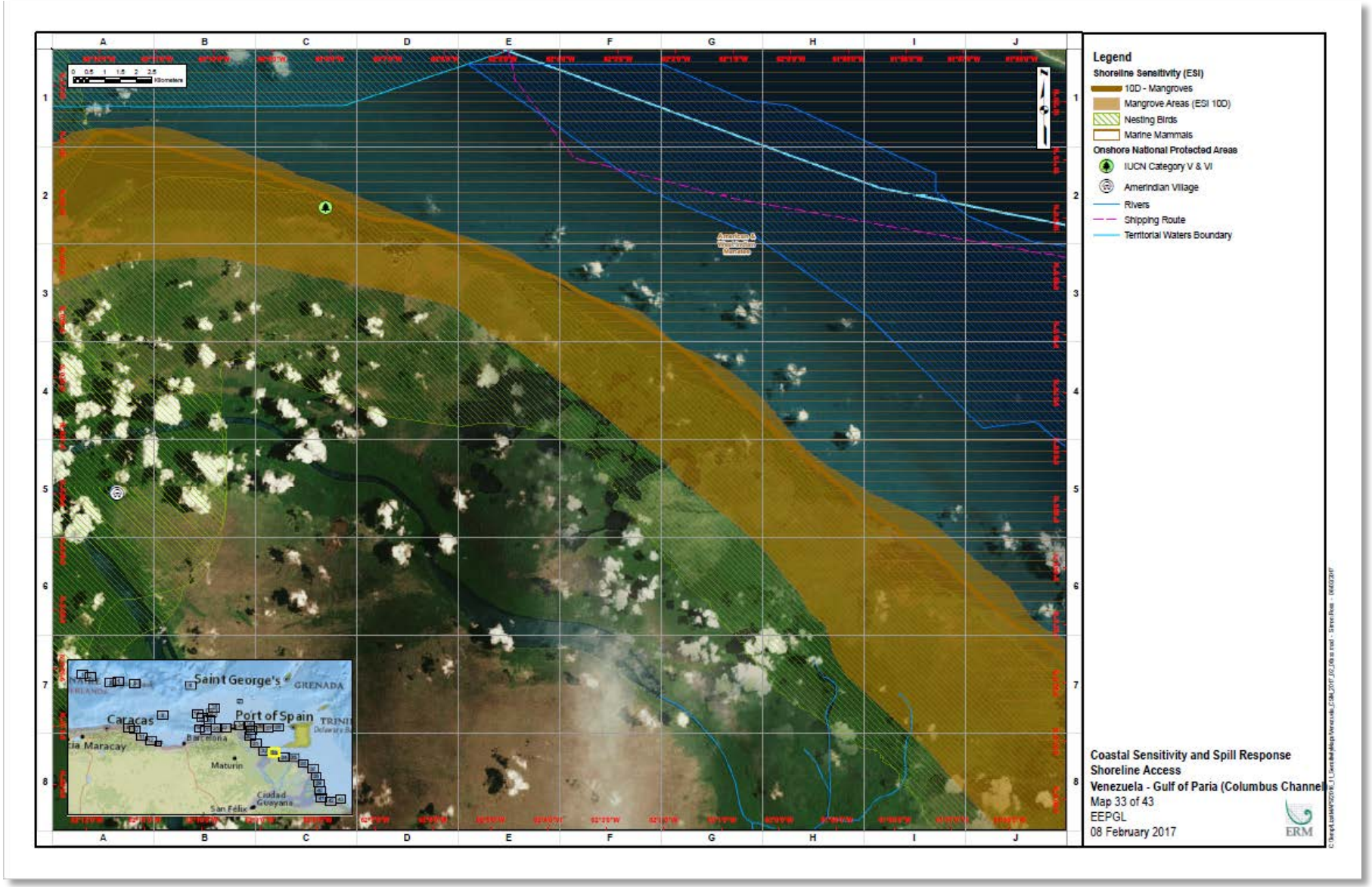

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
9B - Vegetated low banks
Mangrove Areas (ESI 10D)
Turtle Nesting
Nesting Birds
Turtle Nesting Areas
Marine Mammals
Seagrass
IUCN Category I, II
Port or Marina
Rivers
Shipping Route
Territorial Waters Boundary
Península de Paria
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturín
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Peninsula de Paria (East)
Map 28 of 43
EEPGL
08 February 2017
ERM

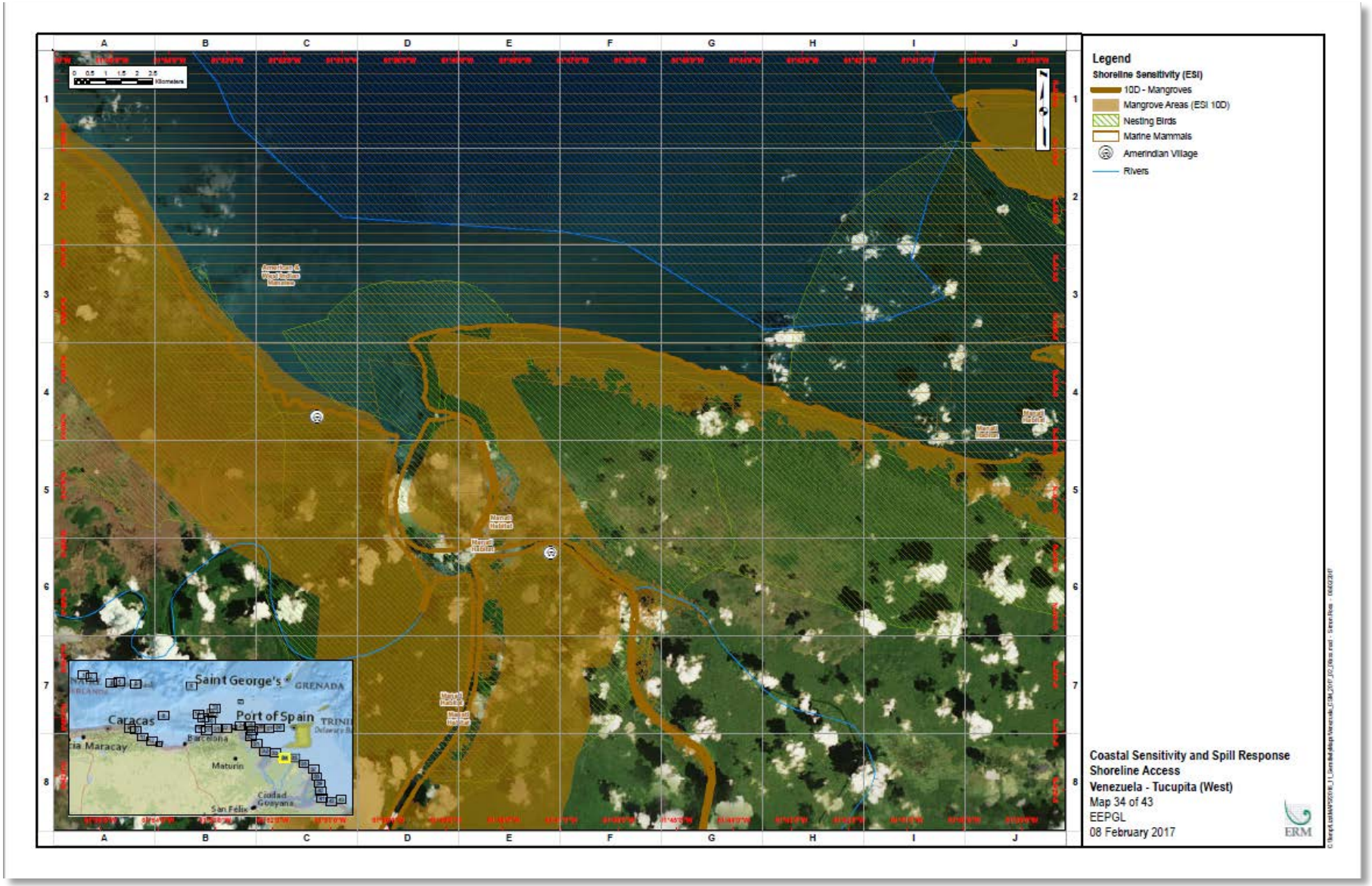

Legend
Shoreline Sensitivity (ESI)
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
IUCN Category I, II
Onshore National Protected Areas
IUCN Category Not Reported
Hospitals
Police Stations
School
Places of Worship
Rivers
Municipal Capital
YAGUARAPARO
Turuepano
Turuepano
Turuepano
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Turuepano (North)
Map 29 of 43
EEPGL
08 February 2017
ERM

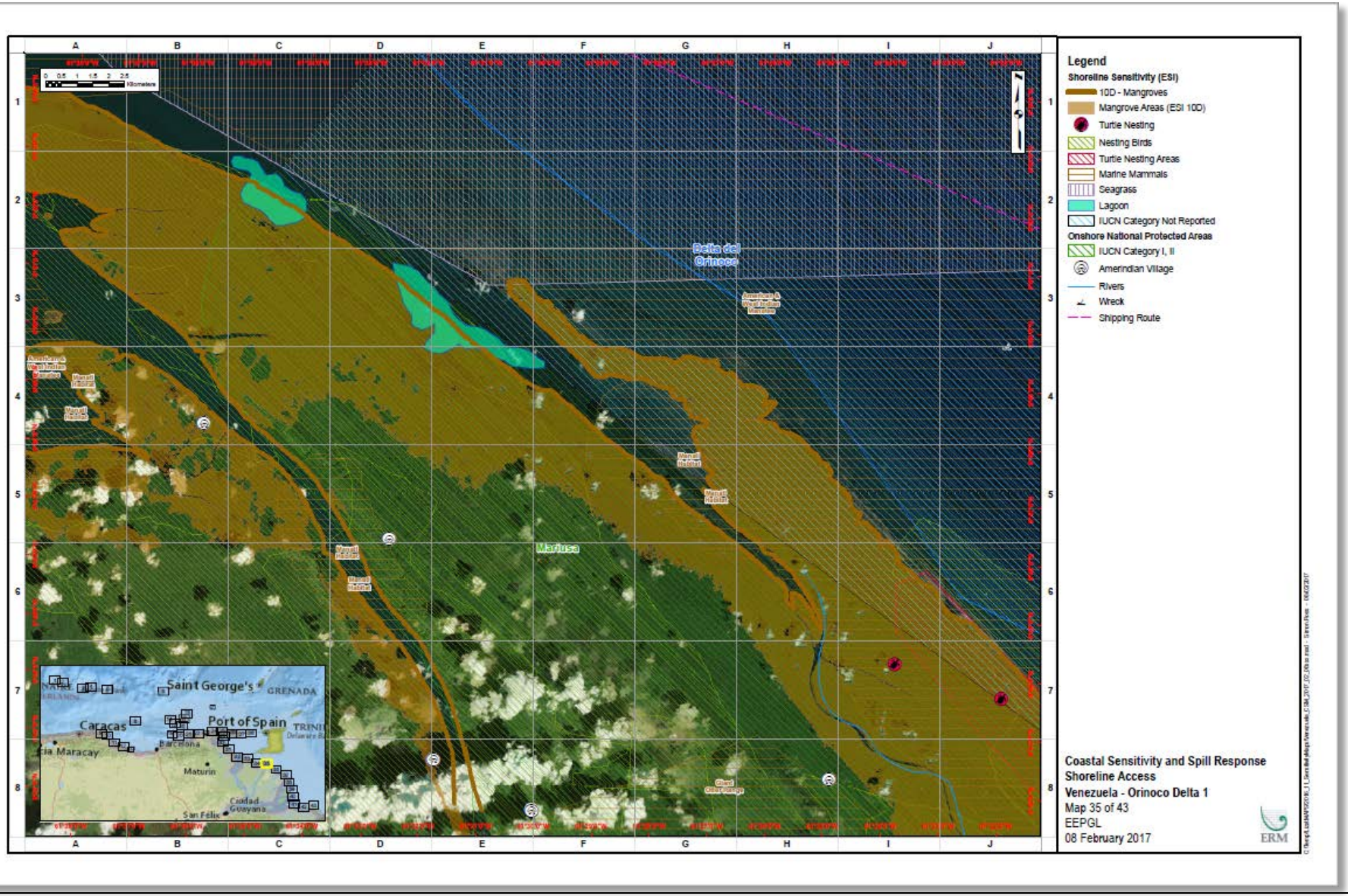

Legend
Shoreline Sensitivity (ESI)
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
Marine National Protected Areas
IUCN Category I & II
IUCN Category I, II
Onshore National Protected Areas
IUCN Category Not Reported
Rivers
Guasipiche
Turuepano
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Turuepano (South)
Map 30 of 43
EEPGL
08 February 2017
ERM

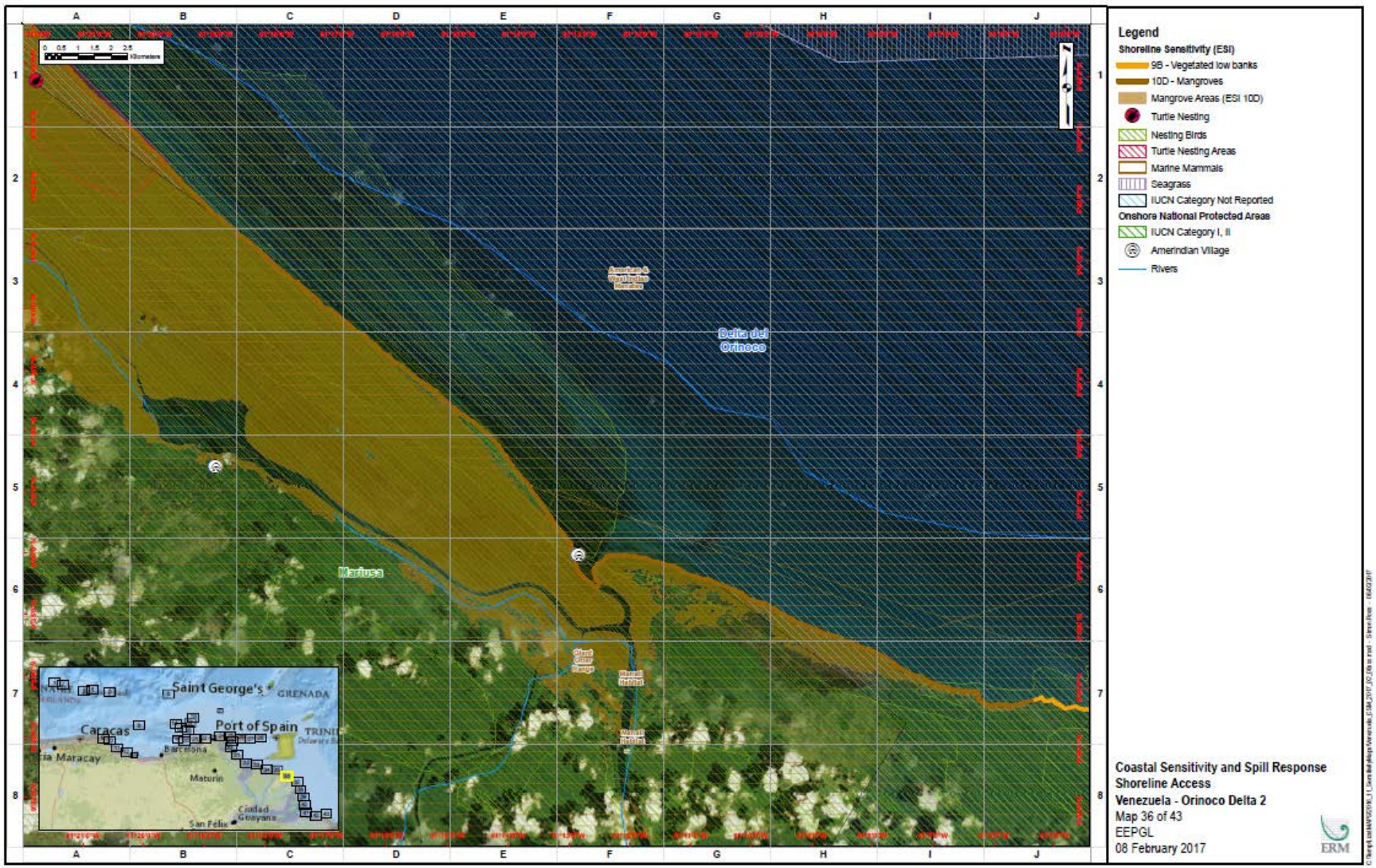

Legend
Shoreline Sensitivity (ESI)
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
Onshore National Protected Areas
IUCN Category Not Reported
Rivers
Shipping Route
Guarapiche
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Gulf of Paria (Rio de San Juan)
Map 31 of 43
EEPGL
08 February 2017
ERM

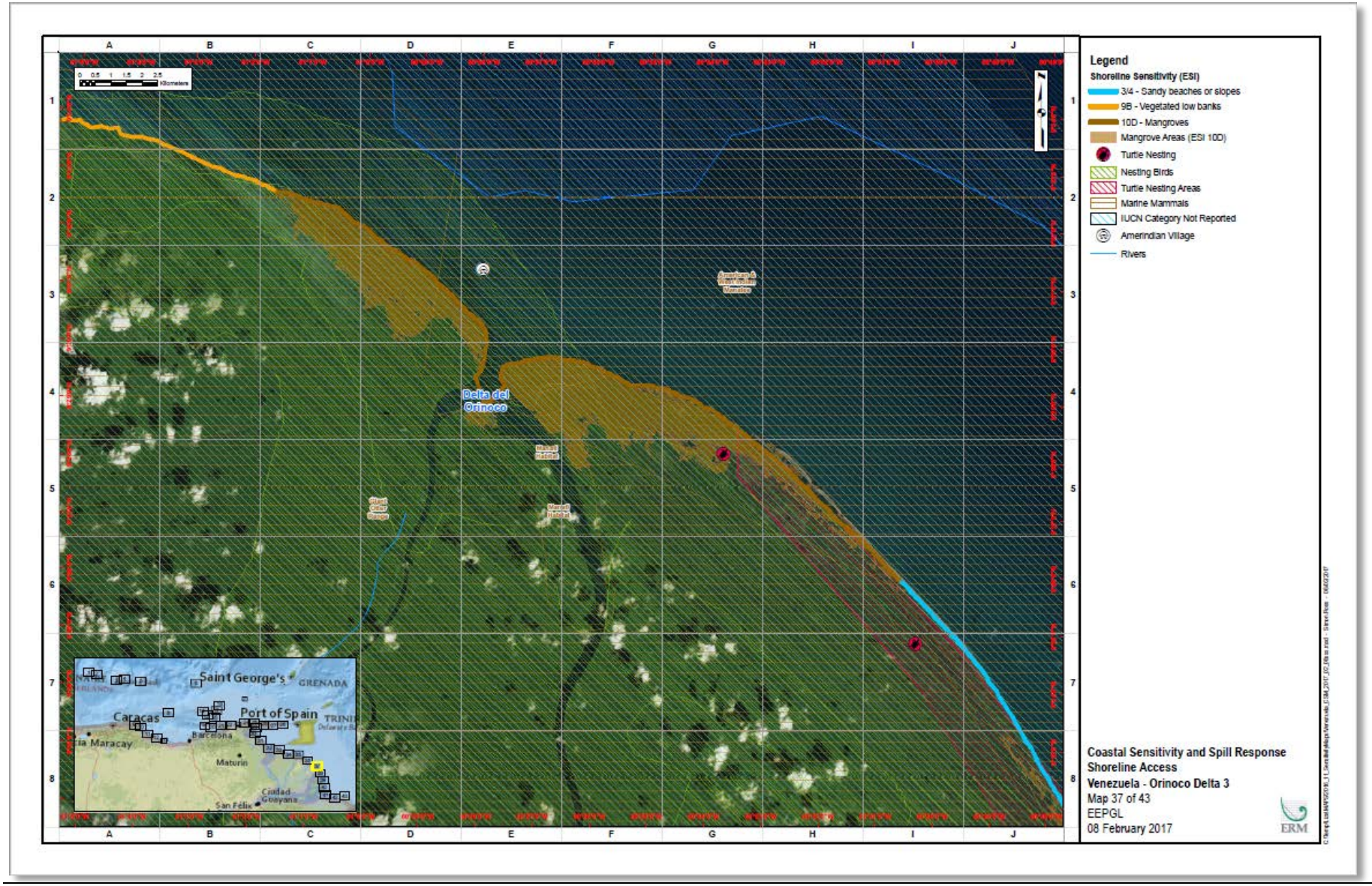

Legend
Shoreline Sensitivity (ESI)
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
Onshore National Protected Areas
IUCN Category Not Reported
Hospitals
School
Amerindian Village
Guarapiche
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Gulf of Paria (Isla Cotorra)
Map 32 of 43
EEPGL
08 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
Onshore National Protected Areas
IUCN Category V & VI
Amerindian Village
Rivers
Shipping Route
Territorial Waters Boundary
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Gulf of Paria (Columbus Channel)
Map 33 of 43
EEPGL
08 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
Amerindian Village
Rivers
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Tucupita (West)
Map 34 of 43
EEPGL
08 February 2017
ERM
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Felix


Legend
Shoreline Sensitivity (ESI)
10D - Mangroves
Mangrove Areas (ESI 10D)
Turtle Nesting
Nesting Birds
Turtle Nesting Areas
Marine Mammals
Seagrass
Lagoon
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category I, II
Amerindian Village
Rivers
Wreck
Shipping Route
Delta del Orinoco
Manuel Rabbit
Mariusa
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Orinoco Delta 1
Map 35 of 43
EEPGL
08 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Turtle Nesting
Nesting Birds
Turtle Nesting Areas
Marine Mammals
Seagrass
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category I, II
Amerindian Village
Rivers
Delta del Orinoco
Mariusa
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Orinoco Delta 2
Map 36 of 43
EEPGL
08 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
3/4 - Sandy beaches or slopes
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Turtle Nesting
Nesting Birds
Turtle Nesting Areas
Marine Mammals
IUCN Category Not Reported
Amerindian Village
Rivers
Delta del Orinoco
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Orinoco Delta 3
Map 37 of 43
EEPGL
08 February 2017
ERM

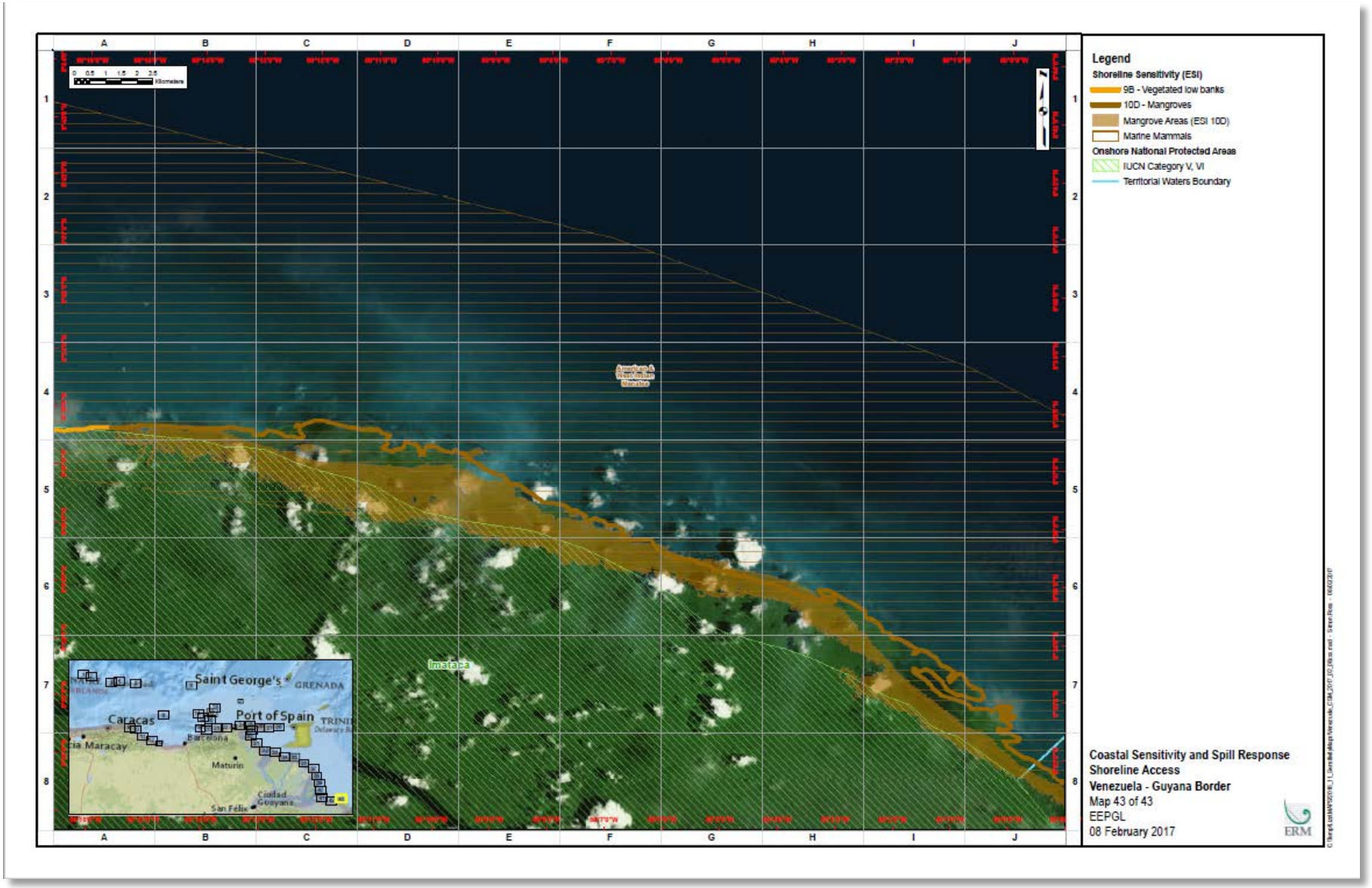

Legend
Shoreline Sensitivity (ESI)
3/4 - Sandy beaches or slopes
7 - Exposed tidal flats
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Turtle Nesting
Nesting Birds
Turtle Nesting Areas
Marine Mammals
IUCN Category Not Reported
Amerindian Village
Rivers
Delta del Orinoco
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Orinoco Delta 4
Map 38 of 43
EEPGL
08 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
3/4 - Sandy beaches or slopes
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
IUCN Category Not Reported
Amerindian Village
Rivers
Delta del Orinoco
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Orinoco Delta 5
Map 39 of 43
EEPGL
08 February 2017
ERM

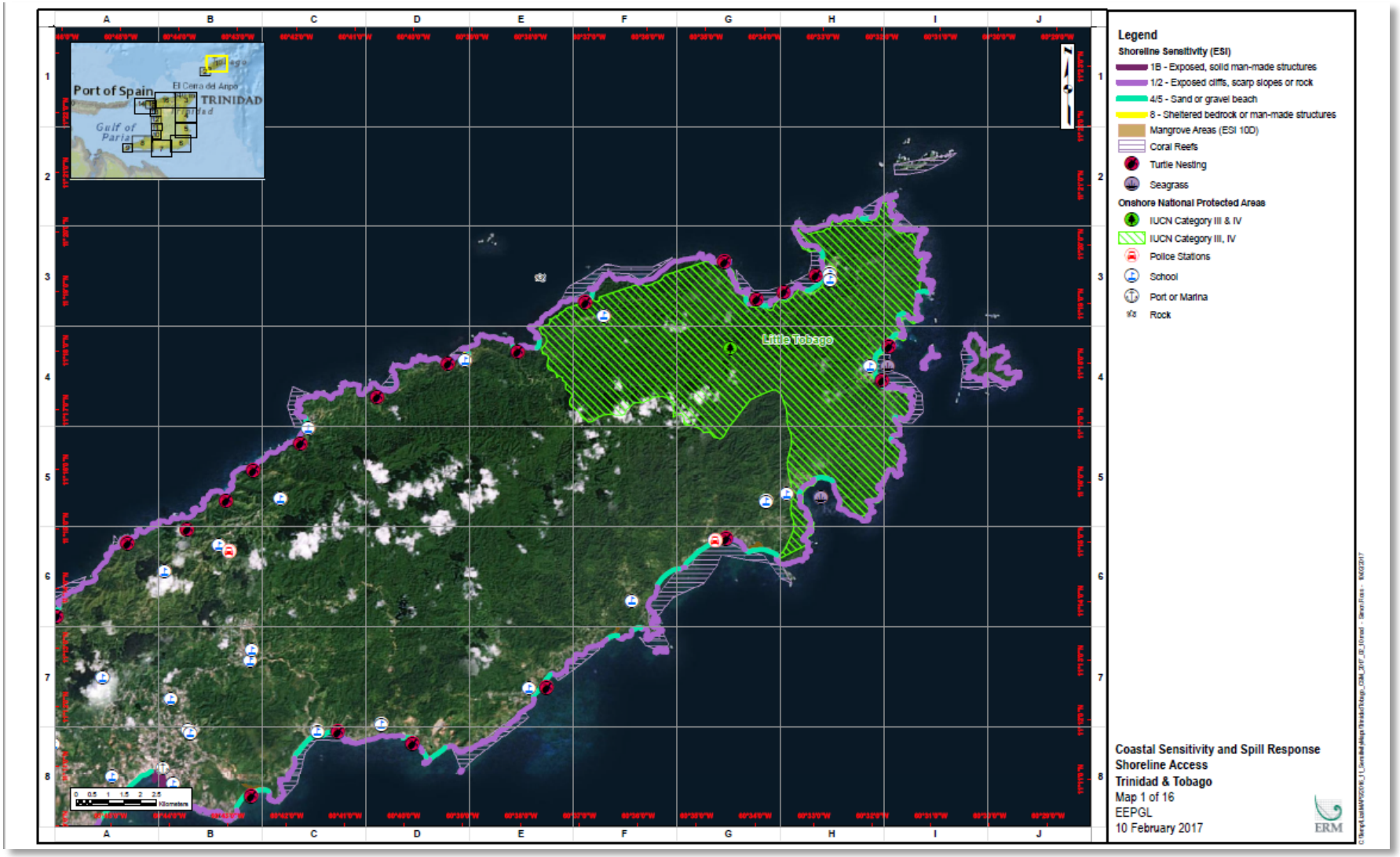

Legend
Shoreline Sensitivity (ESI)
7 - Exposed tidal flats
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
IUCN Category Not Reported
Amerindian Village
Rivers
Delta del Orinoco
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Orinoco Delta 6
Map 40 of 43
EEPGL
08 February 2017
ERM

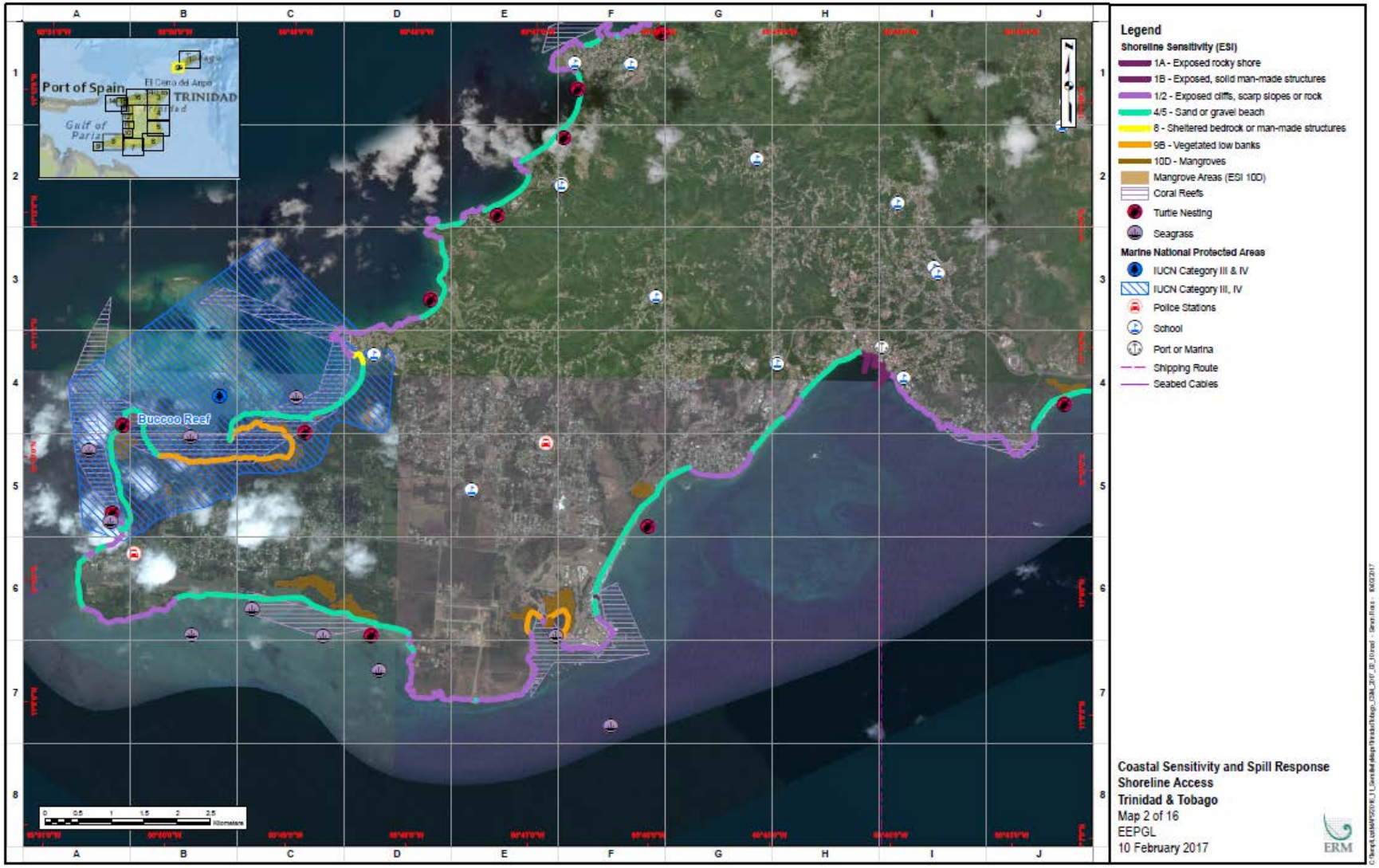

Legend
Shoreline Sensitivity (ESI)
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Nesting Birds
Marine Mammals
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category V, VI
Amerindian Village
Rivers
Delta del Orinoco
Imataca
Saint George's
GRENADA
Caracas
Port of Spain
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Orinoco Delta 7
Map 41 of 43
EEPGL
08 February 2017
ERM

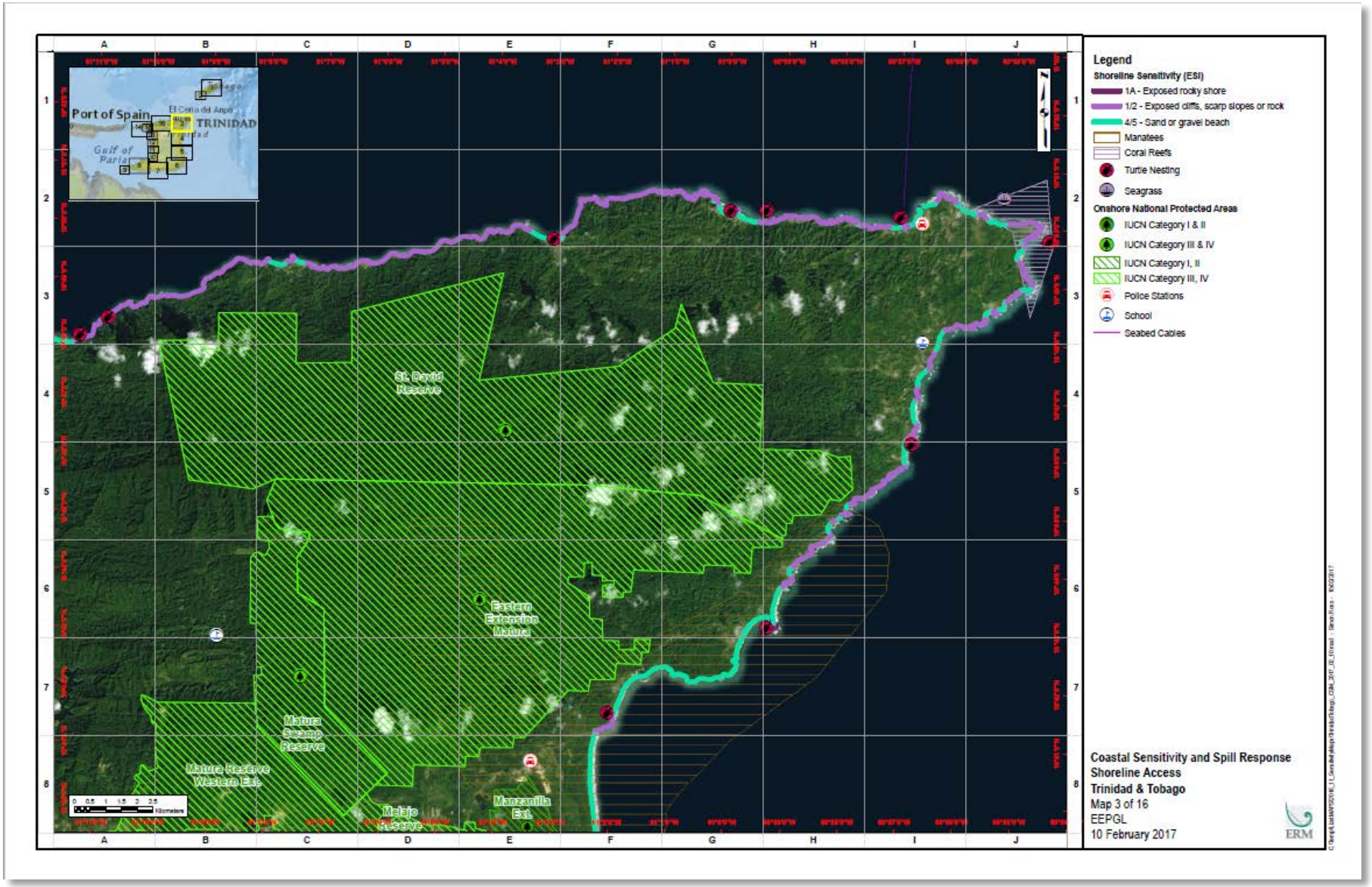

Legend
Shoreline Sensitivity (ESI)
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Marine Mammals
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category V, VI
Delta del Orinoco
Imataca
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Orinoco Delta 8
Map 42 of 43
EEPGL
08 February 2017
ERM

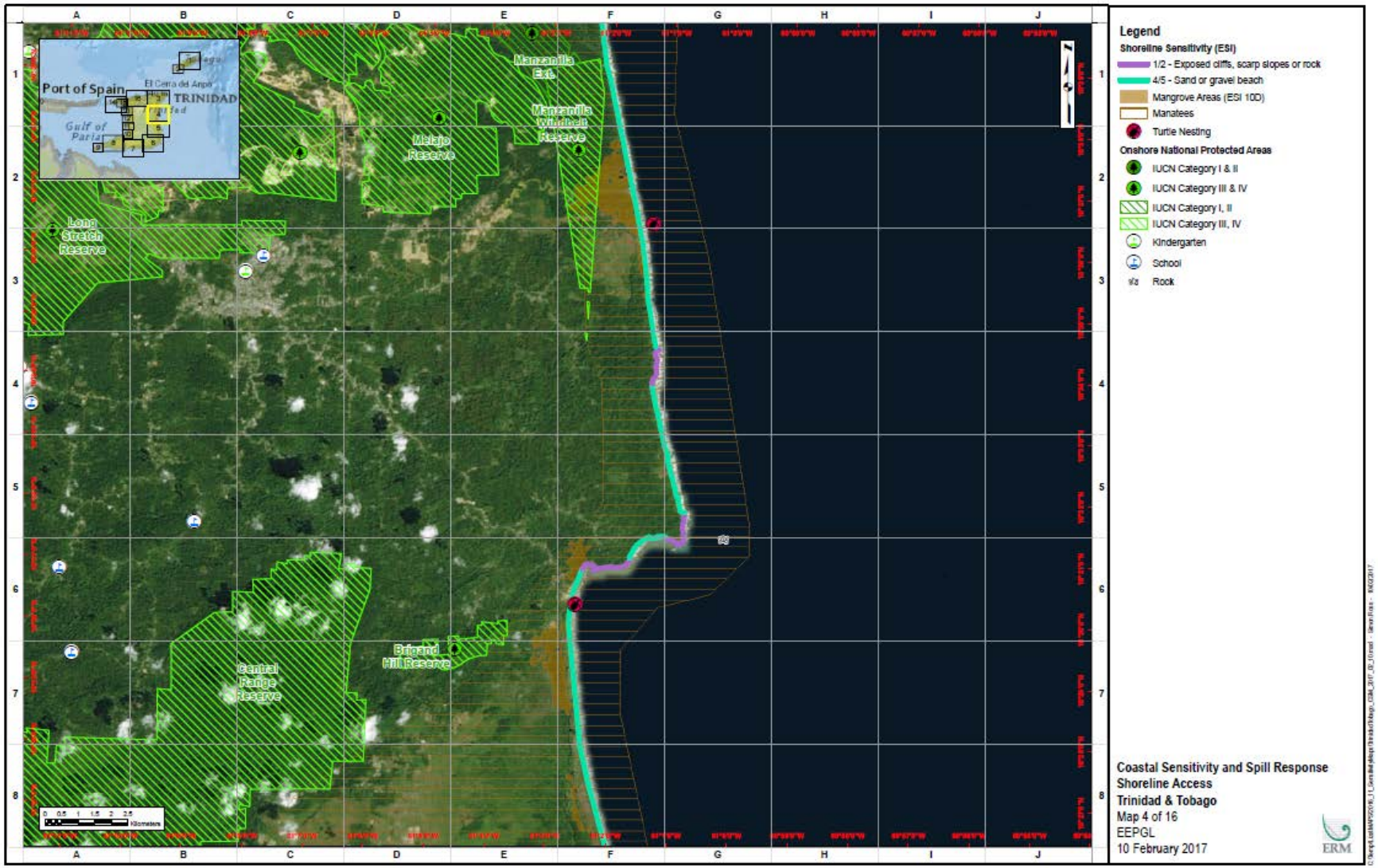

Legend
Shoreline Sensitivity (ESI)
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Marine Mammals
Onshore National Protected Areas
IUCN Category V, VI
Territorial Waters Boundary
Coastal Sensitivity and Spill Response
Shoreline Access
Venezuela - Guyana Border
Map 43 of 43
EEPGL
08 February 2017
ERM
Imataca
Saint George's
GRENADA
Caracas
Port of Spain
Barcelona
Maturin
Ciudad Guayana
San Félix

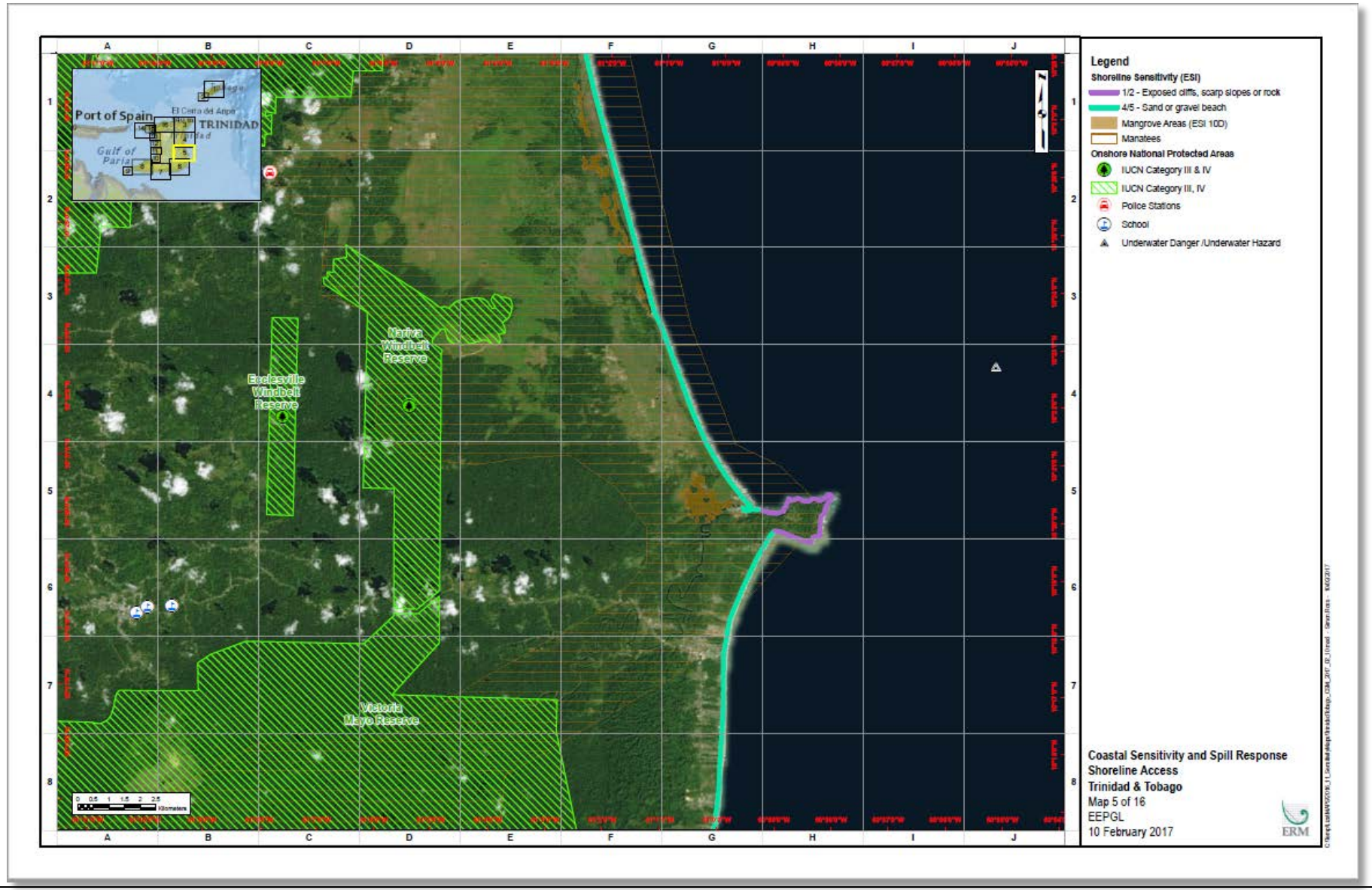
D.3 TRINIDAD AND TOBAGO Coastal Sensitivity Maps

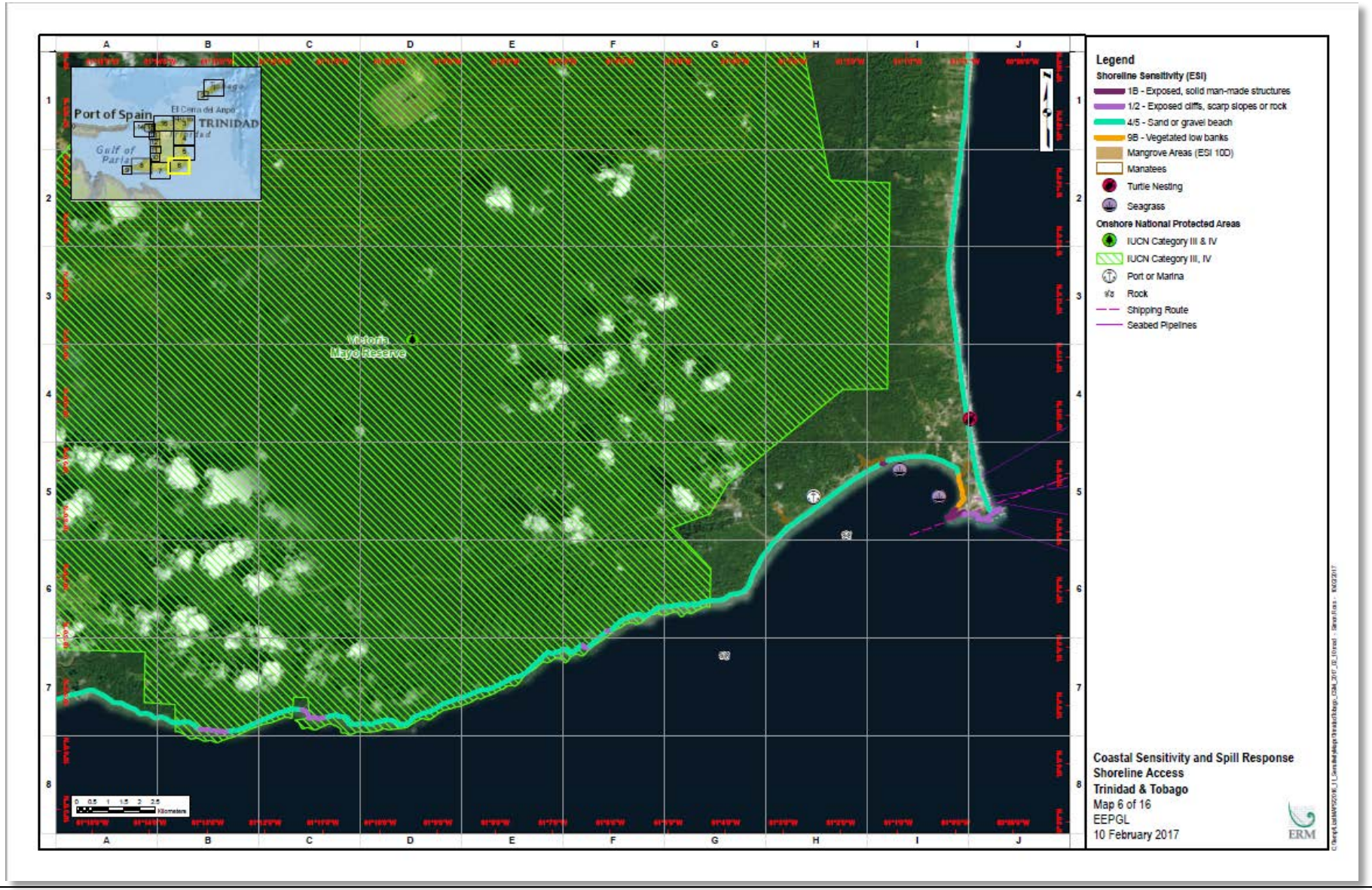


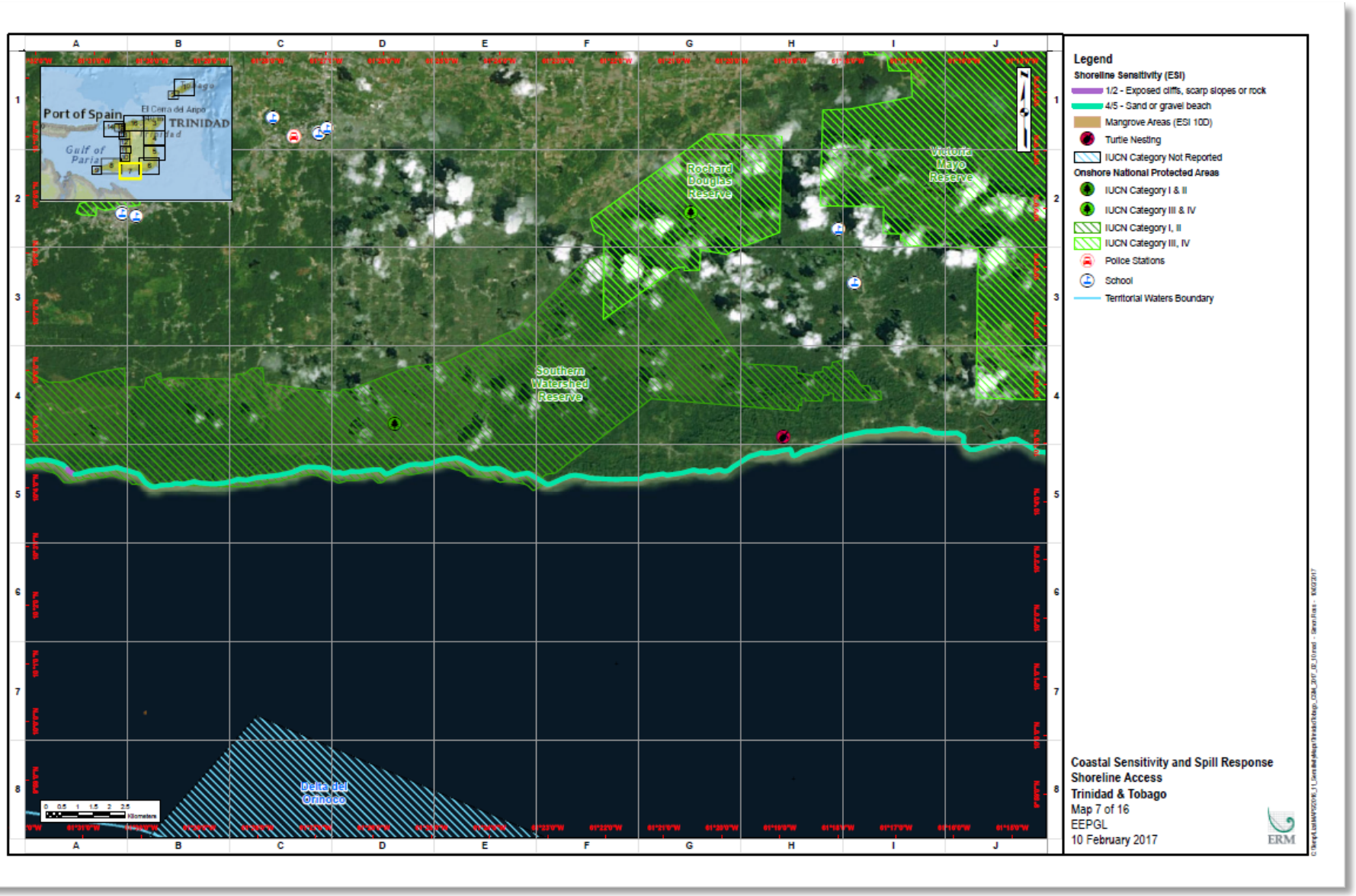

Port of Spain
TRINIDAD
Gulf of Paria
Buccoo Reef
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
9B - Vegetated low banks
10D - Mangroves
Mangrove Areas (ESI 10D)
Coral Reefs
Turtle Nesting
Seagrass
Marine National Protected Areas
IUCN Category III & IV
IUCN Category III, IV
Police Stations
School
Port or Marina
Shipping Route
Seabed Cables
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 2 of 16
EEPGL
10 February 2017
ERM


Port of Spain
TRINIDAD
Gulf of Paria
St. David Reserve
Eastern Extension Matura
Matura Swamp Reserve
Matura Reserve Western Ext.
Melajo Reserve
Manzanilla Ext.
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
Manatees
Coral Reefs
Turtle Nesting
Seagrass
Onshore National Protected Areas
IUCN Category I & II
IUCN Category III & IV
IUCN Category I, II
IUCN Category III, IV
Police Stations
School
Seabed Cables
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 3 of 16
EEPGL
10 February 2017
ERM

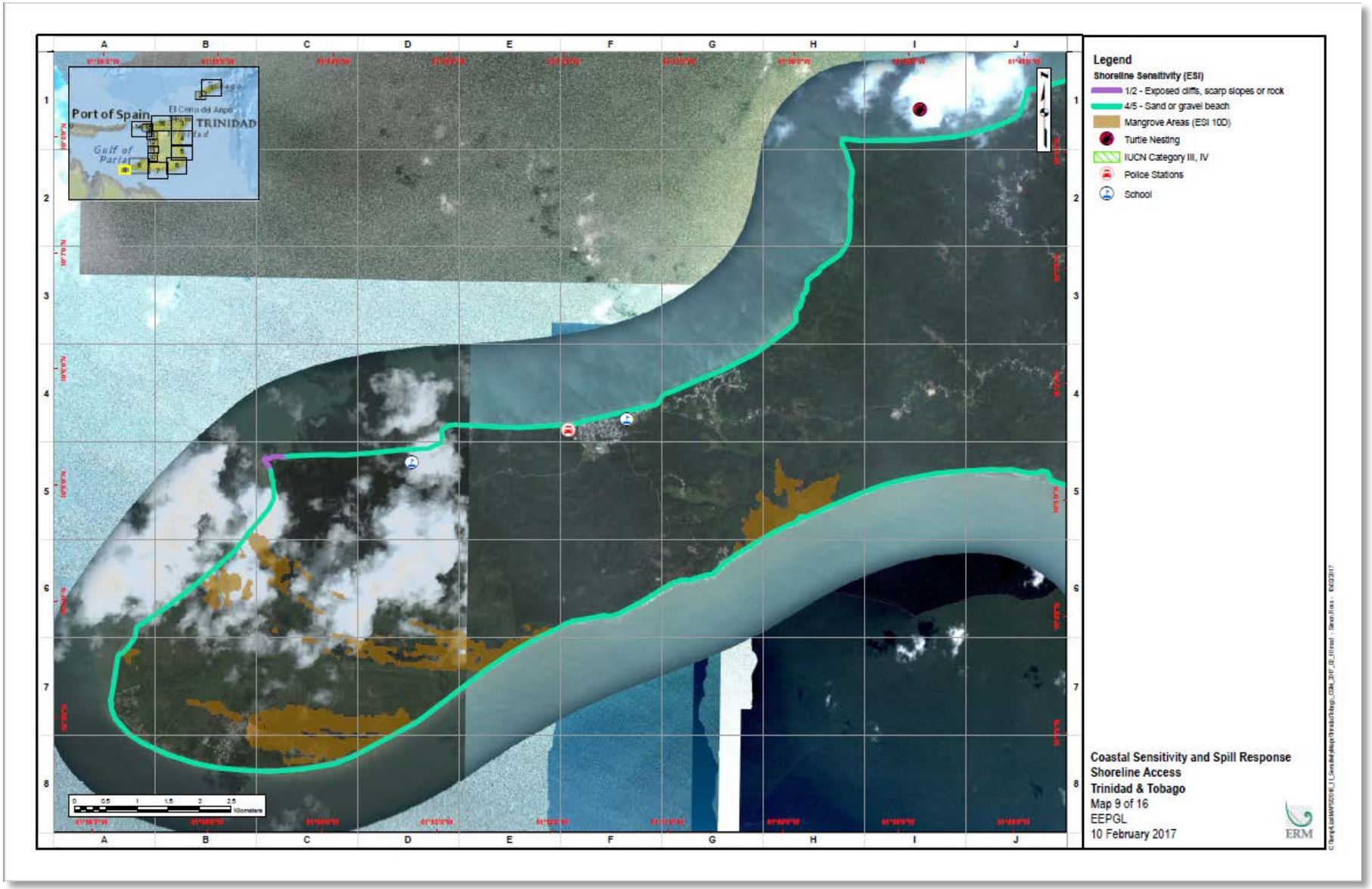

Port of Spain
El Cerro del Aripo
TRINIDAD
Gulf of Paria
Manzanilla Ext.
Manzanilla Wildbird Reserve
Melajo Reserve
Long Stretch Reserve
Brigand Hill Reserve
Central Range Reserve
Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
Mangrove Areas (ESI 10D)
Manatees
Turtle Nesting
Onshore National Protected Areas
IUCN Category I & II
IUCN Category III & IV
IUCN Category I, II
IUCN Category III, IV
Kindergarten
School
Rock
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 4 of 16
EEPGL
10 February 2017
ERM

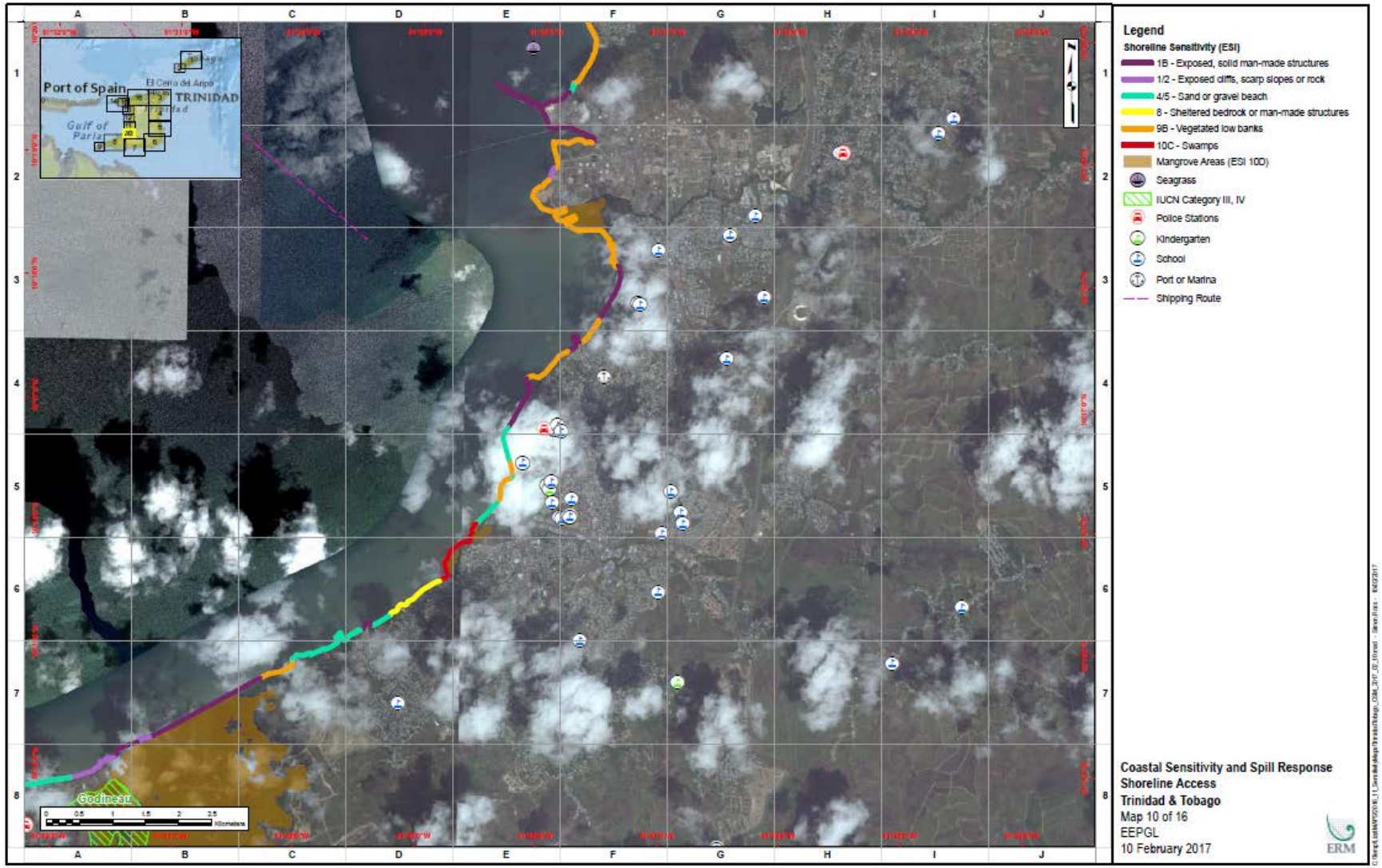

Port of Spain
TRINIDAD
Gulf of Paria
Nariva Windbelt Reserve
Ecclesville Windbelt Reserve
Victoria Mayo Reserve
Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
Mangrove Areas (ESI 10D)
Manatees
Onshore National Protected Areas
IUCN Category III & IV
IUCN Category III, IV
Police Stations
School
Underwater Danger /Underwater Hazard
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 5 of 16
EEPGL
10 February 2017
ERM

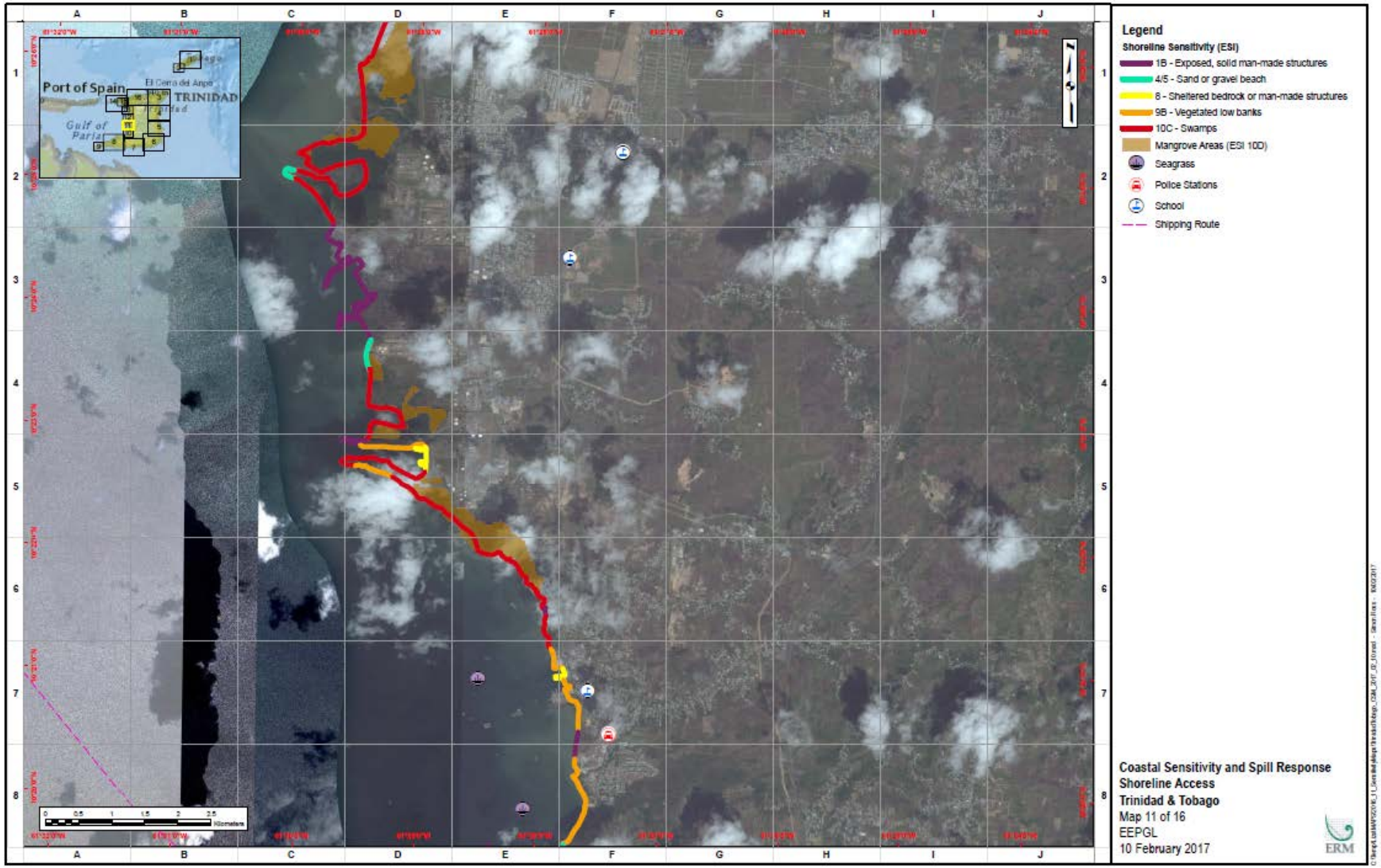

Port of Spain
TRINIDAD
Gulf of Paria
Victoria Mayo Reserve
Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
9B - Vegetated low banks
Mangrove Areas (ESI 10D)
Manatees
Turtle Nesting
Seagrass
Onshore National Protected Areas
IUCN Category III & IV
IUCN Category III, IV
Port or Marina
Rock
Shipping Route
Seabed Pipelines
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 6 of 16
EEPGL
10 February 2017
ERM

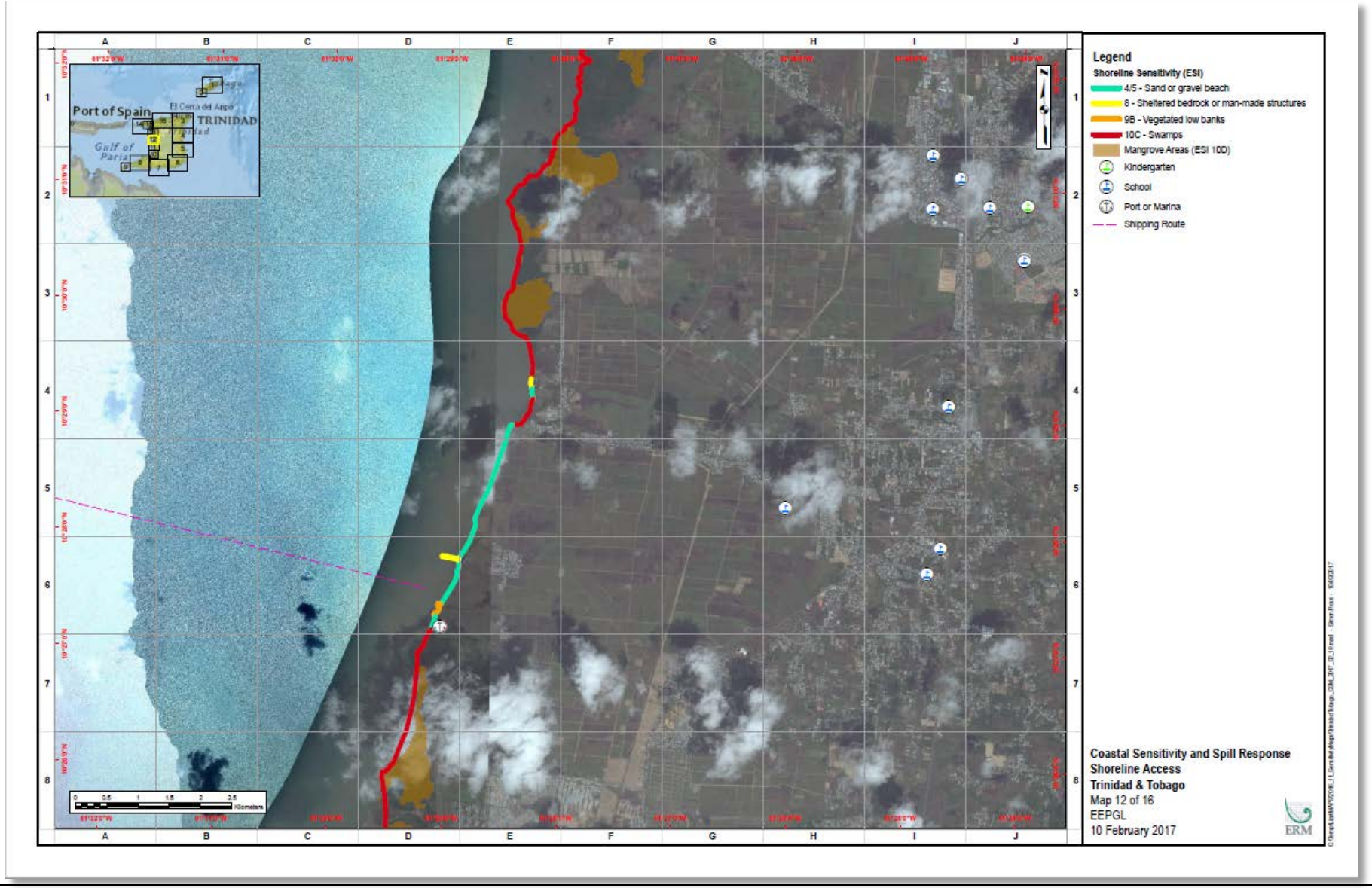

Port of Spain
TRINIDAD
Gulf of Paria
Richard Douglas Reserve
Victoria Mayo Reserve
Southern Watershed Reserve
Delta del Orinoco
Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
Mangrove Areas (ESI 10D)
Turtle Nesting
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category I & II
IUCN Category III & IV
IUCN Category I, II
IUCN Category III, IV
Police Stations
School
Territorial Waters Boundary
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 7 of 16
EEPGL
10 February 2017
ERM

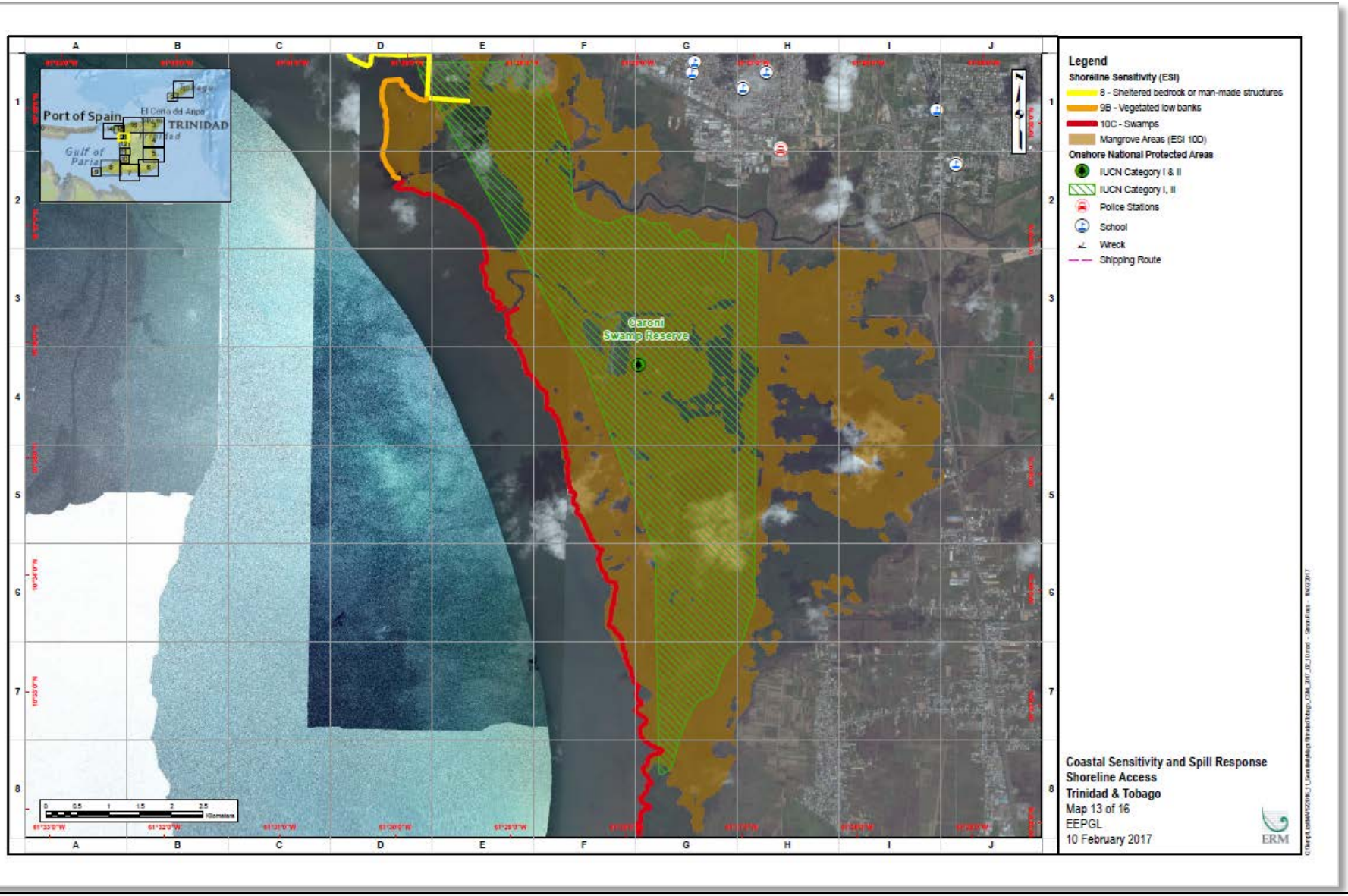

Port of Spain
El Cerro del Aripo
TRINIDAD
Gulf of Paria
Godineau Swamp Reserve
Morne L'Enfer Reserve
Sipara Reserve
Cap de Ville Reserve
Erin Reserve
Cedros Reserve
Southern Watershed Reserve
Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
10C - Swamps
Mangrove Areas (ESI 10D)
Onshore National Protected Areas
IUCN Category III & IV
IUCN Category Not Reported
IUCN Category I, II
IUCN Category III, IV
IUCN Category Not Reported
Police Stations
School
Port or Marina
Shipping Route
Seabed Pipelines
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 8 of 16
EEPGL
10 February 2017
ERM

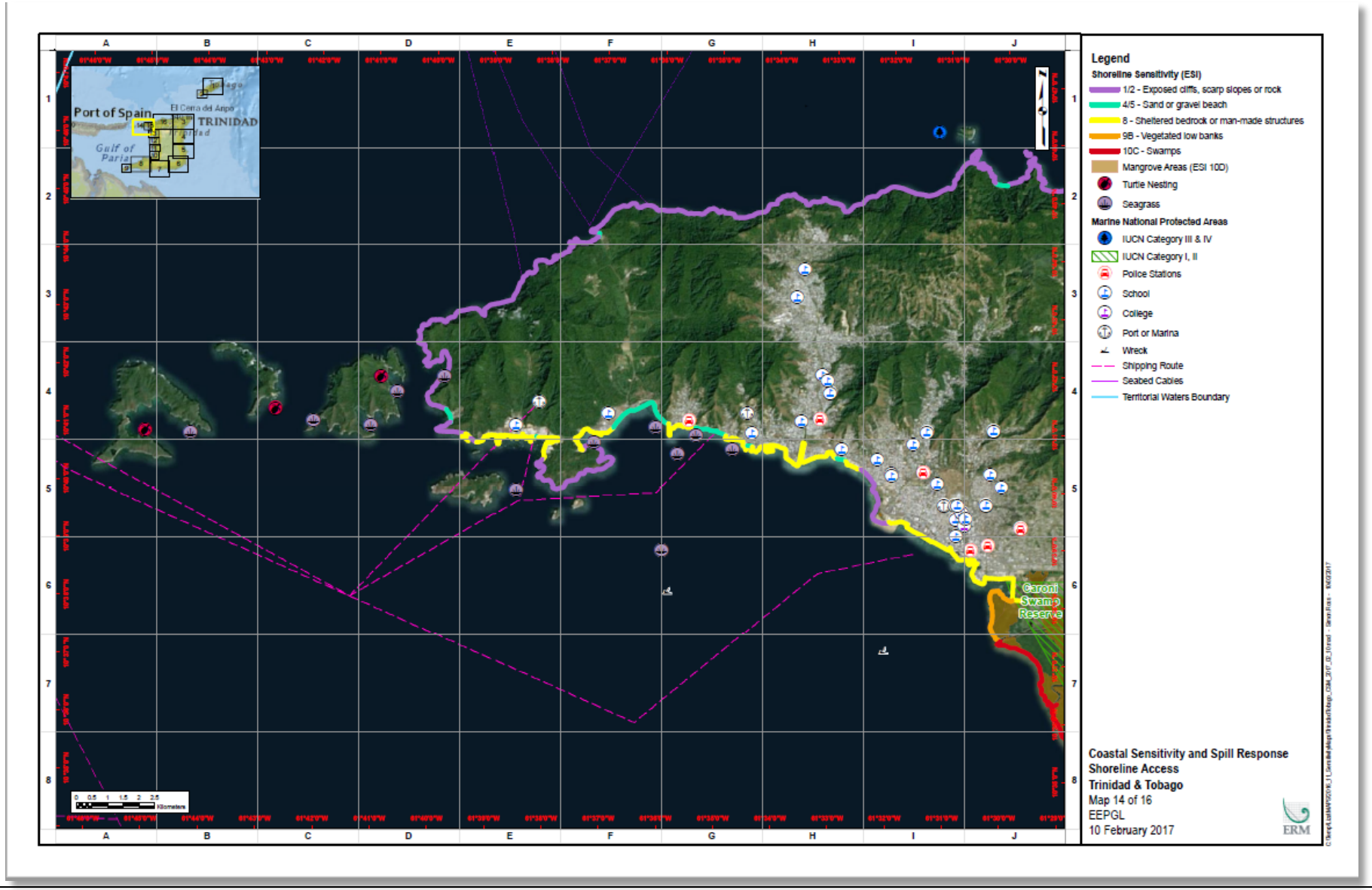

Port of Spain
TRINIDAD
Gulf of Paria
Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
Mangrove Areas (ESI 10D)
Turtle Nesting
IUCN Category III, IV
Police Stations
School
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 9 of 16
EEPGL
10 February 2017
ERM

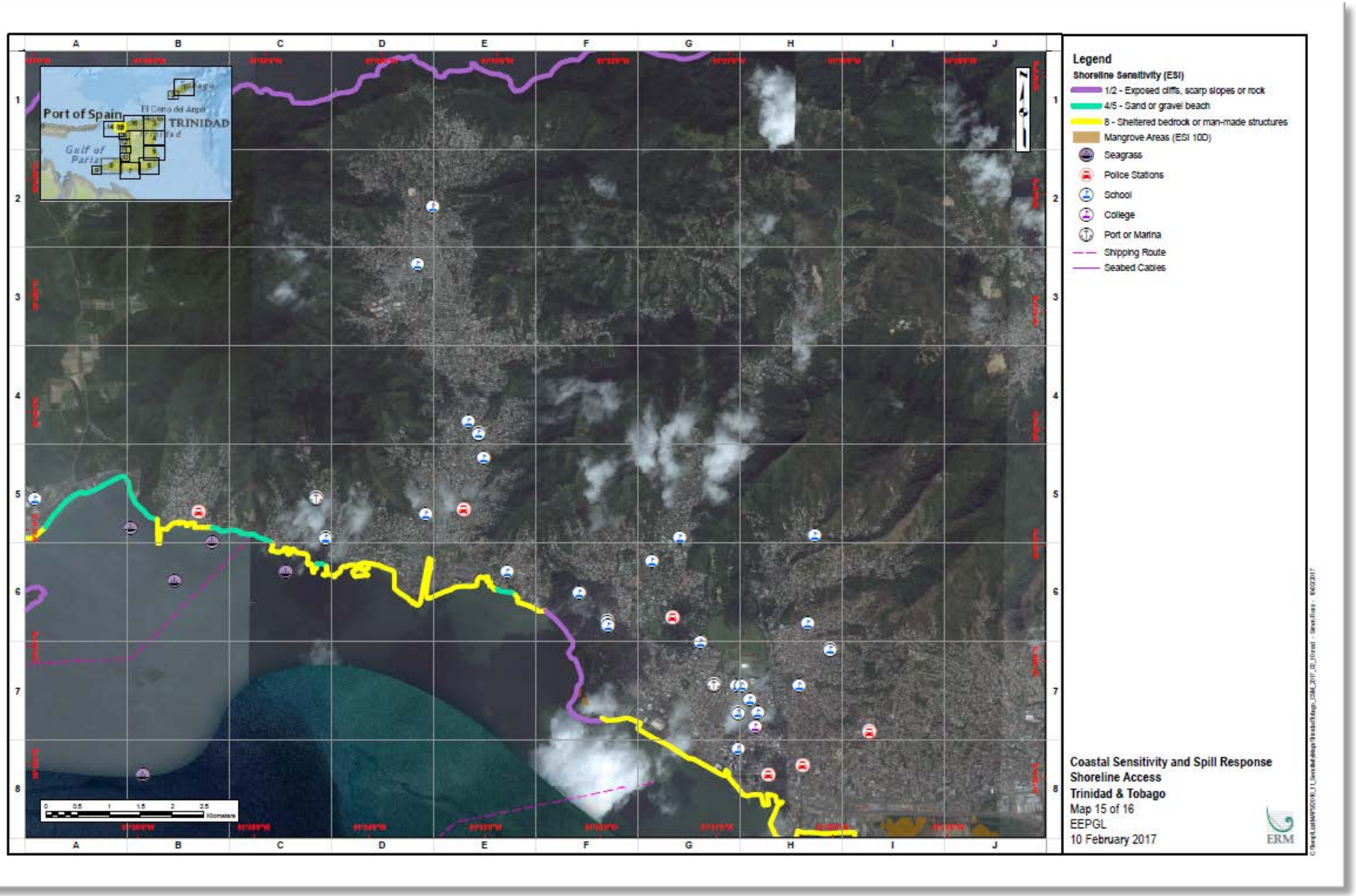

Port of Spain
El Cerro del Aripo
TRINIDAD
Gulf of Paria
Godineau
Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
9B - Vegetated low banks
10C - Swamps
Mangrove Areas (ESI 10D)
Seagrass
IUCN Category III, IV
Police Stations
Kindergarten
School
Port or Marina
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 10 of 16
EEPGL
10 February 2017
ERM


Port of Spain
TRINIDAD
Gulf of Paria
Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
9B - Vegetated low banks
10C - Swamps
Mangrove Areas (ESI 10D)
Seagrass
Police Stations
School
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 11 of 16
EEPGL
10 February 2017
ERM


Port of Spain
TRINIDAD
Gulf of Paria
Legend
Shoreline Sensitivity (ESI)
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
9B - Vegetated low banks
10C - Swamps
Mangrove Areas (ESI 10D)
Kindergarten
School
Port or Marina
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 12 of 16
EEPGL
10 February 2017
ERM

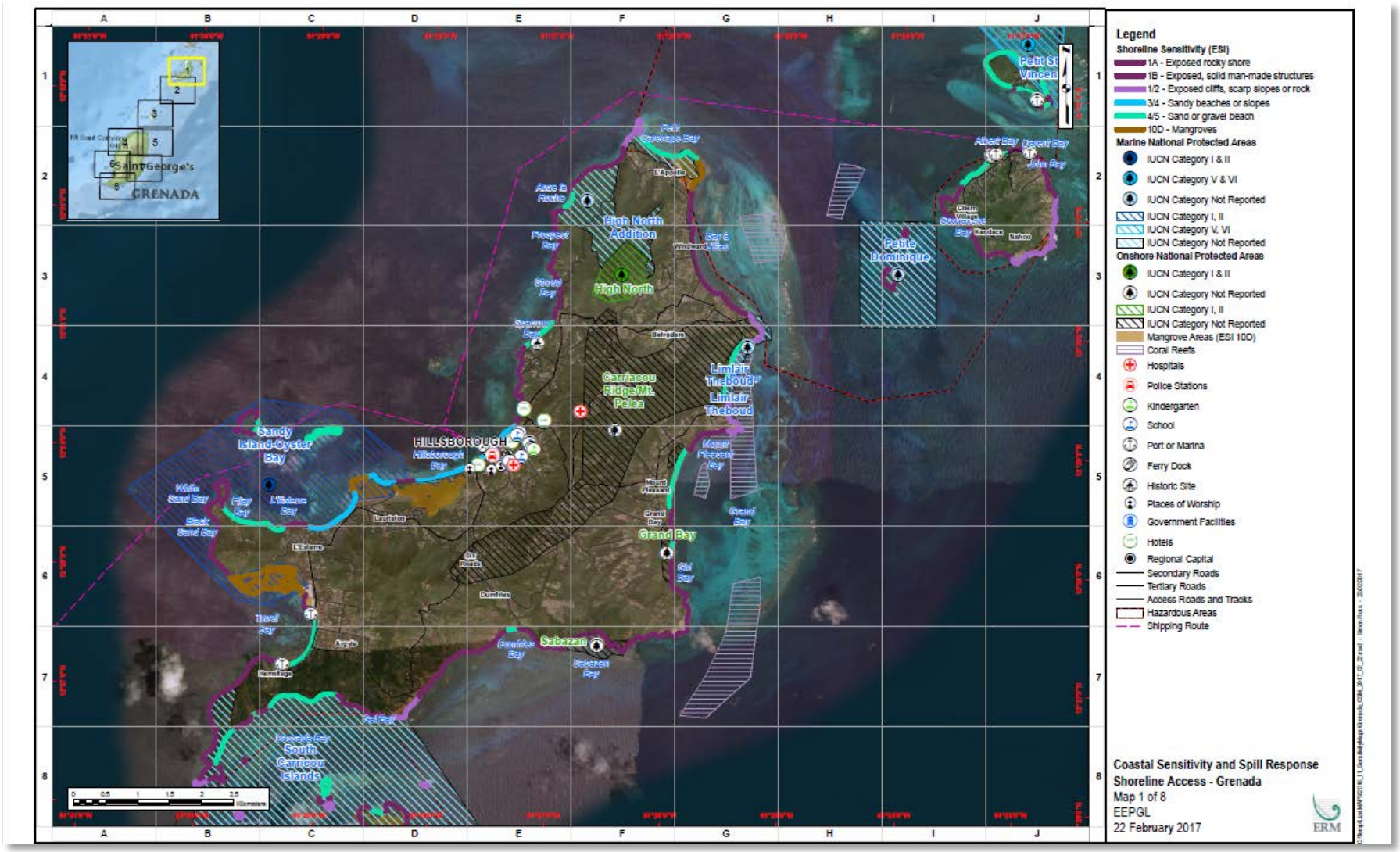

Port of Spain
TRINIDAD
Gulf of Paria
Caroni
Swamp Reserve
Legend
Shoreline Sensitivity (ESI)
8 - Sheltered bedrock or man-made structures
9B - Vegetated low banks
10C - Swamps
Mangrove Areas (ESI 10D)
Onshore National Protected Areas
IUCN Category I & II
IUCN Category I, II
Police Stations
School
Wreck
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 13 of 16
EEPGL
10 February 2017
ERM

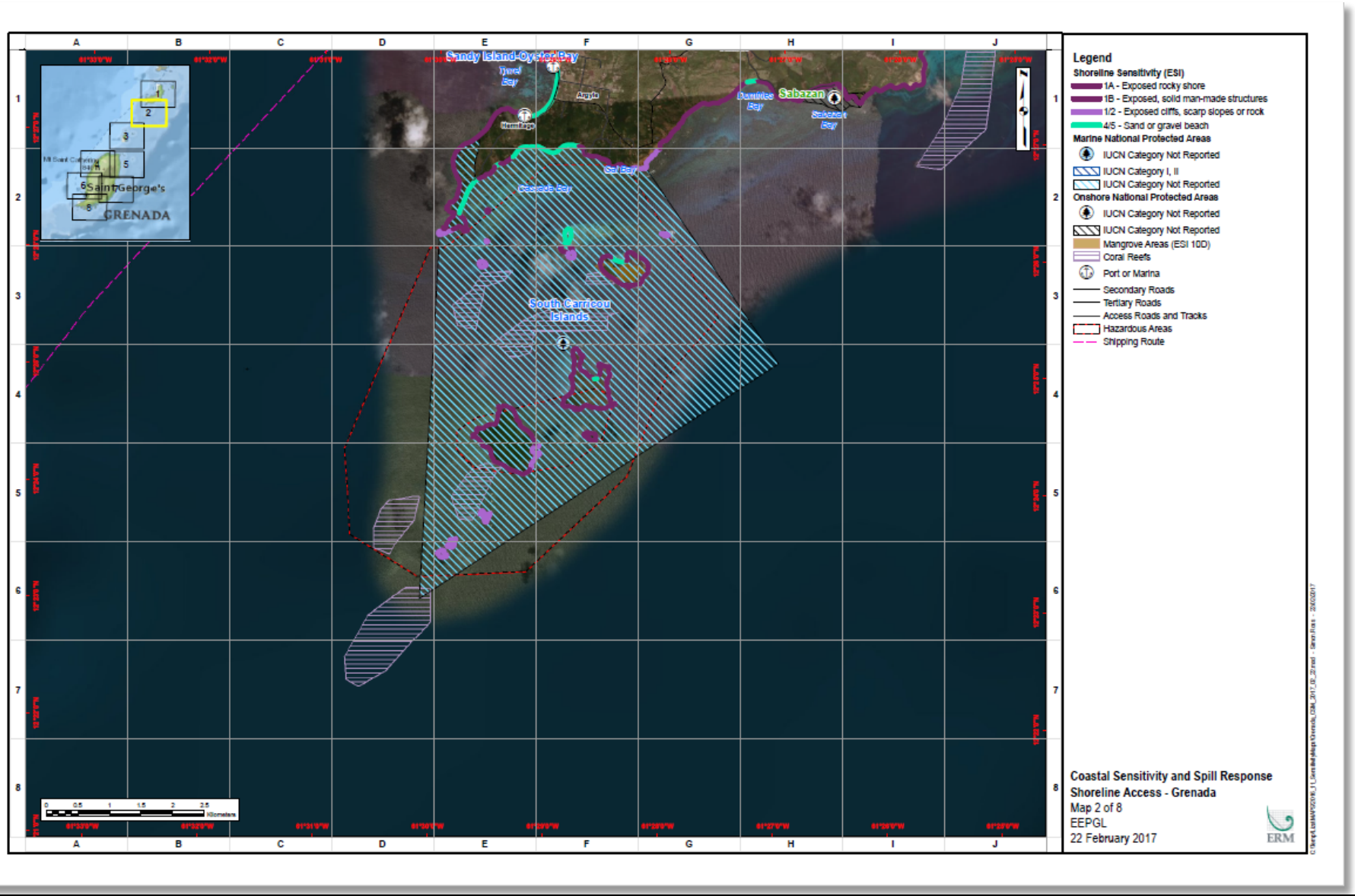

Port of Spain
TRINIDAD
Gulf of Paria
Caroni Swamp Reserve
Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
9B - Vegetated low banks
10C - Swamps
Mangrove Areas (ESI 10D)
Turtle Nesting
Seagrass
Marine National Protected Areas
IUCN Category III & IV
IUCN Category I, II
Police Stations
School
College
Port or Marina
Wreck
Shipping Route
Seabed Cables
Territorial Waters Boundary
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 14 of 16
EEPGL
10 February 2017
ERM

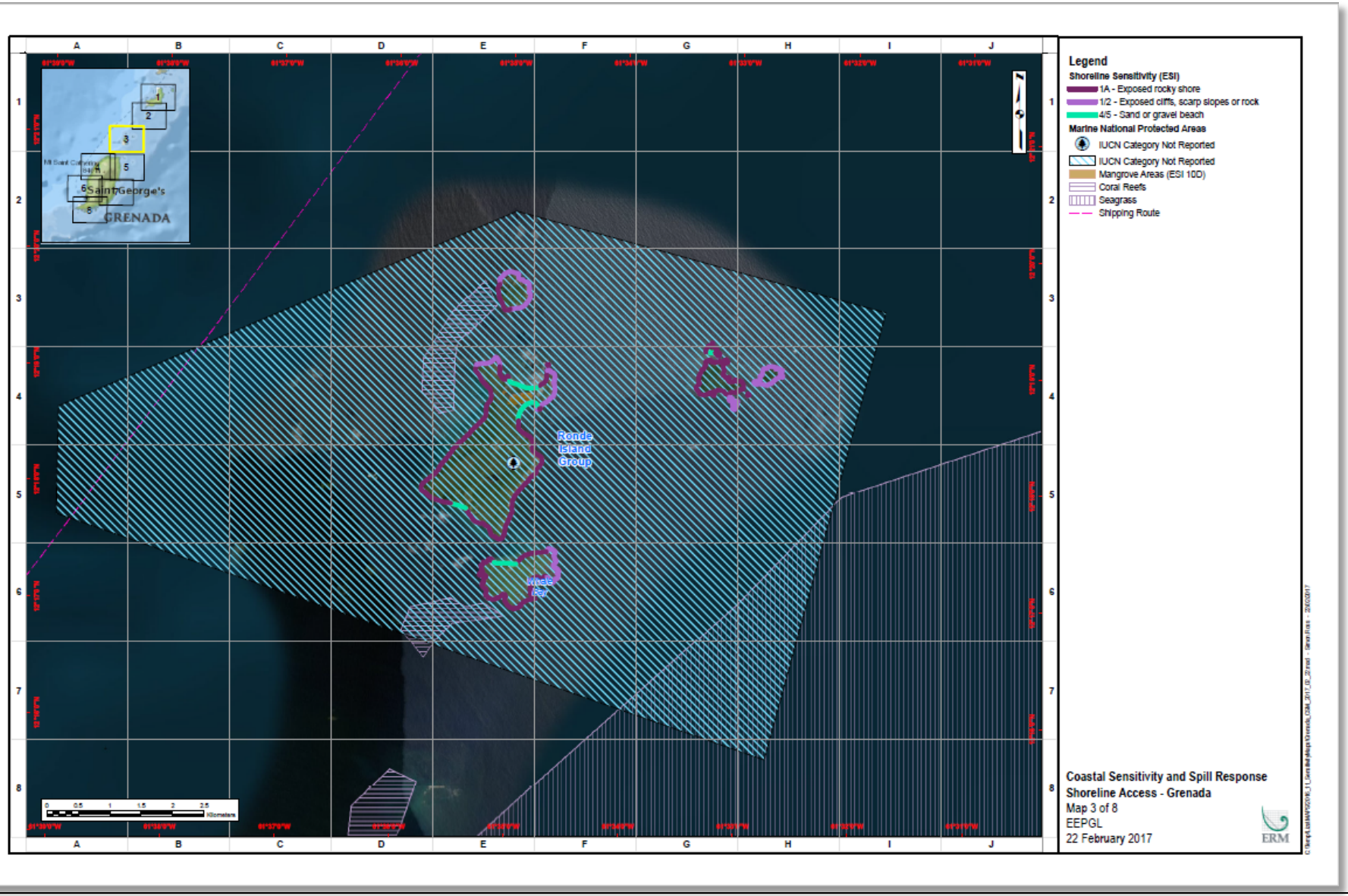

Port of Spain
TRINIDAD
Gulf of Paria
Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
Mangrove Areas (ESI 10D)
Seagrass
Police Stations
School
College
Port or Marina
Shipping Route
Seabed Cables
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 15 of 16
EEPGL
10 February 2017
ERM

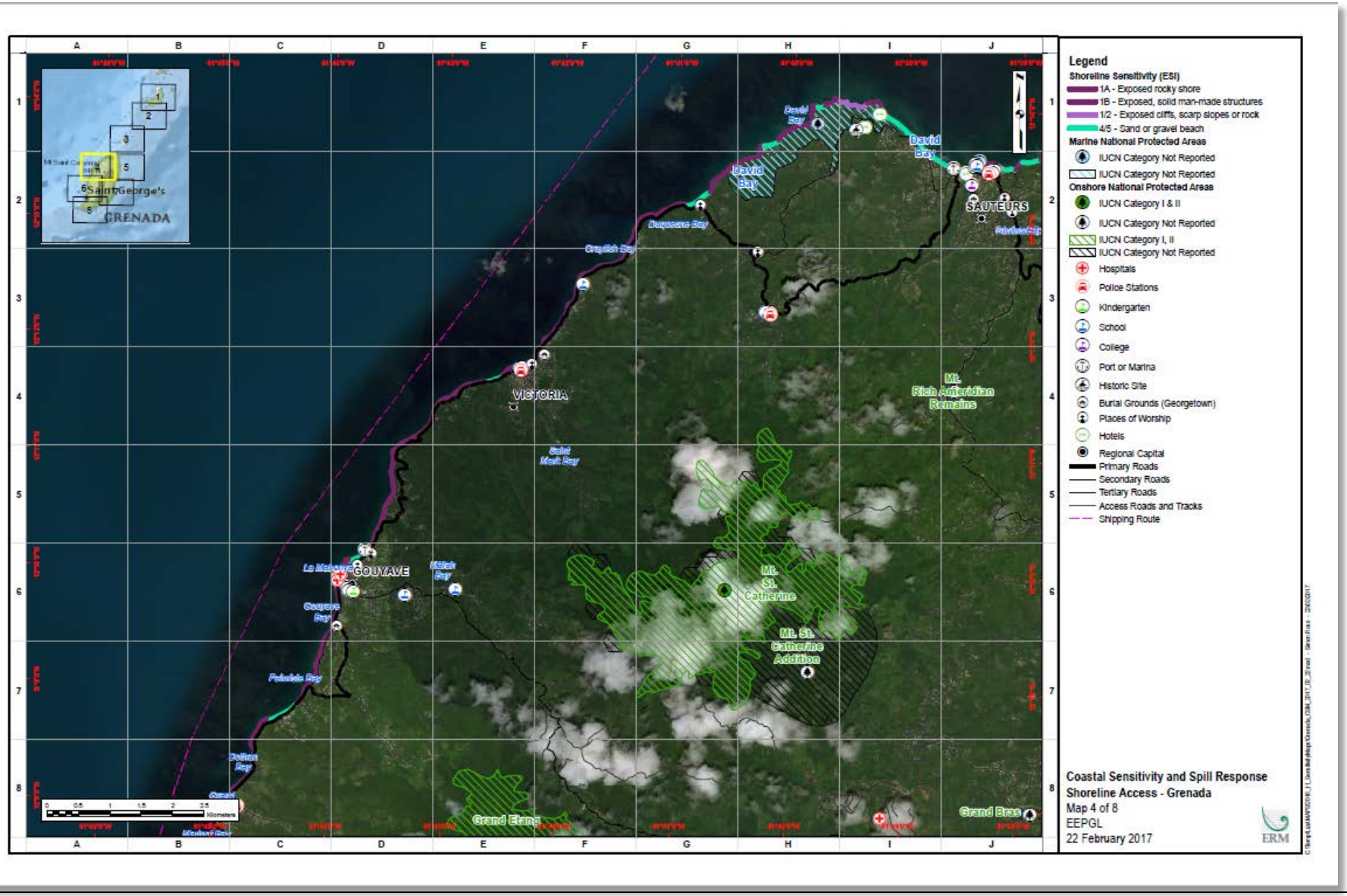

Legend
Shoreline Sensitivity (ESI)
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
Turtle Nesting
Onshore National Protected Areas
IUCN Category I & II
IUCN Category III & IV
IUCN Category I, II
IUCN Category III, IV
Police Stations
School
Port of Spain
TRINIDAD
Gulf of Paria
Las Cuevas Reserve
Yarra Reserve
Blanchisseuse Reserve
Paria Reserve
Nrrb.
Nrrc
Nrra
Tacarigua Reserve
Arima Reserve
Coastal Sensitivity and Spill Response
Shoreline Access
Trinidad & Tobago
Map 16 of 16
EEPGL
10 February 2017
ERM

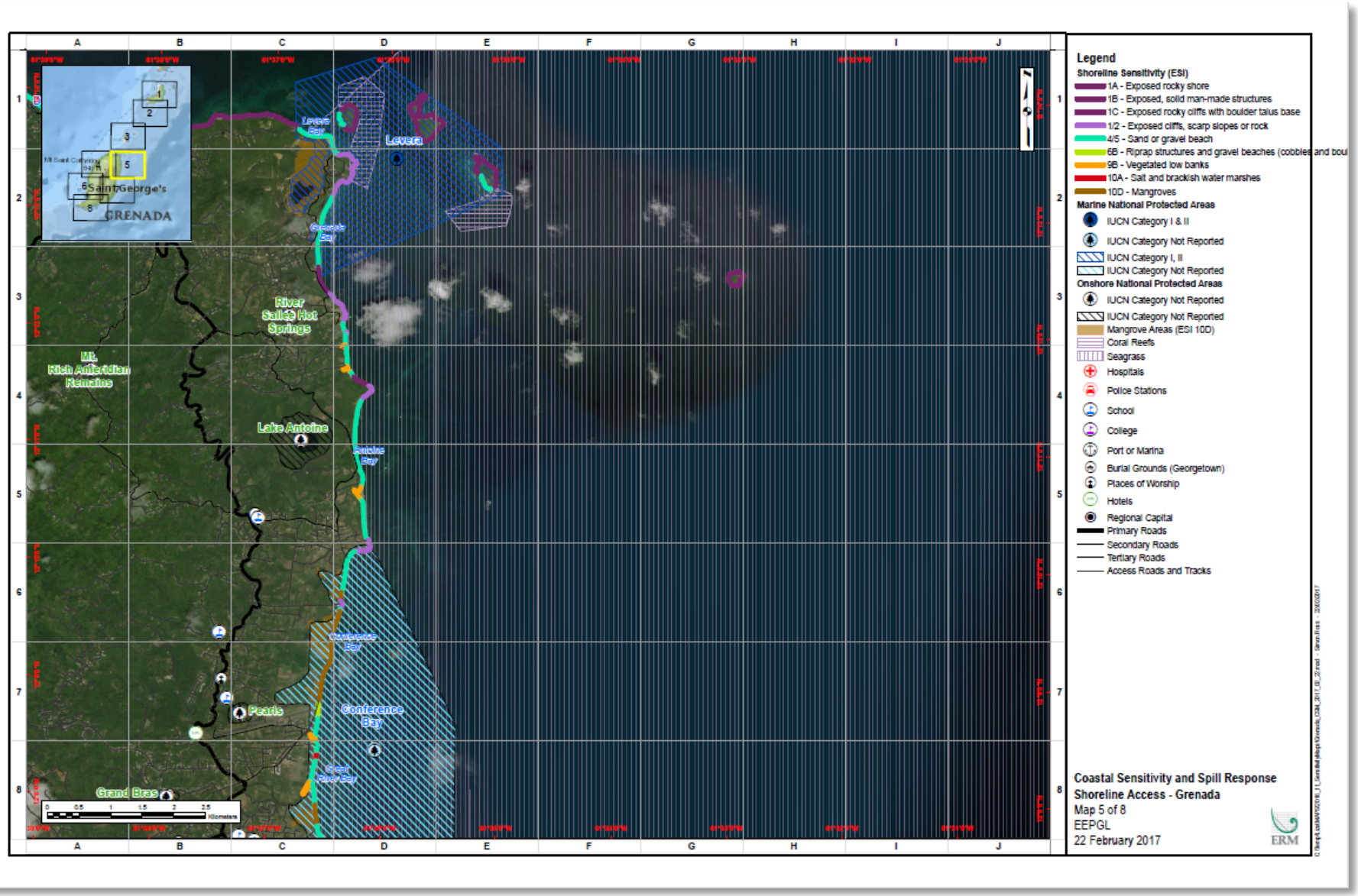
D.4 GRENADA Coastal Sensitivity Maps

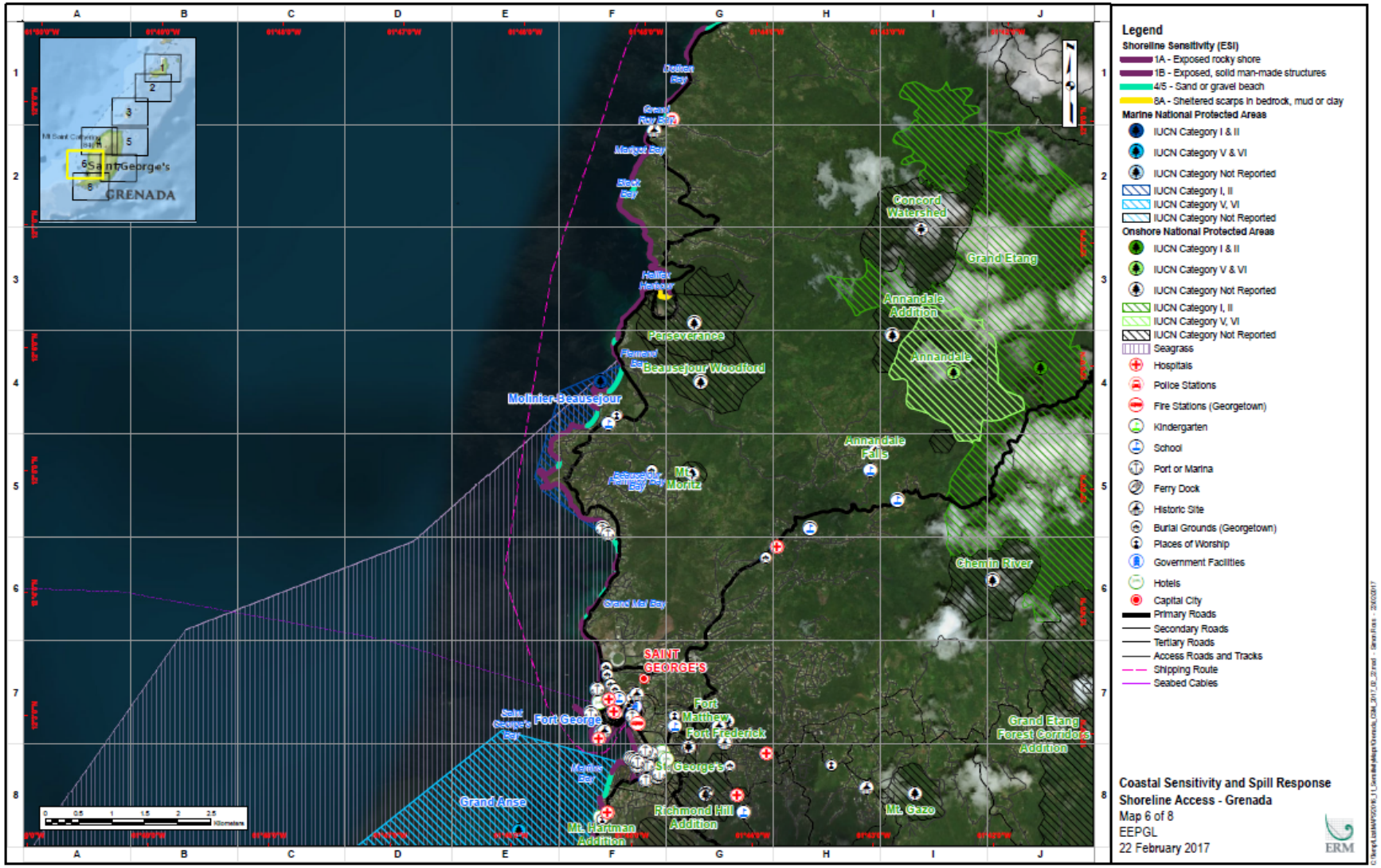


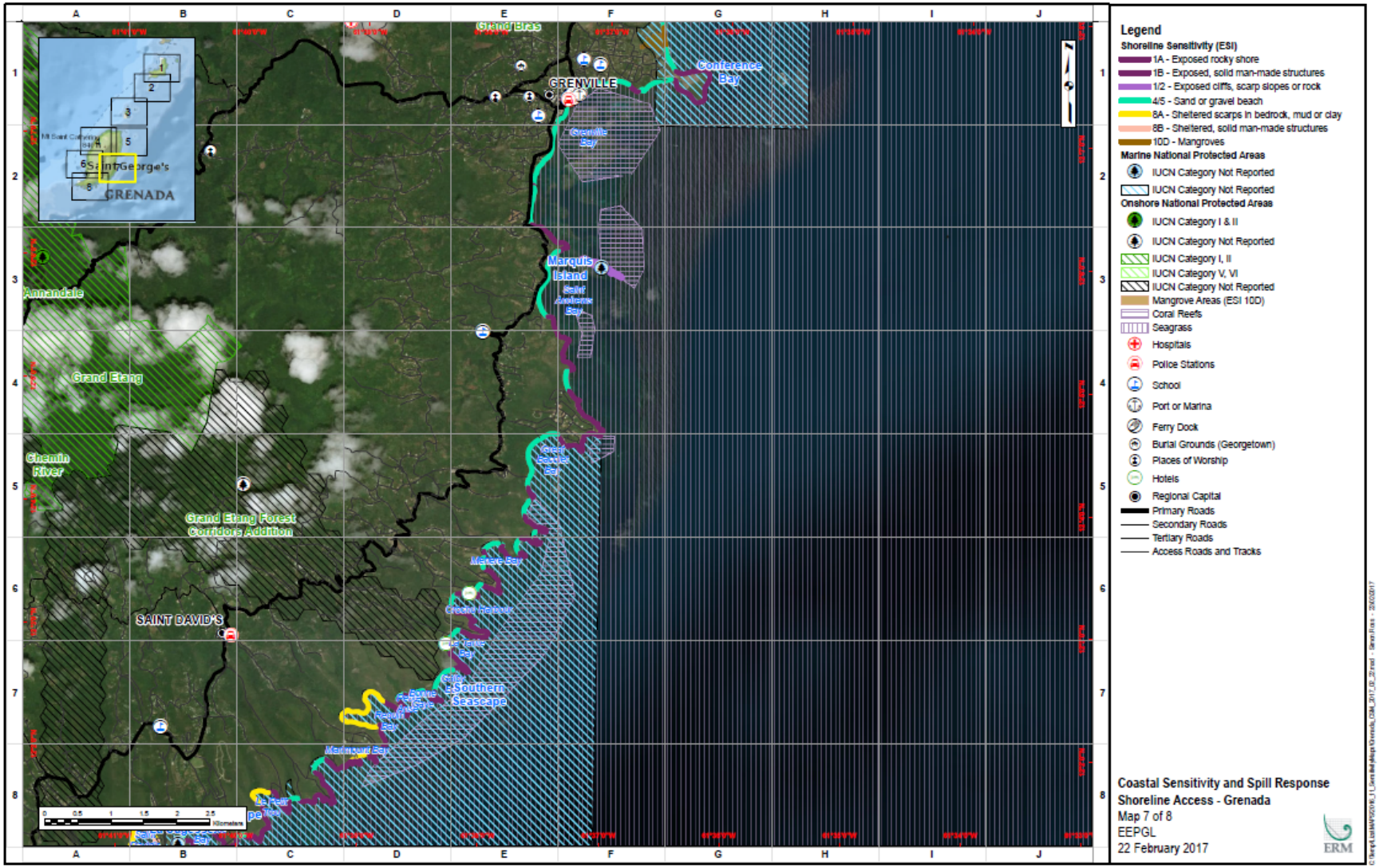

Sandy Island-Oyster Bay
Sabazan
Saint George's
GRENADA
South Carriacou Islands
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
Marine National Protected Areas
IUCN Category Not Reported
IUCN Category I, II
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category Not Reported
IUCN Category Not Reported
Mangrove Areas (ESI 10D)
Coral Reefs
Port or Marina
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Hazardous Areas
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access - Grenada
Map 2 of 8
EEPGL
22 February 2017
ERM

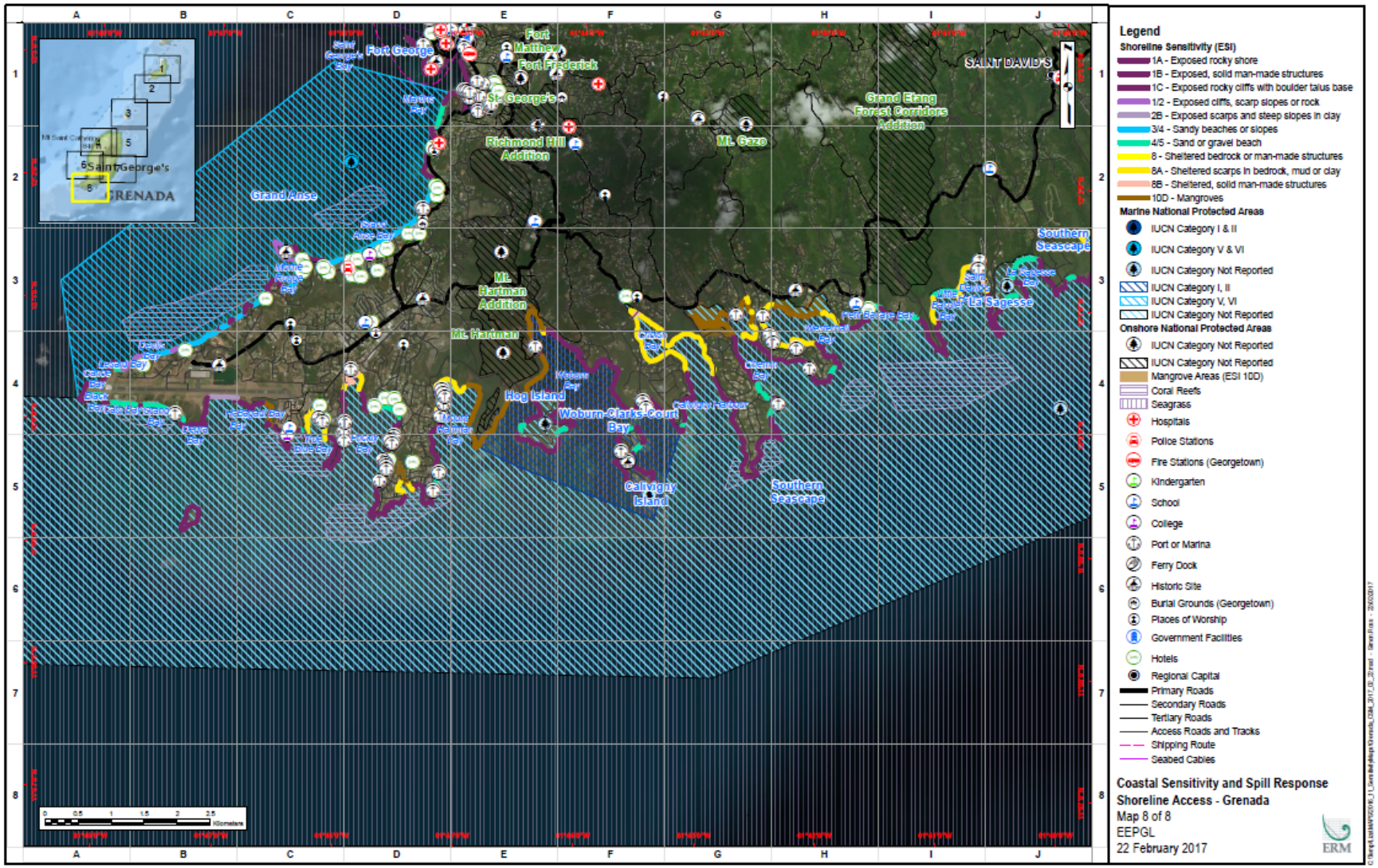

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
Marine National Protected Areas
IUCN Category Not Reported
IUCN Category Not Reported
Mangrove Areas (ESI 10D)
Coral Reefs
Seagrass
Shipping Route
Ronde Island Group
Caille Est
Saint George's
GRENADA
Coastal Sensitivity and Spill Response
Shoreline Access - Grenada
Map 3 of 8
EEPGL
22 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
Marine National Protected Areas
IUCN Category Not Reported
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category I & II
IUCN Category Not Reported
IUCN Category I, II
IUCN Category Not Reported
Hospitals
Police Stations
Kindergarten
School
College
Port or Marina
Historic Site
Burial Grounds (Georgetown)
Places of Worship
Hotels
Regional Capital
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access - Grenada
Map 4 of 8
EEPGL
22 February 2017
ERM
GRENADA
Saint George's
VICTORIA
GOUYAVE
SAUTEURS
David Bay
Duquesne Bay
Mt. Rich Ameridian Remains
Mt. St. Catherine
Mt. St. Catherine Addition
Grand Etang
Grand Bras

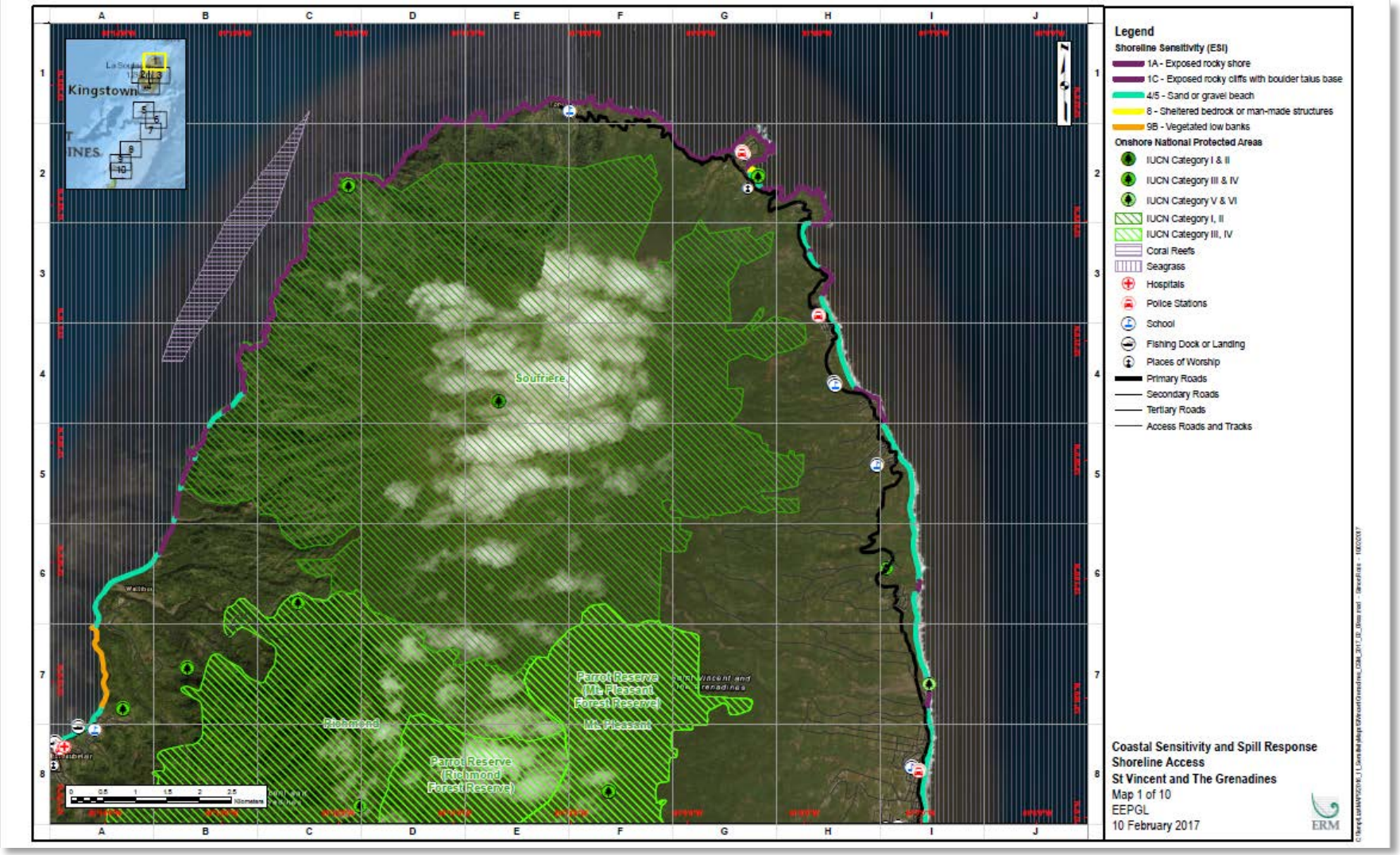

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
6B - Riprap structures and gravel beaches (cobbles and boul
9B - Vegetated low banks
10A - Salt and brackish water marshes
10D - Mangroves
Marine National Protected Areas
IUCN Category I & II
IUCN Category Not Reported
IUCN Category I, II
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category Not Reported
IUCN Category Not Reported
Mangrove Areas (ESI 10D)
Coral Reefs
Seagrass
Hospitals
Police Stations
School
College
Port or Marina
Burial Grounds (Georgetown)
Places of Worship
Hotels
Regional Capital
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Coastal Sensitivity and Spill Response
Shoreline Access - Grenada
Map 5 of 8
EEPGL
22 February 2017
ERM
Levera
Levera Bay
Grenada Bay
River Sallée Hot Springs
Mt. Rich Amerindian Remains
Lake Antoine
Egmont Bay
Conference Bay
Pearls
Great Pond Bay
Grand Bras
St George's
GRENADA

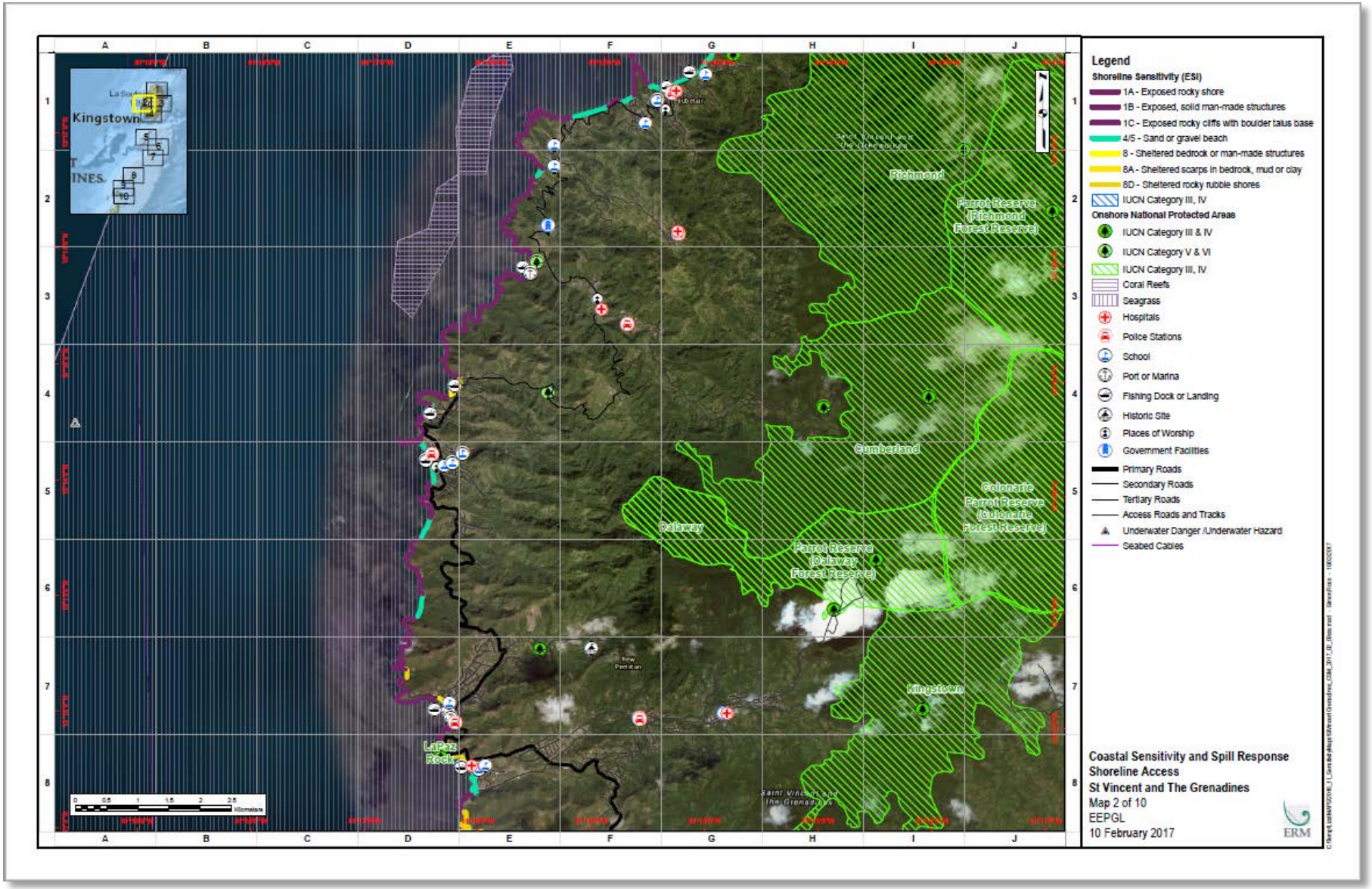

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
4/5 - Sand or gravel beach
8A - Sheltered scarps in bedrock, mud or clay
Marine National Protected Areas
IUCN Category I & II
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category I, II
IUCN Category V, VI
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category I & II
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category I, II
IUCN Category V, VI
IUCN Category Not Reported
Seagrass
Hospitals
Police Stations
Fire Stations (Georgetown)
Kindergarten
School
Port or Marina
Ferry Dock
Historic Site
Burial Grounds (Georgetown)
Places of Worship
Government Facilities
Hotels
Capital City
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Shipping Route
Seabed Cables
Coastal Sensitivity and Spill Response
Shoreline Access - Grenada
Map 6 of 8
EEPGL
22 February 2017
ERM
SAINT GEORGE'S
Fort George
Fort Matthew
Fort Frederick
St. George's
Grand Anse
Mt. Hartman Addition
Richmond Hill Addition
Mt. Gazo
Grand Etang Forest Corridors Addition
Chemin River
Annandale Falls
Annandale
Annandale Addition
Grand Etang
Concord Watershed
Perseverance
Beausejour Woodford
Molinier Beausejour
Mt. Moritz
Grand Mal Bay
Grenada

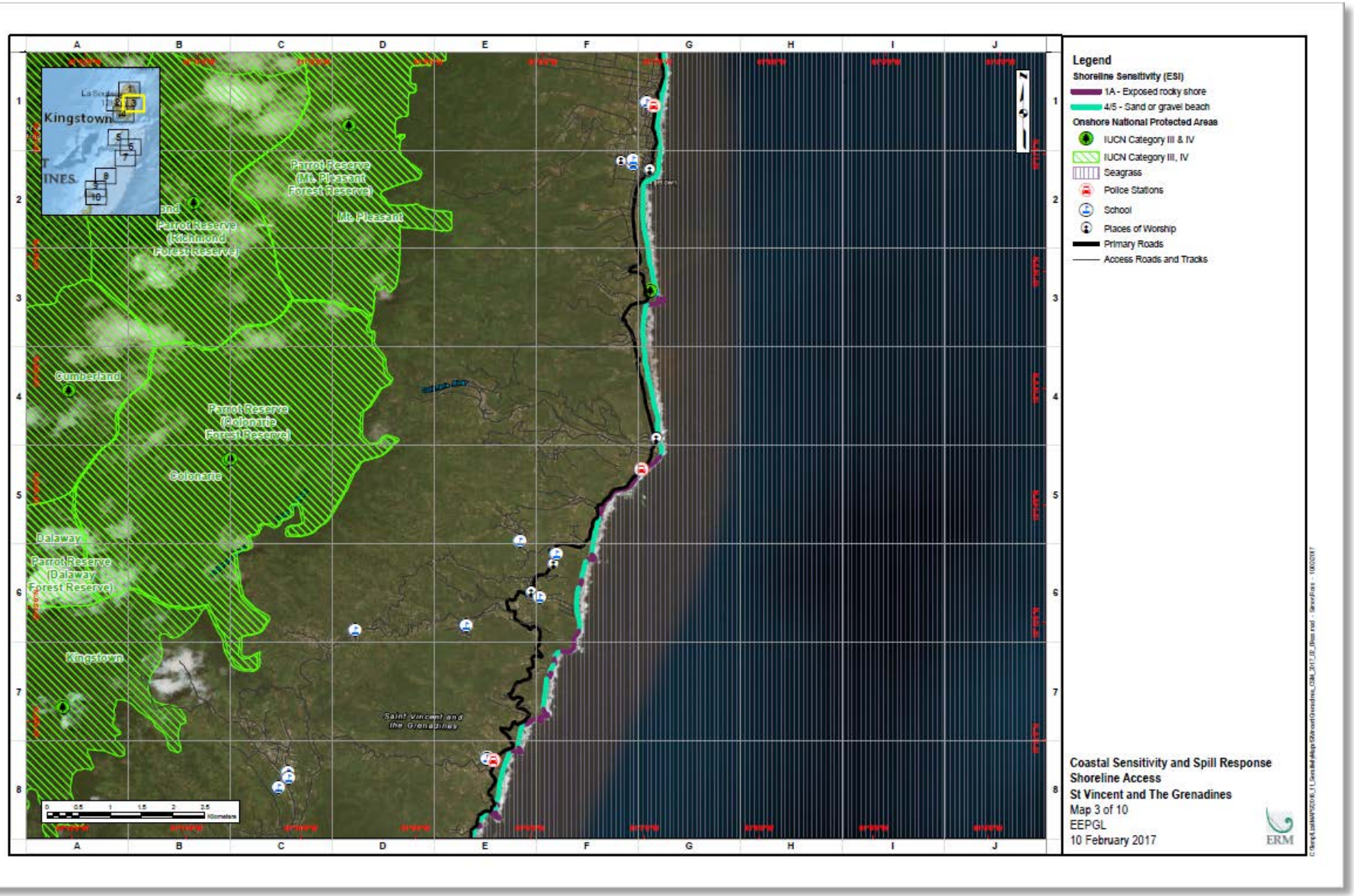

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8A - Sheltered scarps in bedrock, mud or clay
8B - Sheltered, solid man-made structures
10D - Mangroves
Marine National Protected Areas
IUCN Category Not Reported
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category I & II
IUCN Category Not Reported
IUCN Category I, II
IUCN Category V, VI
IUCN Category Not Reported
Mangrove Areas (ESI 10D)
Coral Reefs
Seagrass
Hospitals
Police Stations
School
Port or Marina
Ferry Dock
Burial Grounds (Georgetown)
Places of Worship
Hotels
Regional Capital
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Coastal Sensitivity and Spill Response
Shoreline Access - Grenada
Map 7 of 8
EEPGL
22 February 2017
ERM
GRENADA
GRENVILLE
Grand Bras
Conference Bay
Marquis Island
Annandale
Grand Etang
Chemin River
Grand Etang Forest Corridors Addition
SAINT DAVID'S
Southern Seascape

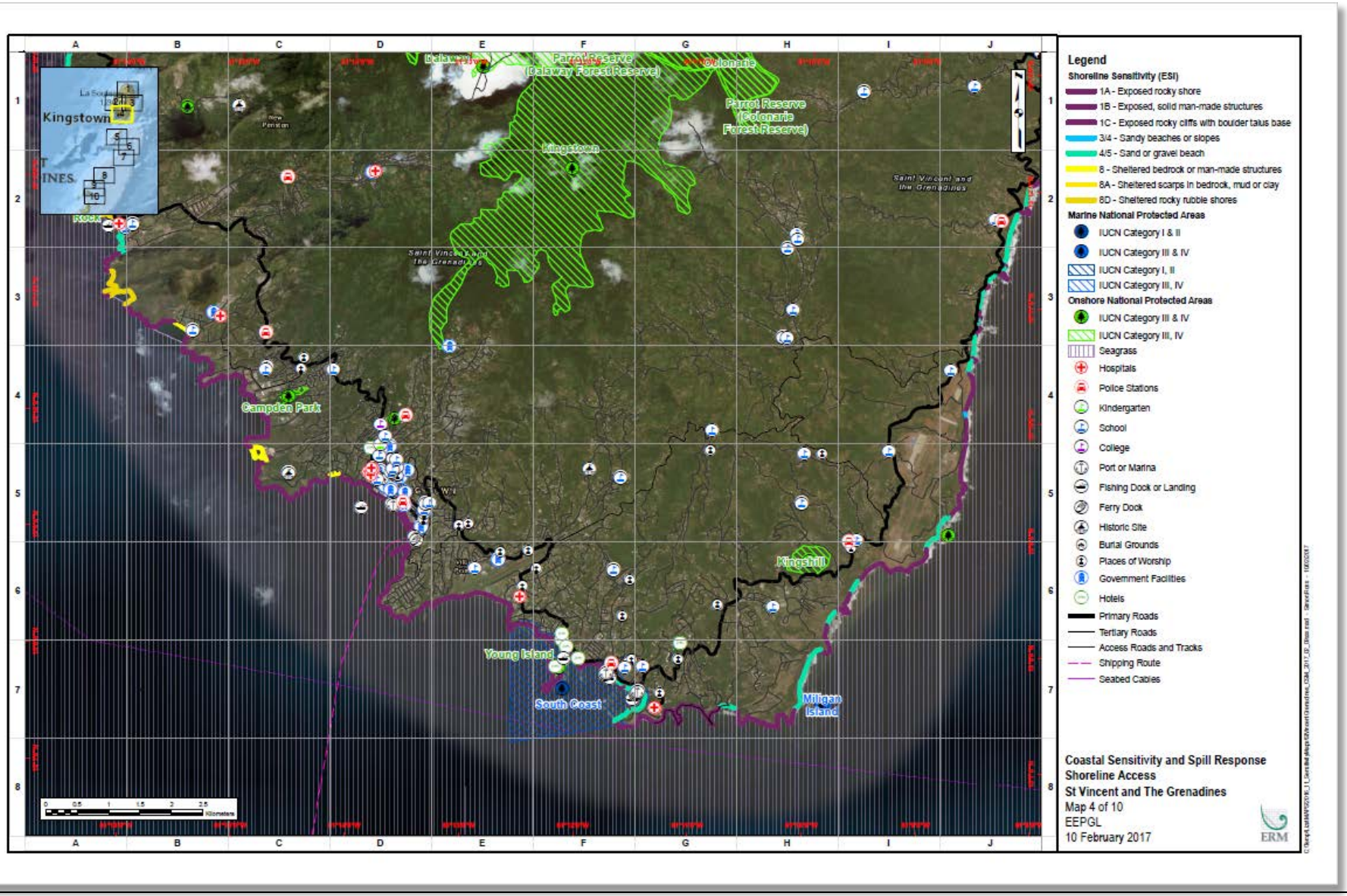

Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
1/2 - Exposed cliffs, scarp slopes or rock
2B - Exposed scarps and steep slopes in clay
3/4 - Sandy beaches or slopes
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
8A - Sheltered scarps in bedrock, mud or clay
8B - Sheltered, solid man-made structures
10D - Mangroves
Marine National Protected Areas
IUCN Category I & II
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category I, II
IUCN Category V, VI
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category Not Reported
IUCN Category Not Reported
Mangrove Areas (ESI 10D)
Coral Reefs
Seagrass
Hospitals
Police Stations
Fire Stations (Georgetown)
Kindergarten
School
College
Port or Marina
Ferry Dock
Historic Site
Burial Grounds (Georgetown)
Places of Worship
Government Facilities
Hotels
Regional Capital
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Shipping Route
Seabed Cables
Coastal Sensitivity and Spill Response
Shoreline Access - Grenada
Map 8 of 8
EEPGL
22 February 2017
ERM
Fort George
Fort Matthew
Fort Frederick
St. George's
SAINT DAVID'S
Grand Etang Forest Corridors Addition
Mt. Gaze
Richmond Hill Addition
Grand Anse
Mt. Hartman Addition
Mt. Hartman
Hog Island
Woburn-Clarks Court Bay
Calivigny Island
Southern Seascape
La Sagesse
GRENADA
Saint George's

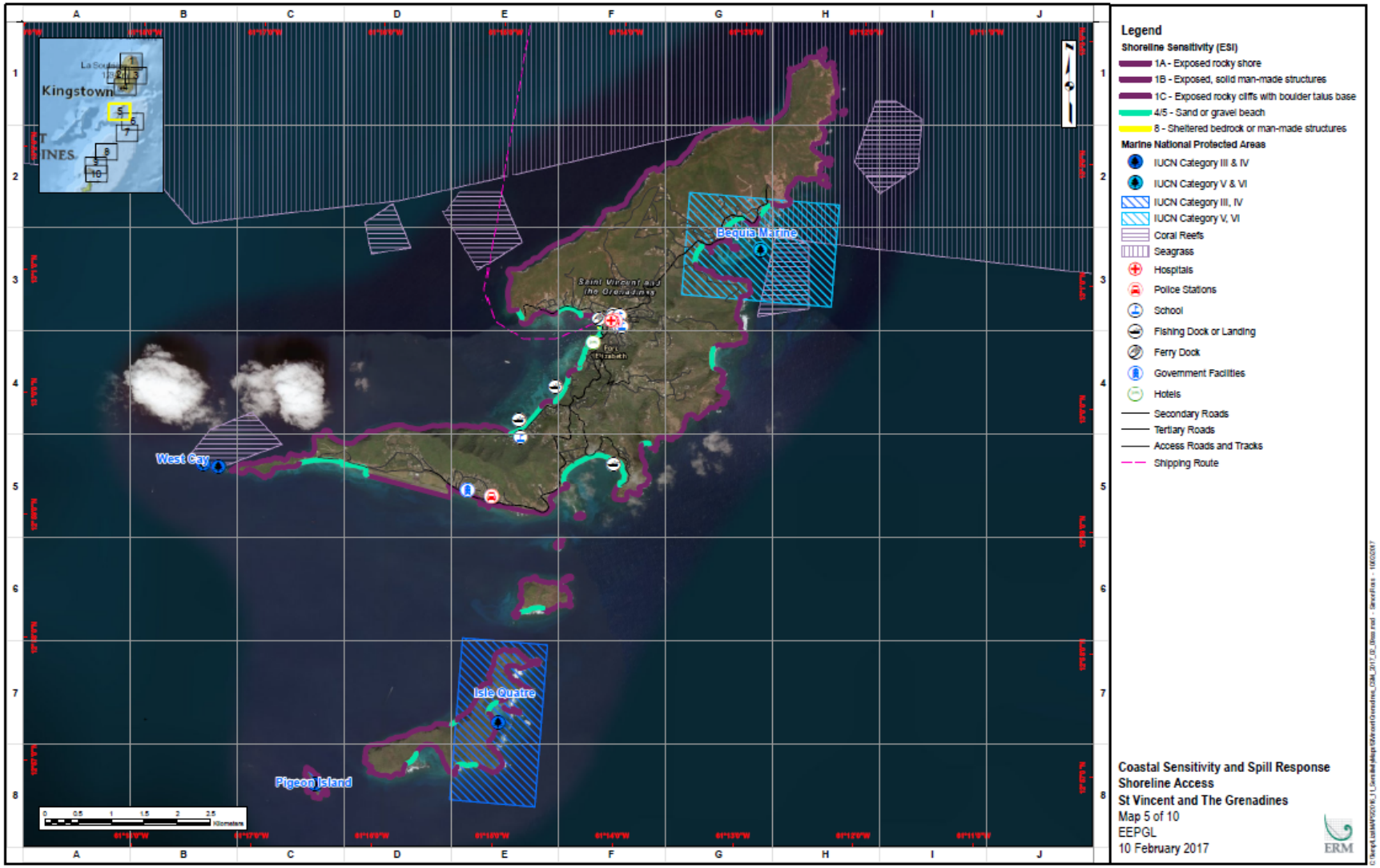
D.5 ST. VINCENT AND GRENADINES Coastal Sensitivity Maps

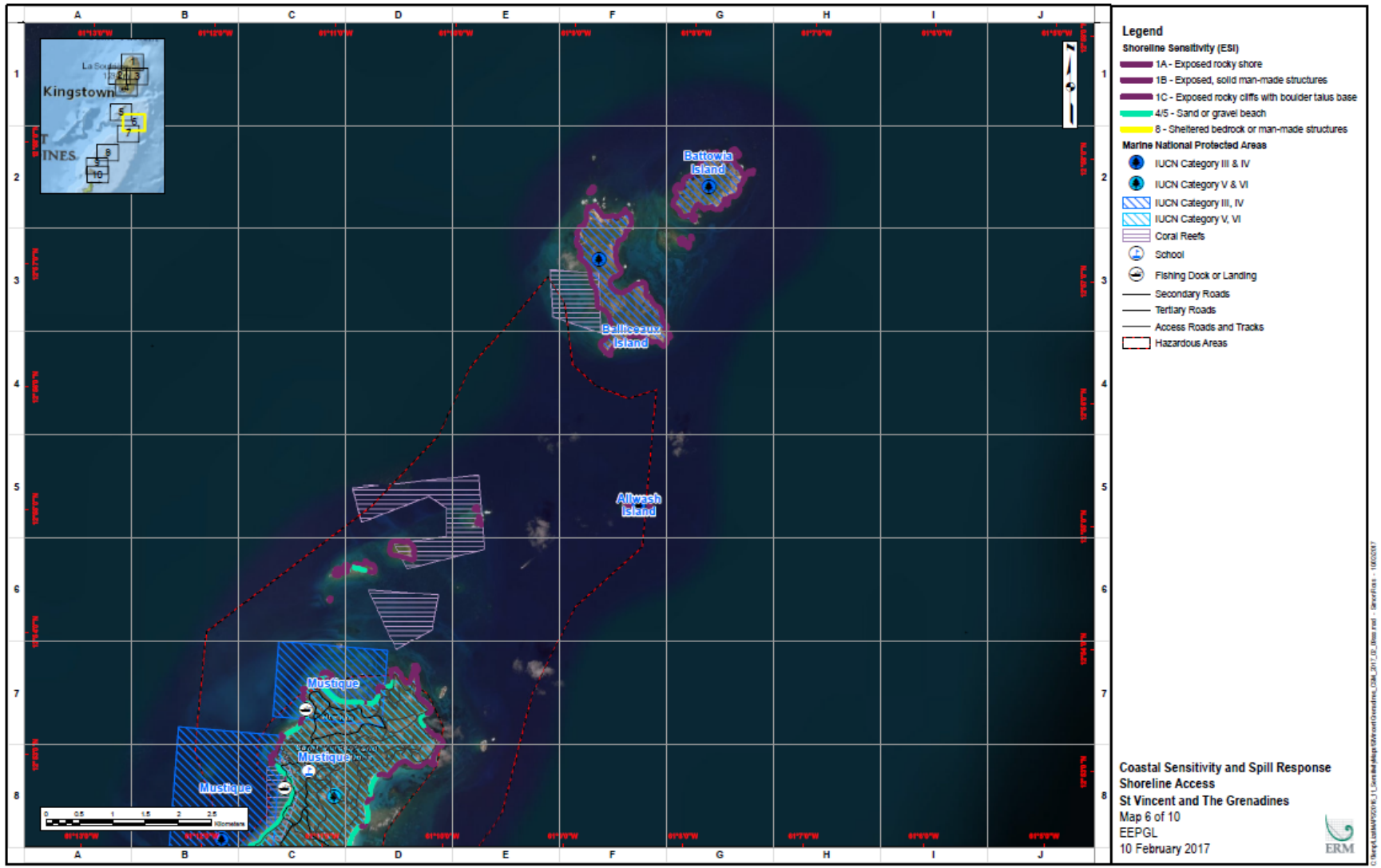


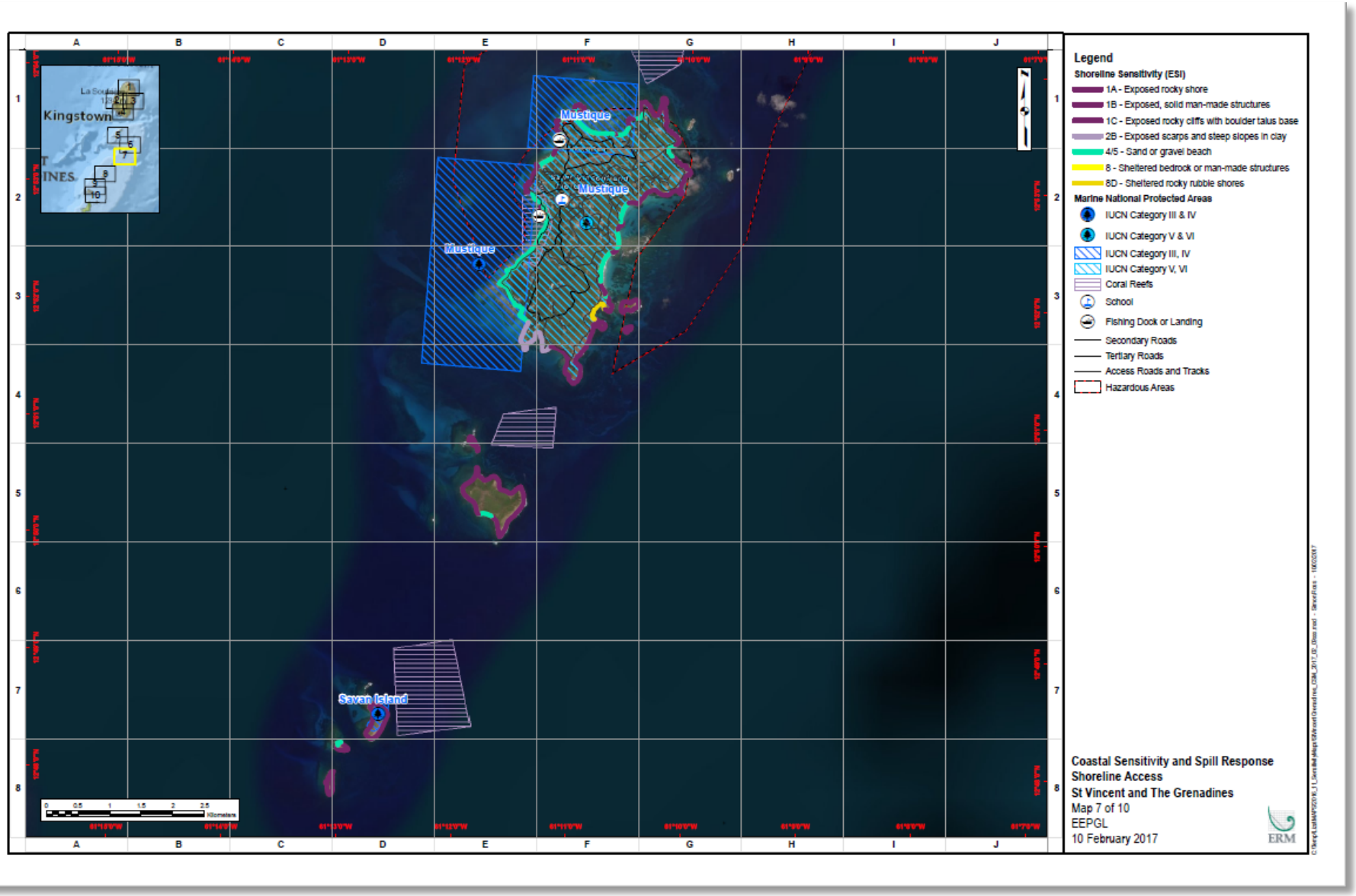

Kingstown
Richmond
Parrot Reserve (Richmond Forest Reserve)
Cumberland
Colonarie Parrot Reserve (Colonarie Forest Reserve)
Dalaway
Parrot Reserve (Dalaway Forest Reserve)
Kingstown
LaPaz Rock
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
8A - Sheltered scarps in bedrock, mud or clay
8D - Sheltered rocky rubble shores
IUCN Category III, IV
Onshore National Protected Areas
IUCN Category III & IV
IUCN Category V & VI
IUCN Category III, IV
Coral Reefs
Seagrass
Hospitals
Police Stations
School
Port or Marina
Fishing Dock or Landing
Historic Site
Places of Worship
Government Facilities
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Underwater Danger /Underwater Hazard
Seabed Cables
Coastal Sensitivity and Spill Response
Shoreline Access
St Vincent and The Grenadines
Map 2 of 10
EEPGL
10 February 2017
ERM

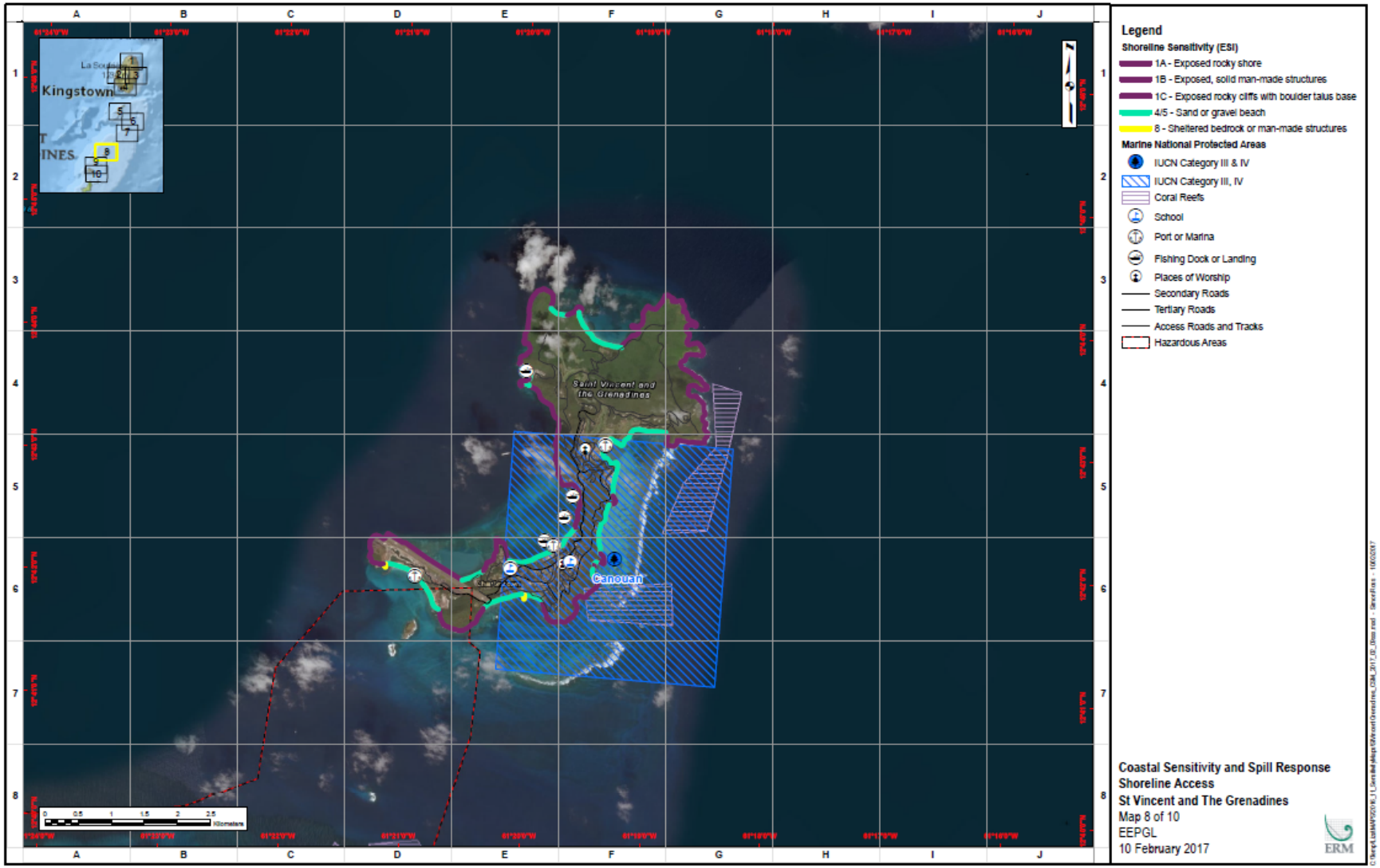

Kingstown
Parrot Reserve (Mt. Pleasant Forest Reserve)
Mt. Pleasant
Parrot Reserve (Richmond Forest Reserve)
Cumberland
Parrot Reserve (Colonarie Forest Reserve)
Colonarie
Dalaway
Parrot Reserve (Dalaway Forest Reserve)
Kingstown
Saint Vincent and the Grenadines
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
4/5 - Sand or gravel beach
Onshore National Protected Areas
IUCN Category III & IV
IUCN Category III, IV
Seagrass
Police Stations
School
Places of Worship
Primary Roads
Access Roads and Tracks
Coastal Sensitivity and Spill Response
Shoreline Access
St Vincent and The Grenadines
Map 3 of 10
EEPGL
10 February 2017
ERM

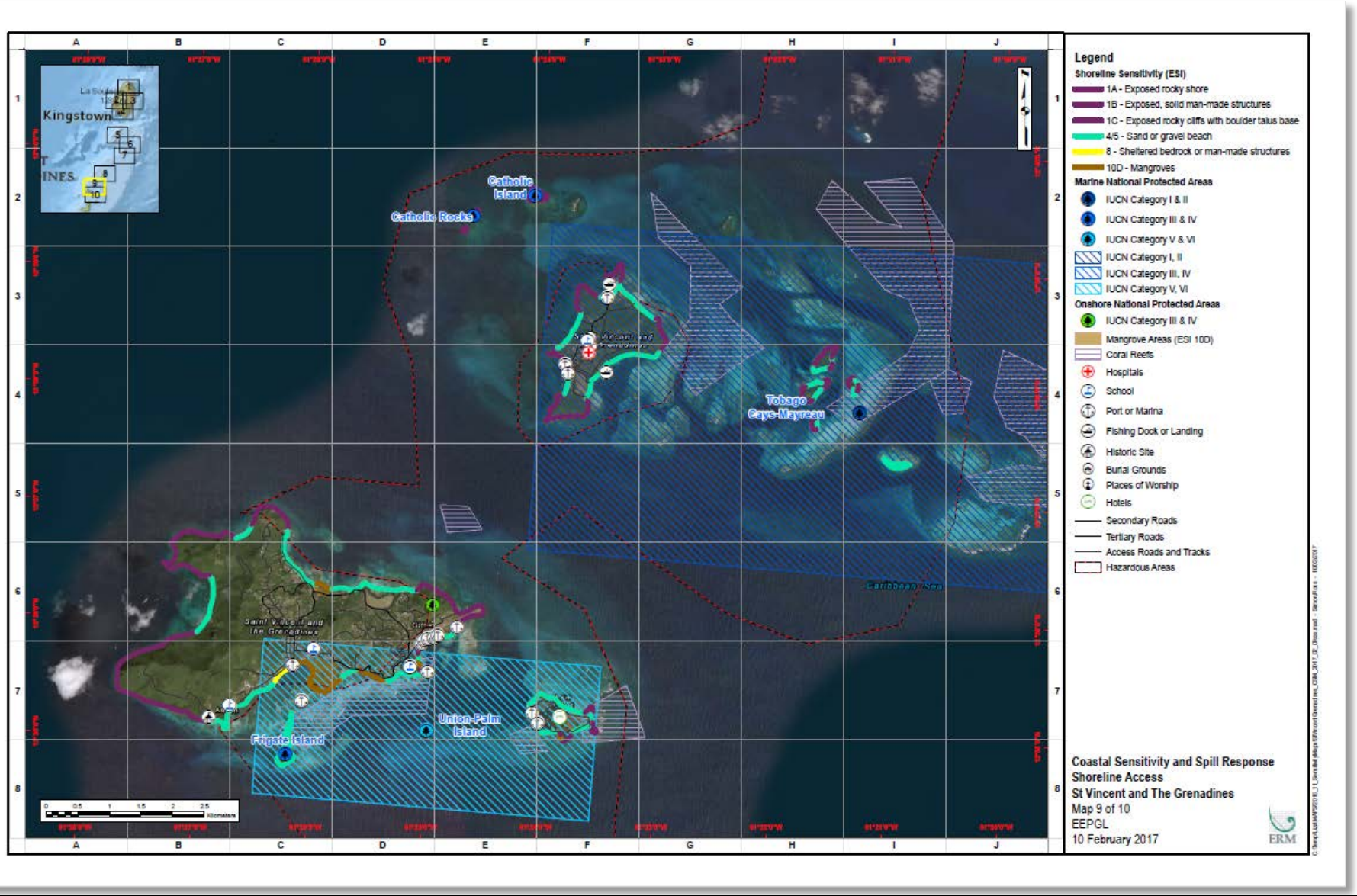

Kingstown
Dalaway Forest Reserve
Parrot Reserve (Dalaway Forest Reserve)
Parrot Reserve (Polonaire Forest Reserve)
Kingstown
Saint Vincent and the Grenadines
Campden Park
Kingshill
Young Island
South Coast
Milligan Island
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
3/4 - Sandy beaches or slopes
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
8A - Sheltered scarps in bedrock, mud or clay
8D - Sheltered rocky rubble shores
Marine National Protected Areas
IUCN Category I & II
IUCN Category III & IV
IUCN Category I, II
IUCN Category III, IV
Onshore National Protected Areas
IUCN Category III & IV
IUCN Category III, IV
Seagrass
Hospitals
Police Stations
Kindergarten
School
College
Port or Marina
Fishing Dock or Landing
Ferry Dock
Historic Site
Burial Grounds
Places of Worship
Government Facilities
Hotels
Primary Roads
Tertiary Roads
Access Roads and Tracks
Shipping Route
Seabed Cables
Coastal Sensitivity and Spill Response
Shoreline Access
St Vincent and The Grenadines
Map 4 of 10
EEPGL
10 February 2017
ERM

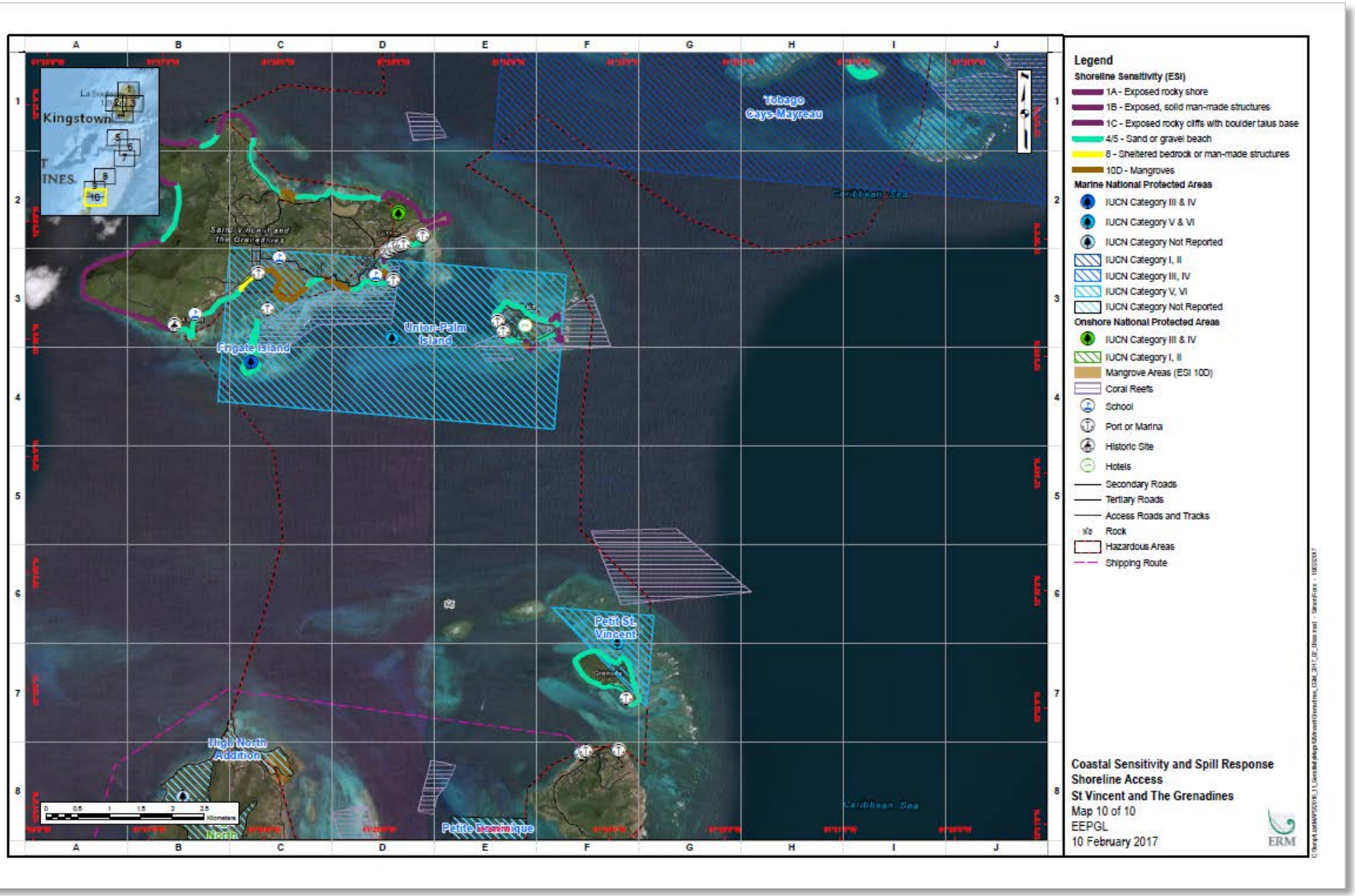

Kingstown
Bequia Marine
West Cay
Isle Quatre
Pigeon Island
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
Marine National Protected Areas
IUCN Category III & IV
IUCN Category V & VI
IUCN Category III, IV
IUCN Category V, VI
Coral Reefs
Seagrass
Hospitals
Police Stations
School
Fishing Dock or Landing
Ferry Dock
Government Facilities
Hotels
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access
St Vincent and The Grenadines
Map 5 of 10
EEPGL
10 February 2017
ERM


Kingstown
Battowia Island
Baillicaux Island
Allwash Island
Mustique
Mustique
Mustique
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
Marine National Protected Areas
IUCN Category III & IV
IUCN Category V & VI
IUCN Category III, IV
IUCN Category V, VI
Coral Reefs
School
Fishing Dock or Landing
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Hazardous Areas
Coastal Sensitivity and Spill Response
Shoreline Access
St Vincent and The Grenadines
Map 6 of 10
EEPGL
10 February 2017
ERM

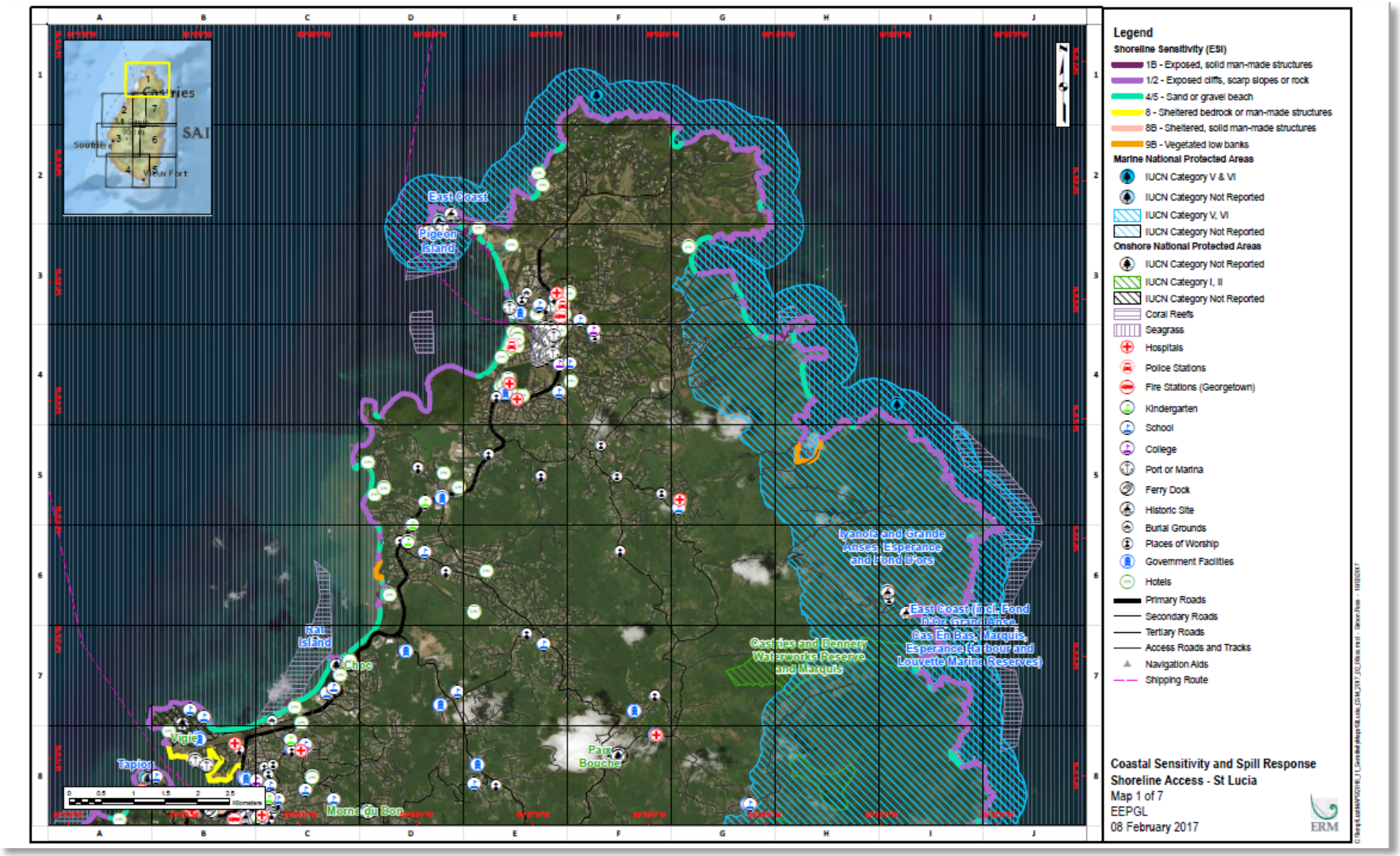

Kingstown
Mustique
Mustique
Mustique
Savan Island
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
2B - Exposed scarps and steep slopes in clay
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
8D - Sheltered rocky rubble shores
Marine National Protected Areas
IUCN Category III & IV
IUCN Category V & VI
IUCN Category III, IV
IUCN Category V, VI
Coral Reefs
School
Fishing Dock or Landing
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Hazardous Areas
Coastal Sensitivity and Spill Response
Shoreline Access
St Vincent and The Grenadines
Map 7 of 10
EEPGL
10 February 2017
ERM

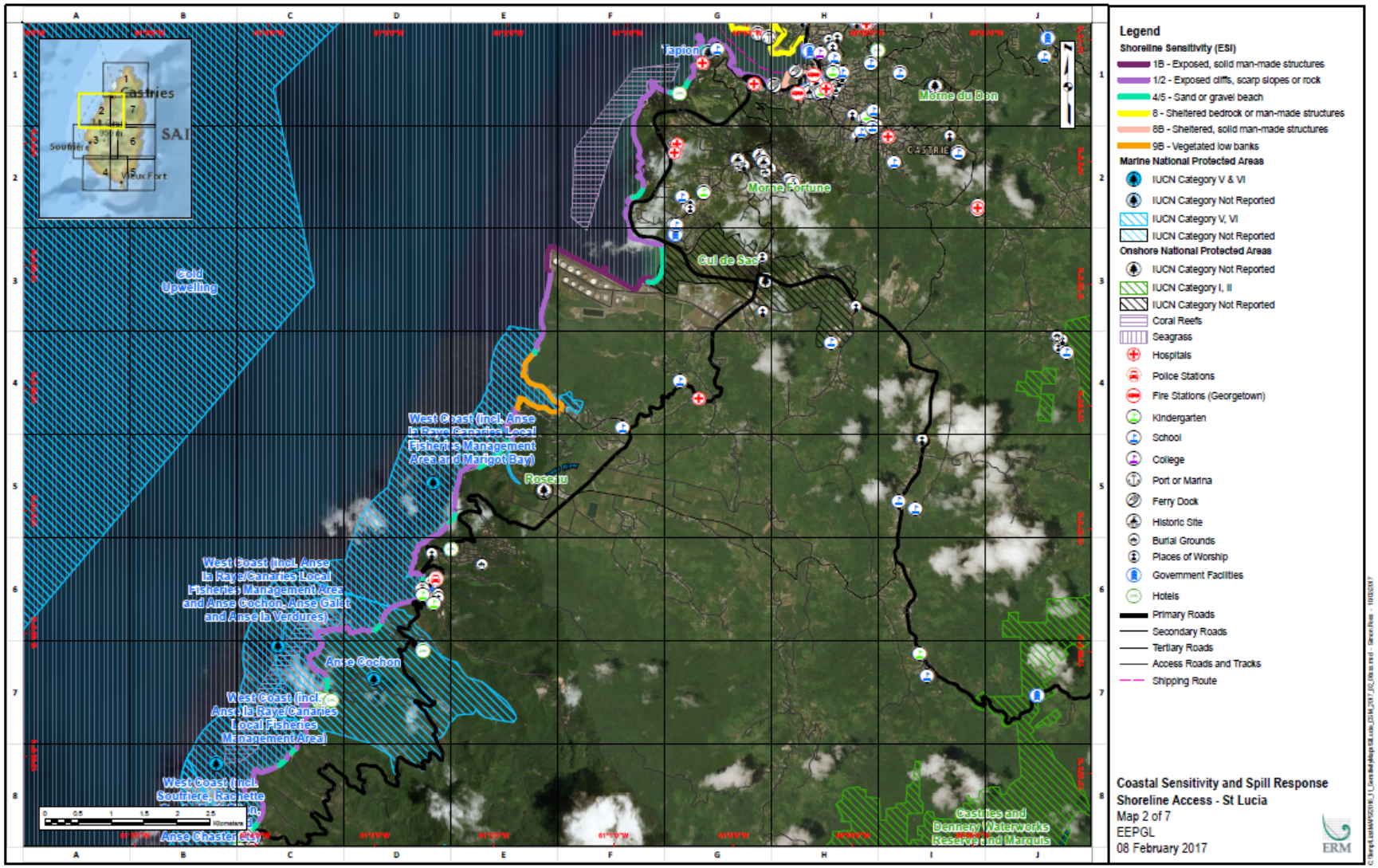

Kingstown
Saint Vincent and the Grenadines
Canouan
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
Marine National Protected Areas
IUCN Category III & IV
IUCN Category III, IV
Coral Reefs
School
Port or Marina
Fishing Dock or Landing
Places of Worship
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Hazardous Areas
Coastal Sensitivity and Spill Response
Shoreline Access
St Vincent and The Grenadines
Map 8 of 10
EEPGL
10 February 2017
ERM

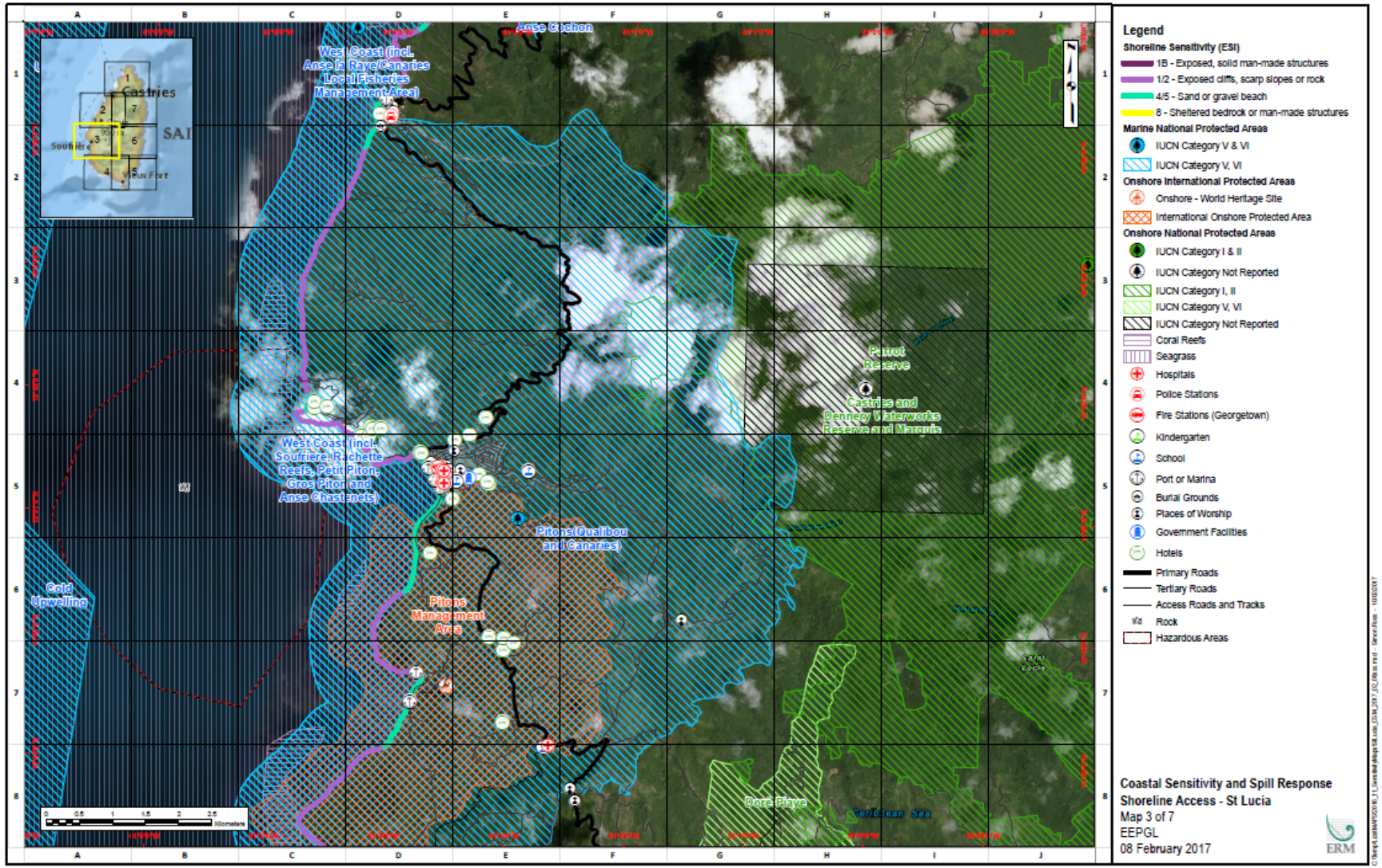

Kingstown
Catholic Island
Catholic Rocks
Tobago Cays-Mayreau
Union-Palm Island
Frigate Island
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
10D - Mangroves
Marine National Protected Areas
IUCN Category I & II
IUCN Category III & IV
IUCN Category V & VI
IUCN Category I, II
IUCN Category III, IV
IUCN Category V, VI
Onshore National Protected Areas
IUCN Category III & IV
Mangrove Areas (ESI 10D)
Coral Reefs
Hospitals
School
Port or Marina
Fishing Dock or Landing
Historic Site
Burial Grounds
Places of Worship
Hotels
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Hazardous Areas
Coastal Sensitivity and Spill Response
Shoreline Access
St Vincent and The Grenadines
Map 9 of 10
EEPGL
10 February 2017
ERM

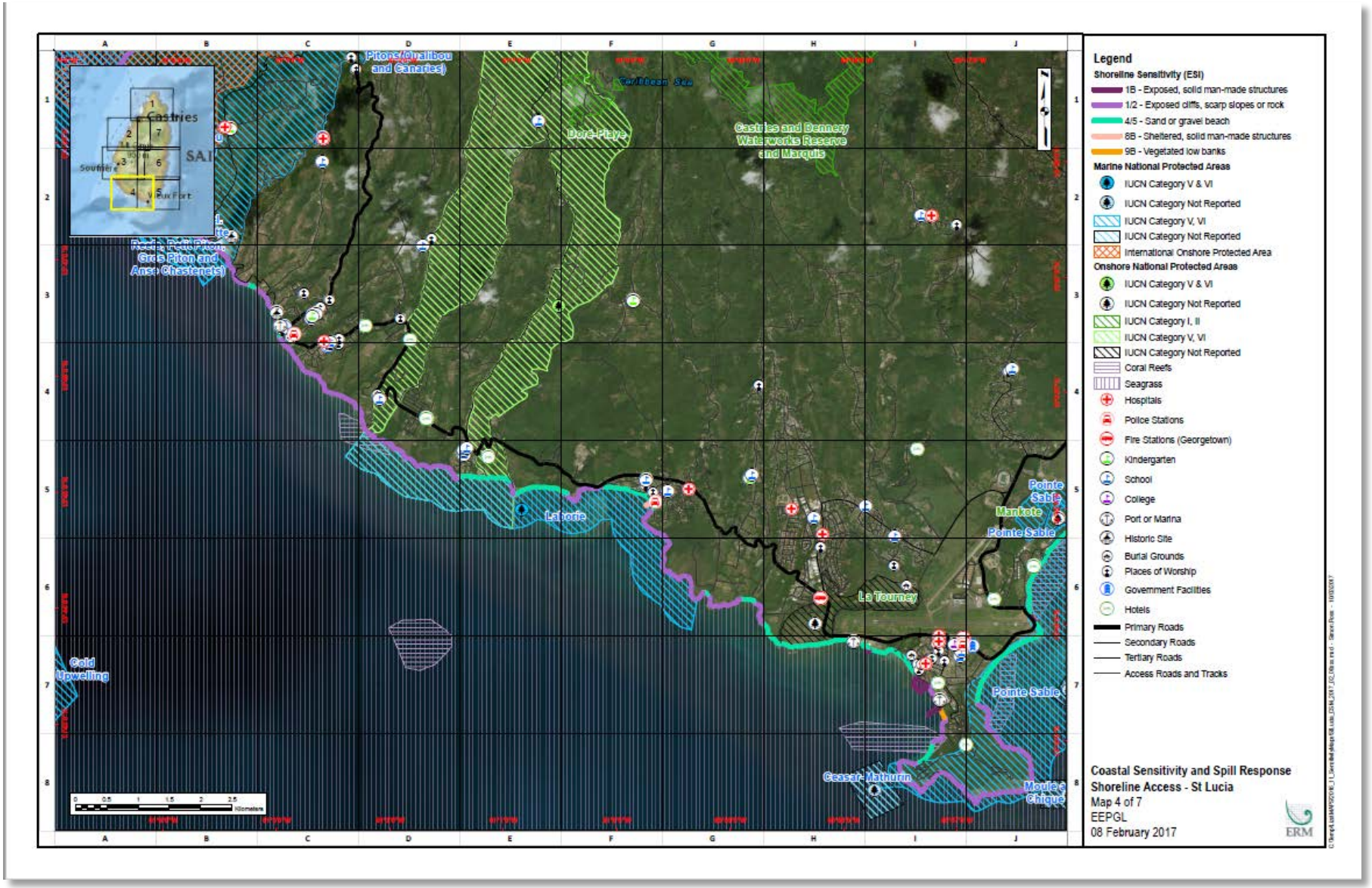

Kingstown
Tobago Cays-Mayreau
Caribbean Sea
Union-Palm Island
Frigate Island
Petit St. Vincent
High North Addition
Petite Martinique
Legend
Shoreline Sensitivity (ESI)
1A - Exposed rocky shore
1B - Exposed, solid man-made structures
1C - Exposed rocky cliffs with boulder talus base
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
10D - Mangroves
Marine National Protected Areas
IUCN Category III & IV
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category I, II
IUCN Category III, IV
IUCN Category V, VI
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category III & IV
IUCN Category I, II
Mangrove Areas (ESI 10D)
Coral Reefs
School
Port or Marina
Historic Site
Hotels
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Rock
Hazardous Areas
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access
St Vincent and The Grenadines
Map 10 of 10
EEPGL
10 February 2017
ERM

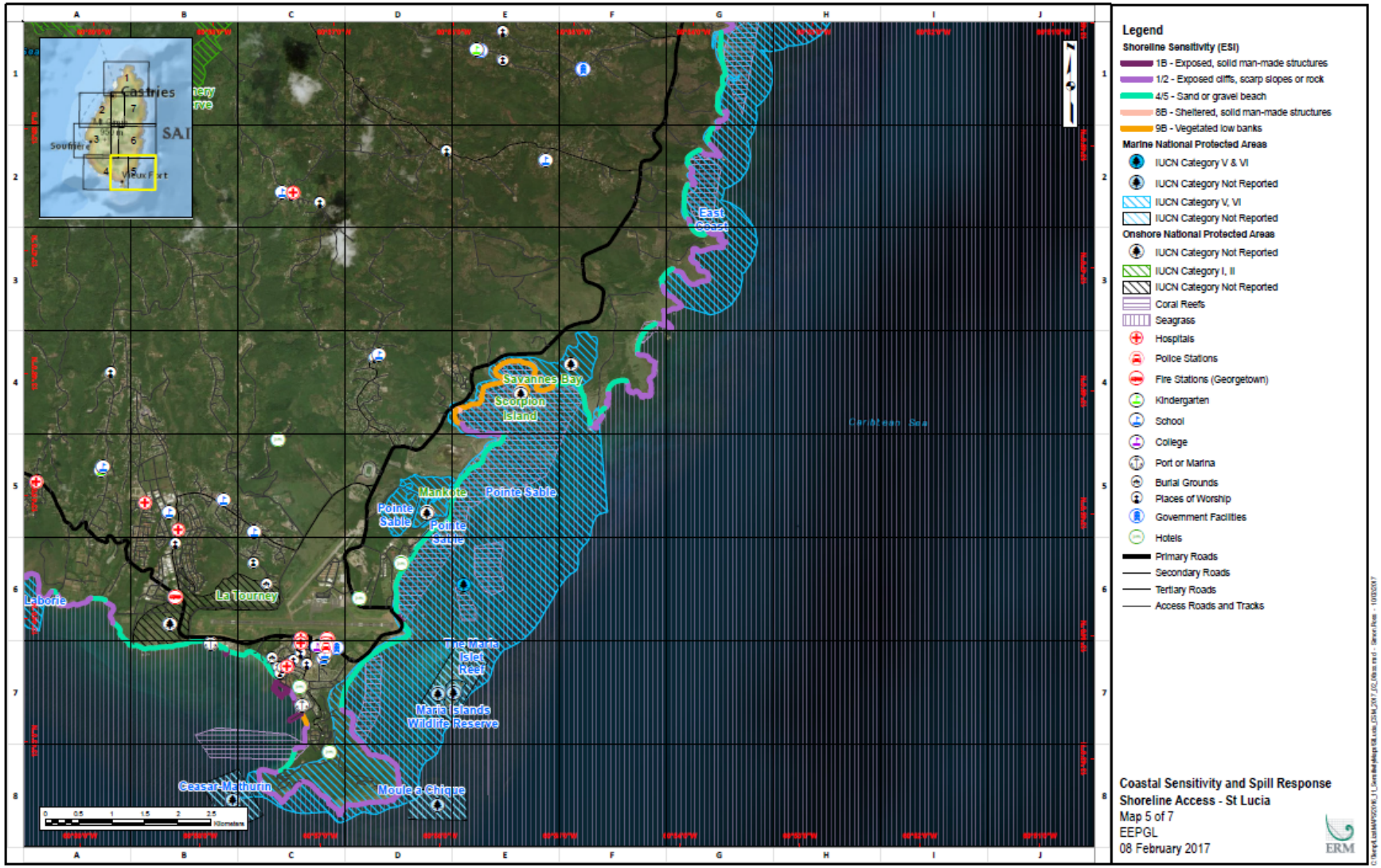
D.6 ST. LUCIA Coastal Sensitivity Maps

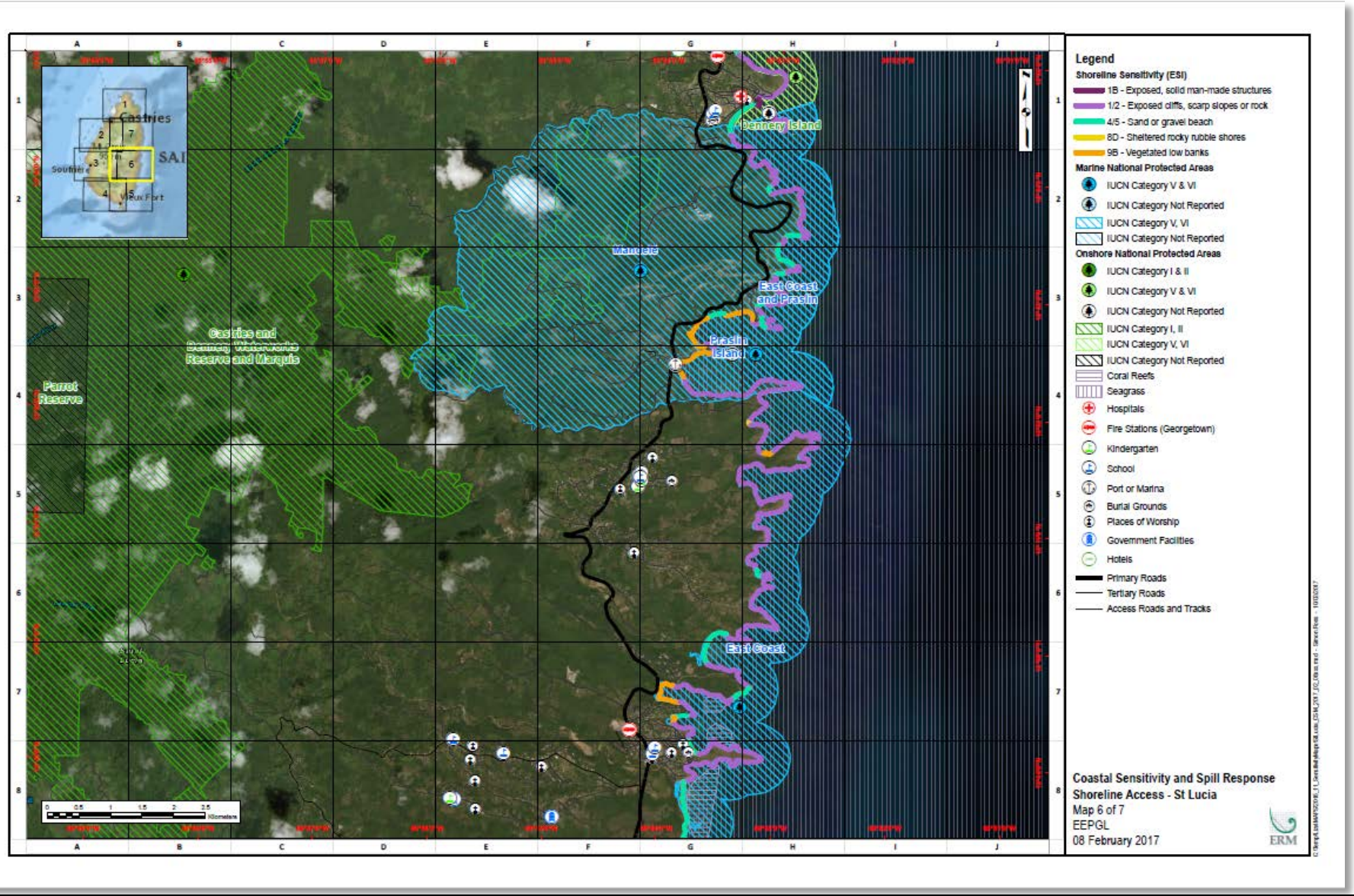


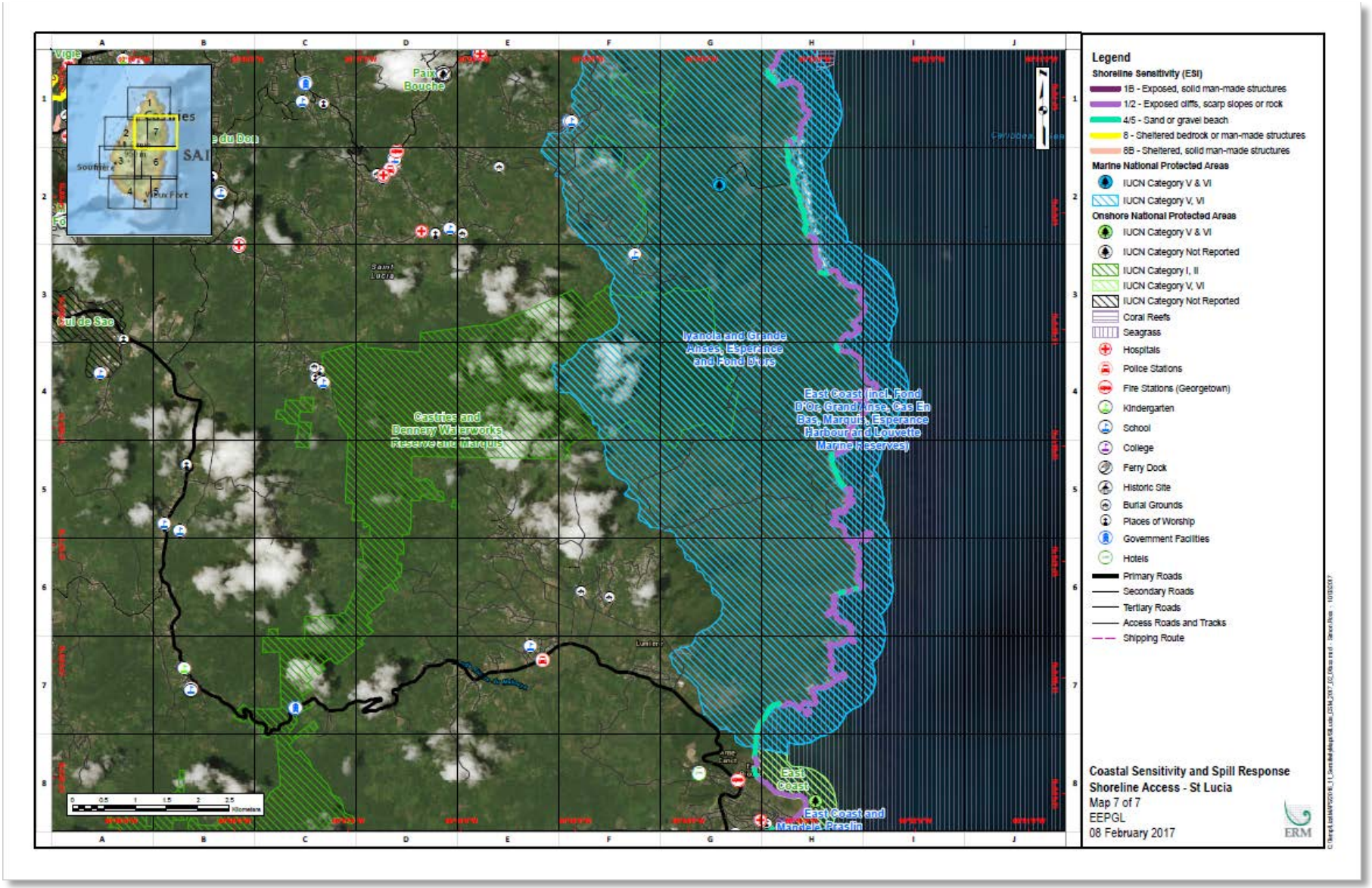

Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
8B - Sheltered, solid man-made structures
9B - Vegetated low banks
Marine National Protected Areas
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category V, VI
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category Not Reported
IUCN Category I, II
IUCN Category Not Reported
Coral Reefs
Seagrass
Hospitals
Police Stations
Fire Stations (Georgetown)
Kindergarten
School
College
Port or Marina
Ferry Dock
Historic Site
Burial Grounds
Places of Worship
Government Facilities
Hotels
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access - St Lucia
Map 2 of 7
EEPGL
08 February 2017
ERM
Castries
Soufrière
Vieux Fort
Tapion
Morne du Don
CASTRIE
Morne Fortune
Cul de Sac
Gold Upwelling
West Coast (incl. Anse La Raye/Canaries Local Fisheries Management Area and Marigot Bay)
Roseau
West Coast (incl. Anse La Raye/Canaries Local Fisheries Management Area and Anse Cochon, Anse Galet and Anse la Verdures)
Anse Cochon
West Coast (incl. Anse la Raye/Canaries Local Fisheries Management Area)
West Coast (incl. Soufrière, Rachette
Anse Chastanet
Castries and Dennery Waterworks Reserve and Marquis


Anse Cochon
West Coast (incl. Anse la Raye/Canaries Local Fisheries Management Area)
Castries
SAI
Soufriere
Vieux Fort
Parrot Reserve
Castries and Dennery Waterworks Reserve and Maquis
West Coast (incl. Soufriere, Rachette Reefs, Petit Piton, Gros Piton and Anse Chastenets)
Pitons (Qualibou and Canaries)
Cold Upwelling
Pitons Management Area
Dore Playe
Caribbean Sea
Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
Marine National Protected Areas
IUCN Category V & VI
IUCN Category V, VI
Onshore International Protected Areas
Onshore - World Heritage Site
International Onshore Protected Area
Onshore National Protected Areas
IUCN Category I & II
IUCN Category Not Reported
IUCN Category I, II
IUCN Category V, VI
IUCN Category Not Reported
Coral Reefs
Seagrass
Hospitals
Police Stations
Fire Stations (Georgetown)
Kindergarten
School
Port or Marina
Burial Grounds
Places of Worship
Government Facilities
Hotels
Primary Roads
Tertiary Roads
Access Roads and Tracks
Rock
Hazardous Areas
Coastal Sensitivity and Spill Response
Shoreline Access - St Lucia
Map 3 of 7
EEPGL
08 February 2017
ERM


Pitons (Gwalibou and Canaries)
Caribbean Sea
Dore-Piaye
Castries and Dennery Waterworks Reserve and Marquis
Gros Piton and Anse Chastenets
Laborie
La Tourney
Pointe Sable
Mankote
Pointe Sable
Cold Upwelling
Pointe Sable
Ceasar Mathurin
Moule a Chique
Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8B - Sheltered, solid man-made structures
9B - Vegetated low banks
Marine National Protected Areas
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category V, VI
IUCN Category Not Reported
International Onshore Protected Area
Onshore National Protected Areas
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category I, II
IUCN Category V, VI
IUCN Category Not Reported
Coral Reefs
Seagrass
Hospitals
Police Stations
Fire Stations (Georgetown)
Kindergarten
School
College
Port or Marina
Historic Site
Burial Grounds
Places of Worship
Government Facilities
Hotels
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Coastal Sensitivity and Spill Response
Shoreline Access - St Lucia
Map 4 of 7
EEPGL
08 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8B - Sheltered, solid man-made structures
9B - Vegetated low banks
Marine National Protected Areas
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category V, VI
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category Not Reported
IUCN Category I, II
IUCN Category Not Reported
Coral Reefs
Seagrass
Hospitals
Police Stations
Fire Stations (Georgetown)
Kindergarten
School
College
Port or Marina
Burial Grounds
Places of Worship
Government Facilities
Hotels
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Coastal Sensitivity and Spill Response
Shoreline Access - St Lucia
Map 5 of 7
EEPGL
08 February 2017
ERM
Castries
Savannes Bay
Scorpion Island
Caribbean Sea
Pointe Sable
Laborie
La Tourney
Maria Islands Wildlife Reserve
Ceasar Mathurin
Moule a Chique


Castries
Southern
Vieux Fort
Bennery Island
Marisule
East Coast and Praslin
Praslin Island
Castries and Bennery Waterworks Reserve and Marquis
Parrot Reserve
East Coast
Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8D - Sheltered rocky rubble shores
9B - Vegetated low banks
Marine National Protected Areas
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category V, VI
IUCN Category Not Reported
Onshore National Protected Areas
IUCN Category I & II
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category I, II
IUCN Category V, VI
IUCN Category Not Reported
Coral Reefs
Seagrass
Hospitals
Fire Stations (Georgetown)
Kindergarten
School
Port or Marina
Burial Grounds
Places of Worship
Government Facilities
Hotels
Primary Roads
Tertiary Roads
Access Roads and Tracks
Coastal Sensitivity and Spill Response
Shoreline Access - St Lucia
Map 6 of 7
EEPGL
08 February 2017
ERM


Legend
Shoreline Sensitivity (ESI)
1B - Exposed, solid man-made structures
1/2 - Exposed cliffs, scarp slopes or rock
4/5 - Sand or gravel beach
8 - Sheltered bedrock or man-made structures
8B - Sheltered, solid man-made structures
Marine National Protected Areas
IUCN Category V & VI
IUCN Category V, VI
Onshore National Protected Areas
IUCN Category V & VI
IUCN Category Not Reported
IUCN Category I, II
IUCN Category V, VI
IUCN Category Not Reported
Coral Reefs
Seagrass
Hospitals
Police Stations
Fire Stations (Georgetown)
Kindergarten
School
College
Ferry Dock
Historic Site
Burial Grounds
Places of Worship
Government Facilities
Hotels
Primary Roads
Secondary Roads
Tertiary Roads
Access Roads and Tracks
Shipping Route
Coastal Sensitivity and Spill Response
Shoreline Access - St Lucia
Map 7 of 7
EEPGL
08 February 2017
ERM
Vigie
Paix Bouche
Cul de Sac
Castries and Dennery Waterworks Reserve and Marquis
Ivanola and Grande Anses, Esperance and Fond D'or
East Coast (incl. Fond D'Or, Grand Anse, Cas En Bas, Marquis, Esperance Harbour and Louvette Marine Reserves)
East Coast
East Coast and Mandele, Praslin

Appendix E WILDLIFE RESPONSE PLAN

Wildlife Response Plan

Prepared for

Esso Exploration and Production Guyana Limited (EEPGL)

ExxonMobil Biomedical Sciences, Inc.
Richard A. Davi

January 27, 2017

1. Introduction

Objective

Prevention of oil spills remains the top priority for EEPGL. In the unlikely event of a spill, it is important to be prepared to minimize the duration and impact of any release. For a subsea well release, capping and containment measures are available to serve this purpose. Beyond those mitigation measures, it is important to have a robust spill response capability utilizing all appropriate tools. The proper selection and use of those tools should be based on minimizing overall harm to environmental and economic resources. A critical aspect of protecting wildlife once oil is released is to minimize the formation of floating slicks and when formed to prevent such slicks from coming ashore driven by wind/currents. As this is not always possible more detailed wildlife response planning is necessary.

This Wildlife Response Plan is supplemental to the Esso Exploration and Production Guyana Limited (EEPGL) Oil Spill Response Plan (OSRP) and is intended to serve as general guidance for wildlife deterrence (hazing), capture, and rehabilitation during an oil spill response. The principal objectives of Wildlife Operations during a spill are:

- Provide the best achievable protection of wildlife and habitats from contamination;
- Minimize injuries to wildlife and habitats from contamination;
- Minimize injuries to wildlife from the cleanup;
- Provide the best achievable capture and care for injured wildlife;
- Document adverse effects that result from the spill and cleanup; and
- Prevent injuries to responders and the public.

In the event of potential wildlife impacts, EEPGL personnel will immediately contact and request assistance/expertise from the ExxonMobil Regional Response Team (RRT), ExxonMobil Biomedical Sciences Inc. (EMBSI), and Sea Alarm/Oil Spill Response Ltd (OSRL). Contact numbers are listed in Table 3-1. Initial wildlife response guidance is provided in Appendix G of this plan.

Potential Oil Spill Impacts on Wildlife

Wildlife may be vulnerable to oiling depending on their behavior, food preferences, and habitat requirements. They may encounter oil in near-shore and intertidal areas, and at sea. The number of individuals and species affected by an oil spill will depend on the size of the spill, chemistry of the petroleum product spilled, meteorological and oceanographic conditions, time of year, and the location of the spill. Species feeding in intertidal and near-shore areas are often vulnerable to oiling. Many important bird and turtle habitats are located in near-shore and intertidal areas. Some mammals may scavenge for food in intertidal areas and may encounter oiled carcasses. Foraging animals may encounter and ingest oil-contaminated vegetation or other oil-contaminated food sources in coastal areas.

Seabirds are highly vulnerable to oiling since they feed and rest on the water surface. Whales and dolphins have low vulnerability to oiling as these animals tend to avoid areas that are oiled. Turtles generally have a low vulnerability to oiling, but vulnerability may increase during nesting seasons.

Exposure to oil can occur from swimming or wading through oil. Ingestion of oil may occur if an animal attempts to clean its oiled feathers or fur. Another route of oil exposure is through the consumption of oil-contaminated food or water.

General effects of oil on wildlife can be separated into physical and toxicological effects. An example of a physical effect is loss of water repellency and insulating properties of feathers when birds become oiled. As a result, the ability to thermo-regulate may be impaired or lost.

Toxicological effects of oil on wildlife include irritation of the eyes, skin, mucous membranes, lungs, and digestive tract. Organ damage and disruption of immune responses may occur. Effects of oil on wildlife reproduction may include altered breeding behavior, decreased hatching success, and decreased survival rates of the young.

Protected Species and Areas of Special Value

Protected species and associated habitats that are at risk of oiling should be given priority protection during an oil spill response. In oiled wildlife response planning, it is important to consider:

- Input from appropriate regulatory agencies;
- Seasonality of species occurrences (breeding, nesting, and migration periods);
- Habitats important for breeding, nesting, feeding, or resting;
- Areas of high density occurrences; and
- Prioritization for protection of important habitats identified in the oil spill response plans.

Appendices A, B, C and D of this plan describe some of the habitats, birds, and marine reptile and mammal species that are at risk of oiling from EEPGL operations. In these appendices, information is provided for key sensitive periods (nesting, molting, migration, breeding, and rearing).

Basis for Wildlife Response Plan

Under the country's Environmental Protection Act, companies active in oil and gas exploration or drilling must prepare an Emergency Response Plan / Oil Spill Contingency Plan that includes provisions for rescuing and restoring plants, animals, etc. (i.e., Oiled Wildlife Response Plan, and Environmental Management or Pollution Prevention Plan). An oiled wildlife response plan provides for pre-planning for the protection of sensitive habitats and species while considering seasonal effects and behaviors. The plan facilitates the identification of protocols, and resources (equipment and personnel) necessary to respond to an incident in a timely manner. Lastly, the plan identifies the needs and capabilities necessary to reduce or avoid impacts to sensitive habitats and species during an oil spill response.

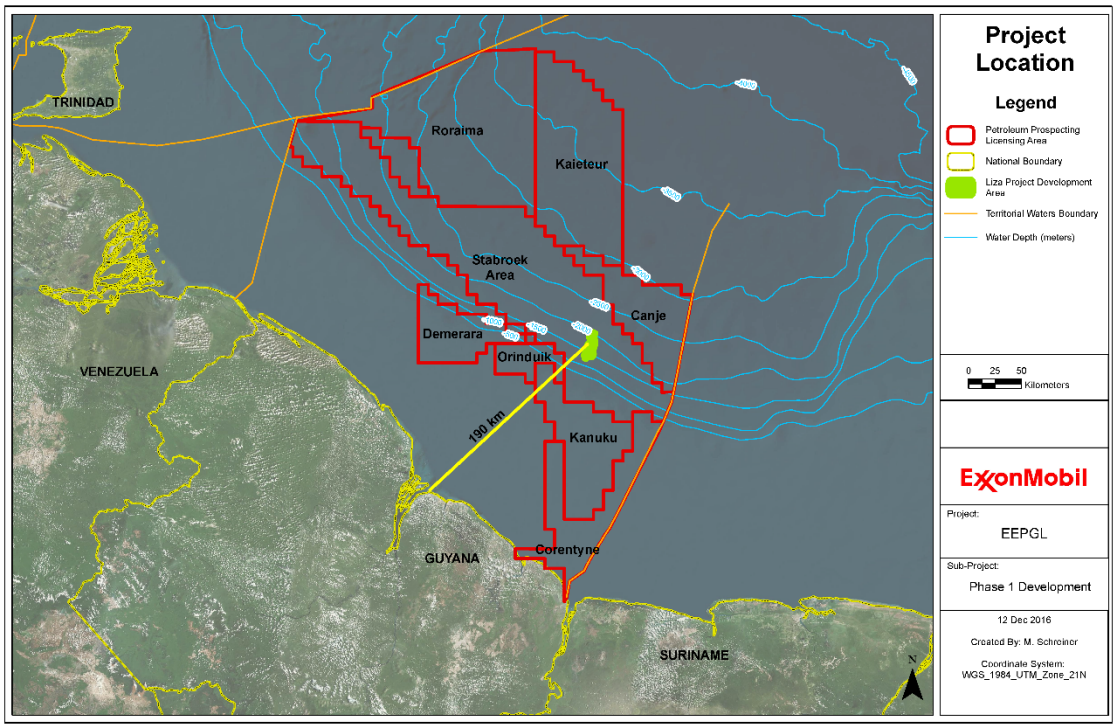
Geographical Extent of Response

The geographic area of concern for response activities for wildlife is typically defined by the extent of the influence of the Project and its alternatives. The normal extent of this Project's influence on relevant resources include the Liza Project Development Area (PDA), as depicted in green in Figure 1-1, which is an approximately 50 km^2 area located 190 km (~120 mi) offshore. In the case of an unplanned event in the form of a larger spill, the sea surface area

that could be potentially affected ranges from 835 to 19,400 km^2 as further reflected in the modeling results provided in Appendix A of the OSRP.

The Project will also involve the use of onshore marine and aviation support facilities including shorebases located in coastal harbors and rivers, heliports, and the associated routes that would be traversed by such support vessels and helicopters between these facilities and the drilling and production areas.

Seasonal winds and the prevailing Guiana Current may extend the area of an oil spill response outside of the Guyana Economic Exclusion Zone, north to the territorial waters of Venezuela, Trinidad and Tobago and several islands in the Lesser Antilles.



** NOTE: Map does not represent a depiction of the maritime boundary lines of Guyana.*

Figure 1-1: Liza PDA and Stabroek Area of Interest

2. Incident Command System and Tiered Response

This section provides a general overview of the Incident Command System (ICS) and a tiered approach used for oil spill response, with emphasis on wildlife response activities. The ICS designed to provide a framework for a consistent, efficient, and effective means to train, activate, and implement EEPGL's response resources. The ICS also facilitates interaction with Contractors, Subcontractors, Guyana government agencies, and non-government organizations that could become involved during a spill response. Table 2-1 shows the sections and key activities of the ICS.

Table 2-1: Key ICS Sections and Activities

ICS Function	Activities
Command Staff	• Overall Oil Spill Response Management • Management Liaison • Government Liaison • Community Liaison • Media/Public Affairs Liaison • Legal Support • Safety and Health Oversight
Operations Section	• Oil Spill Source Control • Site Safety and Security • Surveillance • Dispersant Application • *In-Situ* Burning • Offshore/Near-shore Containment and Recovery • On Land Containment and Recovery • Shoreline, River, and Resource Protection • Pre-Impact Debris Removal • Shoreline Treatment and Cleanup • Bioremediation • Waste Management • Wildlife Deterrence, Capture, and Rehabilitation
Planning Section	• Site Characterization and Analysis • Documentation • Spill Tracking and Surveillance • Sensitive Areas Identification and Characterization • Environmental Monitoring • Incident Action Plan Coordination • Oil Spill Sampling • Oil Spill Response Technical Support • Dispersant / *In-Situ* Burning Support • Waste Management Support • Demobilization
Finance and Logistics Sections	• Transportation (Air, Water, Land) • Housing • Catering • Telecommunications • Customs Clearance • Security • Field Operations Support • Personnel Resourcing • Material Distribution

The structure for the wildlife response organization is designed to fit within the ICS and allows for the integration of wildlife activities into the entire oil spill response plan (IPIECA, 2004).

Wildlife response is typically managed under the Wildlife Branch of the Operations Section of the ICS and coordinated through the Environmental Unit of the Planning Section. For example, the Planning Section identifies and characterizes environmentally sensitive areas and wildlife at risk. The Operations Section is responsible for wildlife deterrence, capture, rehabilitation, and shoreline protection. See Appendix G for initial response activities of the Wildlife Branch.

The tiered response system provides preparedness for the full range of scenarios that may be imaginable, from an insignificant wildlife incident (a few animals threatened or affected) to a worst-case incident (e.g., thousands of animals, a mix of species groups, large stretches of complicated shorelines).

In a tiered response, assets are mobilized locally or from further afield according to the size and complexity of the incident and the availability of appropriate resources. In a Tier 1 response, assets are mobilized within hours of notification of the incident; and can be sourced from pre-identified stocks located at either the Guyana Shorebase or the Trinidad Shorebase, to deal with an incident in its early stage of development. If a more complicated scenario begins to unfold (Tier 2 or 3), EEPGL would activate additional resources such as the ExxonMobil Regional Response Team or OSRL to mitigate the impacts of the spill.

3. Response Personnel

Only trained and qualified personnel should haze, capture, transport, and rehabilitate oiled wildlife. ExxonMobil has contracts in place with two internationally recognized oiled wildlife response organizations: International Bird Rescue (IBR) and Tri-State Bird Rescue & Research, Inc. Experts from these two organizations, and other available international organizations, can be mobilized to Guyana within days by contacting Sea Alarm. ExxonMobil is a participant in a Global Oiled Wildlife Response System (GOWRS) which is monitored by Sea Alarm. Wildlife response experts who are prepared to assist ExxonMobil during an oil spill are listed in Table 3-1.

The OSR Wildlife Plan will be implemented with the assistance of trained and qualified contractors and support groups. Upon notification, contractors and trained local experts (if applicable) will mobilize equipment and trained personnel to the spill site and begin wildlife response operations. Wildlife Response equipment for the initial response is available through OSRL in Fort Lauderdale, Florida, USA. Additional equipment will be brought in as needed. Wildlife response standard operational protocols can be supplied by wildlife experts at the time of response or developed ahead of time to cover Sections 4-9 below.

There are no wildlife rehabilitators in Guyana with oiled wildlife experience. There are also no permanent facilities for oiled wildlife rehabilitation and few organized wildlife rehabilitation programs in the country. The Karanambu Trust may be able to help should otters be affected by a spill. The Guyana Marine Turtles Conservation Society (GMTCS) would likely be involved in marine turtle response. Several small facilities in Trinidad and Tobago are available for Tier 1 responses, and are listed below.

Conservation organizations in Guyana include:

Government Ministries:

- Environmental Protection Agency;
- Protected Areas Commission;
- Guyana Forestry Commission;
- Wildlife Management Authority.

Non-Governmental and Academic Institutions:

- Conservation International;
- Guyana Marine Turtles Conservation Society (GMTCS);
- Guyana Tropical Birds Society;
- Guyana Mangrove Restoration Project;
- Centre for the Study of Biological Diversity;
- School of Earth and Environmental Sciences, University of Guyana;
- Environmental Clubs of Guyana.

Organizations in Trinidad and Tobago:

- Wildlife Orphanage and Rehabilitation Center – WORC (Trinidad);
- El Soccoro Center for Wildlife Conservation (Trinidad);
- Pointe-a-Pierre Wildfowl Trust (Trinidad);
- Tobago SPCA (Tobago).

Table 3-1: Contact Information for Wildlife Experts and Responders

Contact	Contact Name	Contact Information	Comments
GDF Coast Guard	Operations Center	+592-226-8488	Spill notifications
Guyana Environmental Protection Agency	Duty Officer	+592-225-5467 or +592-225-5469	Spill notifications
Guyana Ministry of Natural Resources and the Environment	Department of Governance	+592-231-2506 ministry@nre.gov.gy	Spill notifications
Harbour Master Starbroek, Georgetown	Duty Officer	+592-226-7842	Spill notifications
Guyana Marine Turtle Conservation Society (GMTCS)	Michelle Kalamandeen, Project Coordinator	+592-665-4876 gmtcs@bbgy.com	Conservation organization
The Karanambu Trust	Diane McTurk Executive Director	www.karanambutrustandlodge.org	Giant Otter expertize
ExxonMobil Biomedical Sciences, Inc. (EMBSI)	Richard Davi Richard Woods	+1 (908) 730-1111 richard.a.davi@exxonmobil.com richard.w.woods@exxonmobil.com	Wildlife Response Issues
Sea Alarm	Hugo Nijkamp	(Office) +322 2788 744 (Mobile) +32 494900012 (Mobile) +32 499624772	Oiled Wildlife Response facilitator

Contact	Contact Name	Contact Information	Comments
		Nijkamp@sea-alarm.org	
Oil Spill Response Ltd. (OSRL)	Duty Manager Fort Lauderdale, FL, USA	+1 (954) 983-9880 +44 (0)23 8033-1551 (UK)	Wildlife Response equipment
IBR (International Bird Rescue)	Barbara Callahan	+1 (907) 230-2492 barbara.callahan@bird-rescue.org	ExxonMobil has a contract in place with IBR
Tri-State Bird Rescue & Research, Inc., Delaware	Dr. Heidi Stout, veterinarian	Main +1 (302) 737-9543 hstout@tristatebird.org www.tristatebird.org	ExxonMobil has a contract in place with Tri-State
WORC (Trinidad)	No contact name available	299 Queen Elizabeth Avenue Petit Valley, Trinidad and Tobago, West Indies Tel: (868) 637-3842 Email: worctrinidad@gmail.com	Oiled wildlife facility in Trinidad (25 animal capacity)
El Socorro Center for Wildlife Conservation	Gia Narinesingh Ricardo Meade	Freeport, Trinidad and Tobago +1 (868) 673-5753	Wildlife facility in Trinidad (limited capacity)
Pointe-a-Pierre Wildfowl Trust	Molly Gaskin – Trust President	St. James, Trinidad +1 (868) 658-4200 ext. 2512	Wildlife facility in Trinidad (limited capacity)

A licensed veterinarian is integral to the oiled wildlife response organization. The veterinarian, using a pre-approved decision tree, will confer with the appropriate Guyana authorities and fauna experts to decide which oiled animals should be rehabilitated and which animals should be euthanized. For those animals that will be rehabilitated, the veterinarian administers or supervises the appropriate treatment.

According to the Guyana Agriculture Ministry, there are 45 active veterinarians in Guyana. Contact can be made through the Guyana Veterinary Association.

Trained and qualified personnel are essential to an oiled wildlife response. The training that each person receives will depend on the task that the person will perform during the response. Personnel may conduct wildlife deterrence operations or search for and capture oiled animals. Other personnel may stabilize and transport oiled animals to a treatment area. Once oiled animals arrive at the treatment area, additional personnel maintain records on the animals, clean pens, and prepare food for the animals. Qualified personnel that have received additional training may perform tasks such as administering fluids to dehydrated animals, take blood samples from animals, and wash oiled animals.

4. Training and Health and Safety

Worker health and safety are a priority during oiled wildlife response operations. The following is a summary list of safety precautions that need to be considered in the development of the Wildlife HSE Plan. Additional safety plans may need to be written for operation of specialized equipment (such as propane cannons, etc.).

- Be proficient with Safety Data Sheets (SDS);
- Recognize that most common hazards are slips, trips, and falls;
- Maintain necessary immunizations, including tetanus and hepatitis;
- Observe all industrial hygiene safety precautions stated in the Safety Plan;

- Ensure proper training regarding hazards of the work task, and the proper use of personal protective equipment (PPE);
- ALWAYS work in teams; never conduct wildlife rescue work alone;
- Don't overwork;
- Keep animals at or below one's waist level to protect the face and eyes from pokes, bites, and scratches;
- Wear approved personal protective equipment;
- Always remove PPE and wash hands and face with soap and water or approved cleaners before eating, drinking, or smoking;
- Never eat, drink, or smoke in wildlife handling areas;
- Minimize contact with contaminated materials and inhalation of vapors even when wearing PPE;
- Keep all oil, cleaning compounds, and contaminated materials away from face, eyes, and skin;
- Ensure work areas are clean and well ventilated;
- Report all injuries and illnesses to the supervisor and/or Command Center medical staff;
- Do not work with oiled wildlife if you are ill, pregnant, have an immunosuppressive condition, or are taking medication that might affect your natural immunity.

4.1 Training for Wildlife Response Personnel

In addition to being trained in specific wildlife response tasks, personnel will be trained to recognize and prevent oil-related and physical hazards associated with wildlife response operations. Complete training will be given to a core group prior to participation in oiled wildlife response activities.

4.1.1 Personal Protective Equipment (PPE)

To prevent exposure to oil and injury from wildlife, workers should wear approved personal protective equipment appropriate to their task. The following is a list of recommended PPE:

- Full eye protection (goggles or safety glasses) – eye protection is required when handling animals, especially birds. Birds will peck when under stress and should be considered dangerous as they will aim for eyes;
- Oil resistant rain gear or oil protective clothing (coated Tyvek, Saranex, etc.);
- Gloves (neoprene or nitrile rubber) that are oil resistant and waterproof and provide protection against beaks and claws;
- Non-skid shoes / boots, which are oil resistant and waterproof;
- Duct tape, used to tape rain jacket sleeves to gloves and rain pants to boots;
- Ear protection (muff or ear plug type) during deterrent operations, if appropriate;
- Respiratory protection, if appropriate.

In addition, the following PPE are recommended:

- Long-sleeved shirts;
- Hat (to provide shade in hot weather);

- Change of clothes (to rest or leave in);
- Clean towel / toiletries;
- No jewelry (birds will peck at bright, shiny objects).

Clothing and equipment to protect against bites and scratches should be worn underneath the oil protective equipment whenever necessary. Respiratory protection from organic vapor hazards may also be required for some operations. If respirators are used, respirator training and fit testing are required. Workers will be trained in the proper use and limitations of all PPE prior to using the equipment.

4.2 Worker Safety

Worker safety is the primary consideration in wildlife handling. Handling and restraint techniques appropriate for specific species need to be applied by trained and experienced personnel.

Oiled wildlife response is often physically and emotionally stressful. Dehydration, exhaustion, and poor nutrition can affect a person's ability to assess and react to a dangerous situation. It is therefore important that workers stay well hydrated and eat nutritionally sound meals. Rest is equally important. The safety of all depends on the alertness of each individual.

In addition to hazards from oil, numerous physical hazards may be associated with wildlife response activities. Workers should be aware of changing weather conditions, strong undertows in tidal areas, slick surfaces along shorelines. Personal flotation devices should be worn for all on-water and in-water operations.

4.3 Zoonosis

Wildlife may carry diseases that are transmissible to people. Diseases that are transmitted from animals to humans are called zoonoses, they may be viral, bacterial, fungal, or parasitic. **Individuals who have immunosuppressive conditions are more susceptible to contracting zoonotic diseases.**

Zoonoses can be transmitted to humans by:

- Inhalation of particles (spores, bacteria) in the air;
- Ingestion of feces (i.e. projectile feces, poor hygiene, etc.);
- Contact with the skin.

To reduce risk of contracting a zoonotic disease, wildlife handlers should always:

- Wash hands thoroughly with soap and water after handling wildlife;
- Wash hands well before and after eating or smoking;
- Smoke, drink, or eat in designated areas only and not near wildlife;
- Clean and treat all cuts and scratches;
- Use gloves as much as possible;
- Use surgical masks as appropriate.

In addition, there is a potential health risk to poultry, farm, and domestic animals (including pets) from clothing or equipment that has been in contact with wildlife. Return used oil spill response

equipment and supplies for proper decontamination or disposal. Thoroughly wash, and disinfect as appropriate, all personal items after completing wildlife response tasks for the day.

5 Wildlife Deterrence (Hazing)

5.1 Introduction

The primary strategy for wildlife protection is controlling the spread of spilled oil to prevent or reduce oil contamination of potentially affected species and habitats. Removal of oiled debris and contaminated food sources also protects wildlife. Another method of wildlife protection is deterrence or hazing. Hazing is the term used when a variety of deterrents are used to prevent wildlife from entering areas already oiled or areas that are in the projected pathway of the oil. Hazing should be carefully planned and executed, since hazed wildlife could move into other oiled areas.

Common hazing techniques include:

- Making noise with pyrotechnics, firearms, air horns, motorized equipment, or recorded bird alarm sounds;
- Using scare devices such as mylar tape, helium-filled balloons, scarecrows, predator effigies in oiled areas;
- Herding wildlife using aircraft, boats, ATVs, UAVs, or other vehicles;
- Hazing by human presence.

Information necessary to help determine whether or not to begin hazing operations include time of year, availability of nearby uncontaminated habitat, proximity of nesting colonies and location of species in relation to the spill. The decision tree for hazing is presented in Figure 5-1. Once the decision to haze is made, review the hazing plan with the Operations Section Chief, Incident Commander, and other appropriate authorities and obtain all necessary approvals, and permits (if required). Initiate deterrence activities as soon as possible. Whether or not a deterrent operation will be effective depends on the habitat, season, species, and their residency status and age. Deterrent effectiveness can decrease for birds occupying key habitat areas (established nesting colonies, important foraging areas) or during molting season.

The potential effects of human activity and disturbance on sensitive habitats should be considered prior to starting a hazing operation. For example, take care not to trample fragile vegetation by foot traffic or off-road vehicles. If pyrotechnics or gas operated cannons are used, take care to prevent igniting vegetation. Wakes from boat operations should not push floating oil further into wetlands or mangroves. If nesting season, consider the potential effects of hazing on bird reproduction. Young birds are more susceptible to predation if they become separated from their parents.

Each spill situation will be unique and preplanned deterrence activities are considered tentative. Consultation with local experts is advisable. Regulations should be followed regarding the purchase, possession, and discharge of firearms or explosives, including shotgun and pistol-launched pyrotechnics.

No attempt should be made to haze oiled wildlife. Depending on the extent of oiling, wildlife that is already oiled may need to be captured and cleaned. Hazing is most effective if the area of

concern can be hazed as continuously as possible. Avoid hazing in areas with oiled habitat or adjacent to oiled habitats where hazed wildlife could become contaminated with oil.

Habituation is the gradual decrease in response to a deterrence method due to increased familiarity and acceptance. Habituation can be minimized by using a combination of hazing methods and frequently changing the type, timing, and location of the hazing devices. It is recommended that human patrols be incorporated in hazing operations. Molting birds are not easily deterred and require a combination of different techniques.

Hazing is not generally recommended for marine mammals. Before hazing is being considered for marine mammals (whales, dolphins, seals, otters, manatees), consult the appropriate regulatory authorities and marine mammal experts. There are no established methods or data for hazing whales and dolphins. Attempts to haze seals from rookery or haul out areas may cause panic and a stampede, resulting in injuries or death, especially for pups. Pup mortalities can also result from abandonment.

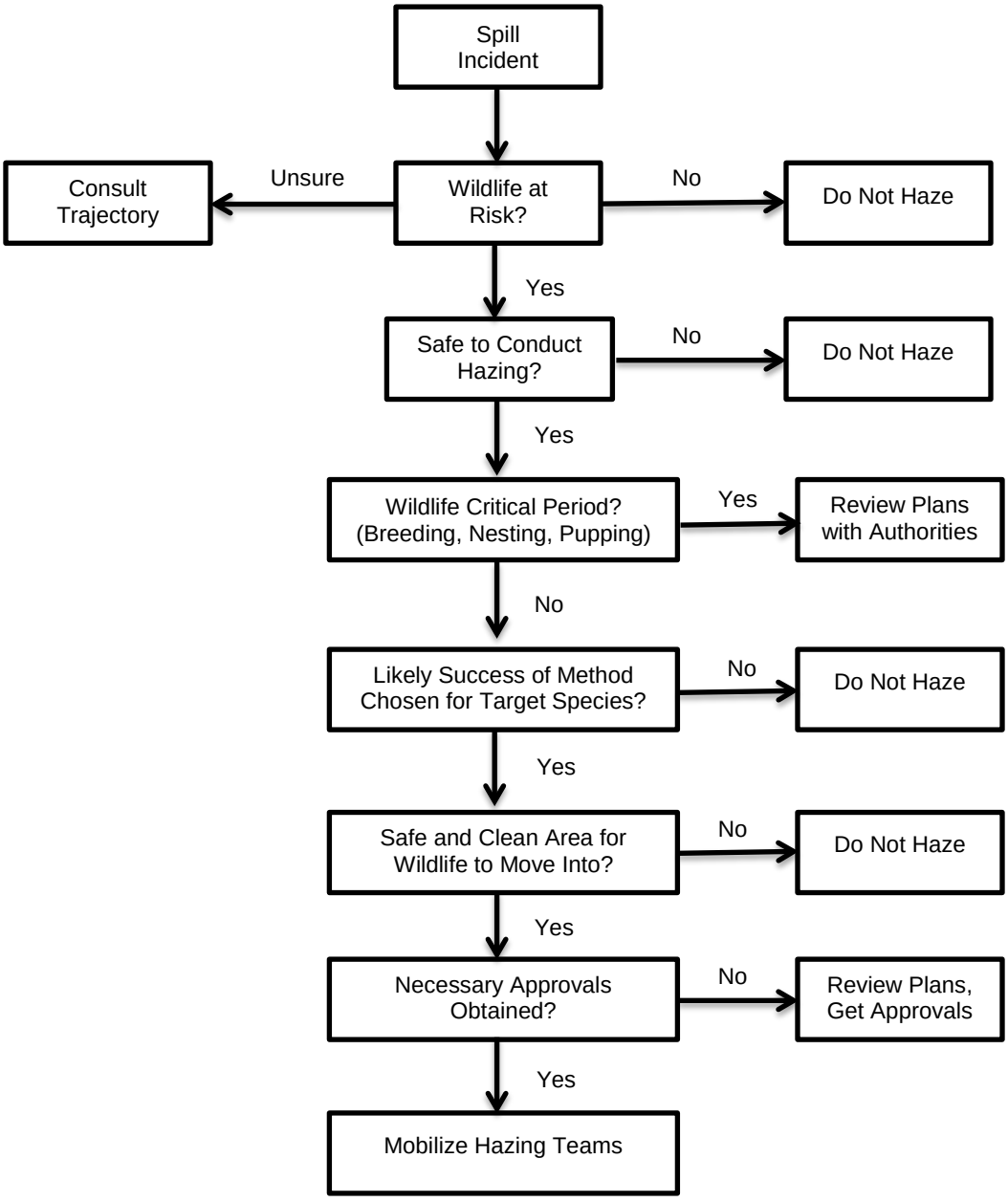


Figure 5-1: Hazing Decision Tree

5.2 Deterrence Methods and Equipment

Deterrent operations should include both visual and auditory techniques. Some petroleum products are highly flammable during the first few hours after a spill, due to high concentrations of volatile oil fractions. Techniques with potential to induce sparks should be avoided in these situations. The effects of sound emitting devices on humans, in terms or irritation and noise, especially at night, will influence whether or not some hazing methods will be acceptable.

5.2.1 Gas-Operated Cannons

Gas-operated cannons should only be used by trained personnel. The cannons produce a loud shotgun-like noise when discharged. Blasts are emitted at adjustable time intervals from less than one minute to as much as 30 minutes. If multiple cannons are used in an area, stagger the firing intervals. Cannons should be elevated at a 45 degree angle and preferably aimed downwind to increase effectiveness. Propane cannons are more effective for migrating and hunted species that associate danger with loud noises.

5.2.2 Pyrotechnics

Pyrotechnic devices disturb wildlife by producing a whistling noise, explosion, and/or flash of light. Types include shotgun-launched projectiles (crackers), fireworks, and a variety of pistol-launched projectiles. Pyrotechnic devices are potentially dangerous and should only be used by trained personnel. Safety goggles and ear protection should be worn by operators. When using these devices, care must be taken not to ignite spilled oil or vegetation.

5.2.3 Aircraft

Aircraft are often effective for deterring birds and terrestrial mammals because of the combination of loud noise and rapid approach from above. Because of their maneuverability and noise, helicopters are probably more effective than fixed-wing aircraft.

5.2.4 UAVs

Unmanned Aerial Vehicles (UAVs) operate similarly to manned aircraft, but may be able to operate at lower altitudes. Typically they operate in conjunction with ground or boat based personnel. UAVs can be used to scare off birds in flight. UAVs should be operated by trained personnel and must be approved by the Aviation Branch and appropriate government authorities.

5.2.5 Boats

Air boats or boats propelled by outboard motors can be used to haze wildlife and marine mammals. Small, noisy, shallow draft boats have been reported to be particularly effective. Boats can be used in combination with other hazing methods (i.e., UAVs, pyrotechnics).

5.2.6 All-Terrain Vehicles (ATVs)

ATVs are moderately effective for hazing many species of wildlife. Human presence reinforces the effects of the noise and rapid movement of the vehicle.

5.2.7 Air Horns

Air horns can be used to deter wildlife. Since habituation may be rapid, it is recommended that air horns be used in combination with other deterrent methods or devices.

5.2.8 Electronic Sound Generators

Sound generators broadcast loud, intermittent electronically synthesized sounds. The units can be adjusted to the most effective range of sound patterns for the target species. Sound generators can be positioned on land, mounted on boats, or housed within floats in water. When a sound generator is deployed within a drifting slick, the potential of scaring birds directly into the oil-contaminated water is reduced.

5.2.9 Balloons

All-weather helium balloons are considered effective if frequently refilled and moved. They can be suspended from land or from floating objects in water (e.g., spill booms). They should not be located near trees or other objects that could cause puncturing.

5.2.10 Human Effigies and Predator Models

Human effigies (scarecrows) and raptor models may be effective if they appear lifelike, have motion, are moved frequently, and are used in combination with loud sounds or recorded distress calls.

Additional hazing techniques are available. The recommendation to haze will be guided by site-specific and species-specific factors present at the time of the spill, and availability of proven hazing techniques.

6 Capture and Transport of Oiled Wildlife

6.1 Objective

The sooner oiled wildlife can be captured and treated the better their chances for survival. It is helpful to plot and number oiled wildlife on maps and charts to identify search and recovery patterns. Reconnaissance surveys for oiled wildlife may occur in offshore and near-shore waters, shorelines in oiled areas, in addition to areas that could potentially be oiled. Reconnaissance surveys may also be conducted at nearby feeding and nesting areas to detect oiled wildlife that may have moved away from oiled areas. The objectives of a reconnaissance survey are to 1) evaluate the number, species, and locations of wildlife potentially affected by an oil spill and 2) determine the feasibility to rescue oiled wildlife.

Local experts can provide information regarding special site considerations (i.e., nesting grounds, cultural or historic sites) and oiled species prioritization for capture. An effort should be made to avoid capturing birds, or other animals, that are not impacted by the spill, unless otherwise authorized.

Wildlife capture operations should only be conducted when weather conditions permit. Captured wildlife may be aggressive and should be regarded as potentially dangerous. Only trained individuals should undertake the capture and treatment of oiled wildlife.

6.2 Capture

A capture team consists of two or more individuals wearing appropriate protective clothing. Capture strategies should be discussed before any attempt to capture oiled wildlife. Safety of individuals is not to be compromised for the objective of capture.

A variety of methods can be used to capture wildlife:

- Dip nets, throw nets, or mist nets can be used for small birds and mammals;
- Seine nets and net guns can be used for larger birds or turtles;
- Capture poles can also be used.

Oiled birds can be approached using boats, but it is best to allow them to reach the shore if possible. Oiled wildlife should be approached carefully so as not to further stress the animal.

Appropriate handling techniques are based on the size and species of the animal. Field personnel should be properly trained before attempting to handle oiled wildlife.

Dead wildlife should also be collected to prevent other wildlife from becoming oiled as they attempt to eat the carcasses. Each carcass should be labelled, numbered, and documented on the appropriate form.

6.3 Transport

Oiled wildlife should be transported in well ventilated containers of sufficient size for the species captured. Some species may be placed 2 or 3 to a container. Containers should be placed in an area separate from the operator of the transport vehicle to protect the operator from inhaling vapors. Temperature should be maintained at an adequate level to prevent hypothermia or overheating.

7 Stabilization, Rehabilitation, and Husbandry

7.1 Introduction

If an oiled animal is hypothermic, dehydrated, sick, or injured, it may not survive the stress of being washed. Stabilization increases an oiled animal’s chances for a successful rehabilitation and release.

7.2 Stabilization

A stabilization center will serve as a collection site for all oiled wildlife collected by the wildlife search teams. A field stabilization group will provide initial care in the field prior to transportation to the rehabilitation facility. Stabilization can include warming or cooling of oiled animals to stabilize body temperature, preliminary examinations and initial cleaning, and providing fluids and nutrition.

7.3 Rehabilitation

A suitable facility must have a large open space that can easily be reconfigured to accommodate the changing needs of the wildlife rehabilitation process. Contracted wildlife specialists and/or agency representatives should be consulted regarding facility requirements for optimum rehabilitation. The following are equipment and facility considerations:

- Location with respect to location of spill;
- Anticipated number of animals;
- Types and numbers of species;
- Season / weather;
- Hot and cold water capacity;
- Electric and lighting;
- HVAC systems (good air handling necessary);
- Communications;
- Noise control;
- Waste management issues (collection and storage);
- Appropriate holding pens (species dependent).

Each wildlife rehabilitation facility must have a Site Safety Plan in place prior to start-up. The Site Safety Plan must include checklists for measures to avoid physical, chemical, and biological hazards, safe animal handling procedures, and other emergency procedures and contact numbers.

Buildings of Opportunity

It may be possible to secure an appropriate building for oiled wildlife rehabilitation that is normally used for some other purpose but can be quickly transformed into a suitable facility. Examples may include warehouses, fairgrounds, community centers, etc. To utilize this option will require considerable planning and contracts with building owners, suppliers and tradesmen to ensure that the facility can be up and running within hours when needed, and is able to provide the required space, water, heating and ventilation necessary to meet the goals of the wildlife plan (IPIECA, 2014).

Mobile facilities

Mobile facilities are comprised of modules (trailers, containers, tents, etc.) that can be easily transported and set up wherever they are needed. Infrastructure needs may vary, and potential settings could, for example, range from a large warehouse space with water and utilities to a level field or the deck of a barge or large ship. Such facilities may be used for field operations or all phases of rehabilitation. A wide variety of examples of mobile units exist that are intended for use as specific components or as a complete oiled wildlife rehabilitation facility (IPIECA, 2014).

8 Wildlife Release Considerations

The goal in rehabilitating oiled wildlife is the release of healthy animals back into their natural environment. Release of rehabilitated wildlife requires planning in advance. Consultation with local wildlife experts, government agencies, and Incident Command is necessary to determine appropriate release sites and disposition of animals that cannot be released. Timely release is important to prevent or reduce occurrence of secondary problems associated with captivity. For wildlife that cannot be released, the options are euthanasia or placement in a long-term facility.

To be released, wildlife must exhibit:

- Normal behavior;
- Normal body weight;
- Waterproof (particularly in seabirds);
- Normal blood values and physical exam;
- Normal feeding.

Release sites should:

- Be free of oil contamination and not at risk of re-contamination;
- Same general geographic area or habitat of capture;
- Minimal human disturbance;
- Appropriate seasonal range for species (important for long rehabilitations);
- Safe for response personnel.

If post-release monitoring is necessary, wildlife should be tagged or banded prior to release to aid visual observation.

9 Record Keeping

Record keeping is an important part of a wildlife rehabilitation program. Records are essential for evaluating the effectiveness of treatments and whether the rehabilitation efforts were successful. In addition records are used to determine a spill's impact on wildlife. Records are usually divided into the following types:

- Field Survey and Wildlife Collection:
  - Document species collected, numbers, condition, location, etc.;
- Chain-of-Custody:
  - Used to track transport and transfer of all collected animals;
- Admission and Examination:
  - Record of admission to rehab center, initial assessments, etc.;
- Treatment:
  - Tracks treatment of individual animals, feeding, behavior, etc.;
- Necropsy:
  - For use by veterinarian for determining cause of death.

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Appendix A – Habitats

Coastal and Marine Habitats

Several habitat types are present in the network of plains and low hills that comprise Guyana's coast, including mangroves, salt to brackish lagoons, brackish herbaceous swamps, swamp woods and swamp forests. The swamps are an important source of freshwater to mangroves and other flora and fauna. The coastal mangroves are vital to Guyana's biodiversity, physical security, and economy. Guyana has relatively few beaches, but the beaches that do occur are critically important nesting habitats for sea turtles.

Guyana's continental shelf occupies an area of 48,665 sq. km. The average width of the continental shelf is 112.6 km (NDS, 1997). The shelf is widest near the Suriname and Venezuela borders, and slightly narrower near the center, north of Georgetown. The entire continental shelf, continental slope, and the adjoining portion of the abyssal plain (including the Sorubim and Liza Areas of Interest) are part of the North Brazil Large Marine Ecosystem (LME). The North Brazil LME is an oceanic habitat unit that extends from the Caribbean Sea south to the Parnaiba River in Brazil. Marine benthic biological resources offshore of Guyana are poorly studied, but do not include the matrix of shallow coral reefs and seagrass meadows that are characteristic of coastal tropical Atlantic environments elsewhere. This is due to the highly turbid conditions offshore of Guyana, which do not permit the growth of warm water corals, since they rely on symbiotic photosynthetic algae for nourishment (ERM, 2016).The substrate is generally composed almost entirely of mud and silt deposited by the North Brazil Current.

Mangroves

Mangroves are important ecosystems to security of the biodiversity of the entire Guiana Shield region. They occupy over 81,000 hectares of Guyana's coast but the distribution of mangroves along the coast is highly dynamic, and subject to rapid change. Six of Guyana's ten geopolitical regions have mangroves but approximately 75% of the country's mangroves are concentrated in the Barima-Waini and Pomeroon-Supenaam regions.

There are currently three species of mangrove in Guyana: *Rhizophora mangle* (Red mangrove), *Avicennia germinans* (Black mangrove), and *Laguncularia racemosa* (White mangrove). Many invertebrates live either on or in close proximity to mangrove roots and substrate and include snails, barnacles, tunicates, mollusks, polychaete worms, oligochaete worms, shrimps, crabs, sponges, jellyfishes, amphipods and isopods. These small organisms provide forage for birds, mammals, reptiles, amphibians, fish, crabs, and shrimp.

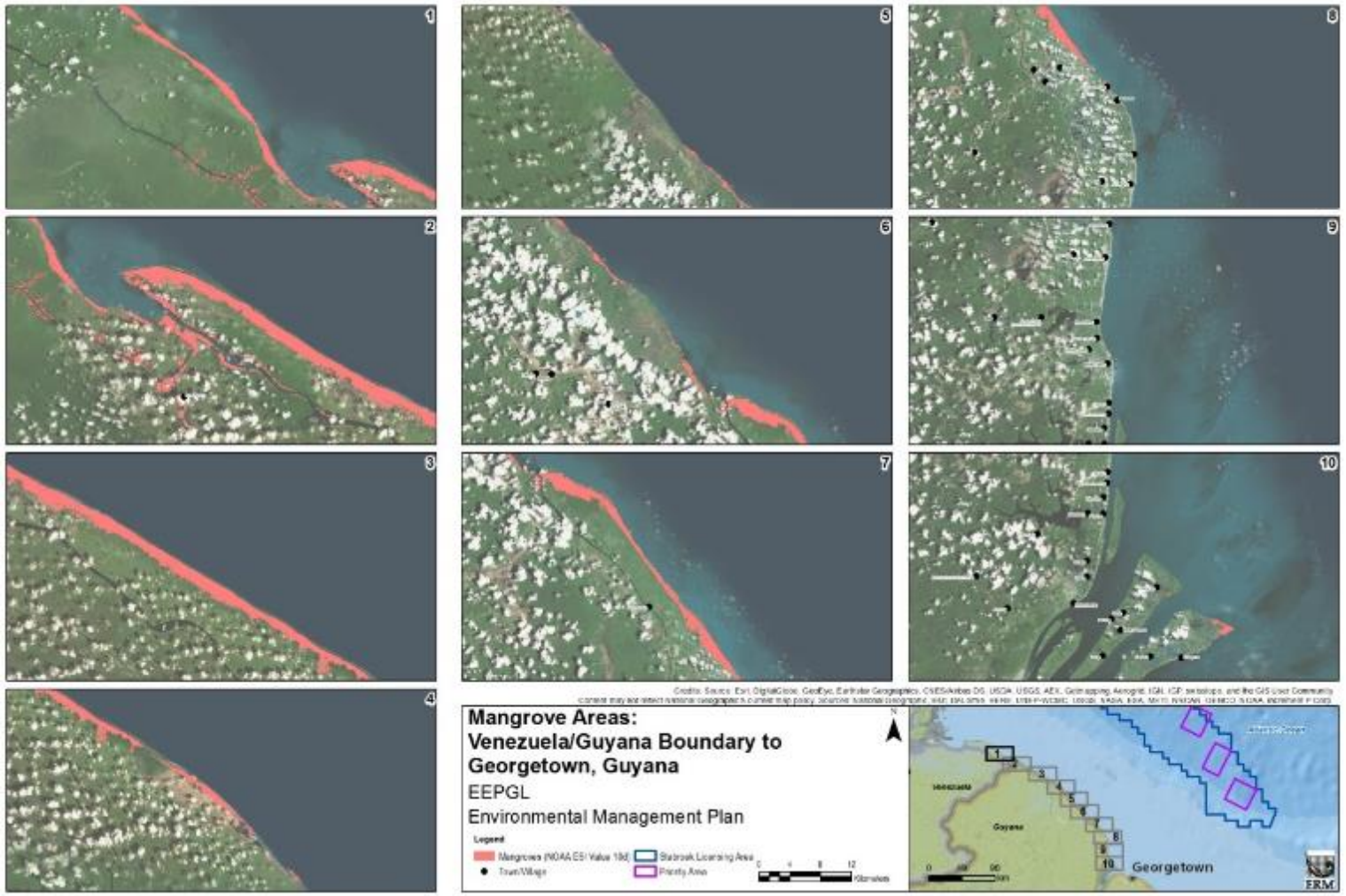


Figure A-1: Guyana's Mangrove Distribution (Georgetown west to Venezuelan Border)

Mud Banks

The 1,500 km-long coast of South America between the Amazon and Orinoco River mouths is the world's muddiest coastline. Mud banks extend approximately 20 to 40 km offshore to a depth of 20m, and are located seaward of the mangrove swamps that fringe much of the coastline. The mud banks are rich in invertebrate fauna, including plankton and micro-plankton assemblages, algae mats (diatoms), and benthic communities of Nematodes (worms), Tanaidacea (crustaceans), and Foraminifera (amoeboid protists). These small organisms provide habitat for fish species, post-larval and juvenile shrimps, and crabs, and numerous resident and migratory shore birds.

Shell Beach

Shell Beach is a protected area on Guyana's coast that could potentially be impacted by a spill. It accounts for 200,000 ha or approximately 11% of Guyana's total protected area. Figure A-2 provides a detailed map of Shell Beach and the surrounding area. It is located in northwestern Guyana and extends for almost 140km between the Waini, Baramani, and Moruka Rivers and the Atlantic Ocean. Shell Beach is a dynamic area and constantly changes due to the competing effects of erosion and deposition along the shorefront. Seventy percent of the area is forested; the rest is made up of mostly swamp (28.8%), and sandy beaches (1.2%). Shell Beach supports numerous species of plants including coconut, papaya, and palm trees.

Shell Beach is not the only portion of Guyana's coast that contains mangroves; mangroves are a prominent feature along much of northwest Guyana's coastline. They are ecologically important, and are a critical natural component of Guyana's coastal defense network, protecting the low-lying inland areas of the coast from sea-level rise and saltwater intrusion during storm events.

Shell Beach is best known as a marine turtle nesting site. The composition of the substrate at Shell Beach, its geographical location and the low human impact makes it an ideal nesting site for sea turtles. Most nesting beaches in Guyana are used by only one or two species of sea turtle but four species of sea turtle (Leatherback, Hawksbill, Olive Ridley, and Green Turtle) found in Guyana nest at Shell Beach (Pritchard, 2001).

In addition to the sea turtles there are also at least four other species of turtles present within the protected area including the yellow-foot tortoise (*Geochelone denticulate*), scorpion mud turtle (*Kinosternon scorpioides*), giant river turtle (*Podocnemis expansa*) and mata mata (*Chelus fimbriata*).

The Shell Beach area is also home to several species of mammals, including howler monkeys (*Alouatta* spp.), jaguars (*Panthera* spp.), and manatees (*Trichechus* sp.) (ERM, 2016). Amerindian groups also inhabit the Shell Beach area and are concentrated along the areas of Almond Beach, Father's Beach, and Assakata (ERM, 2016).

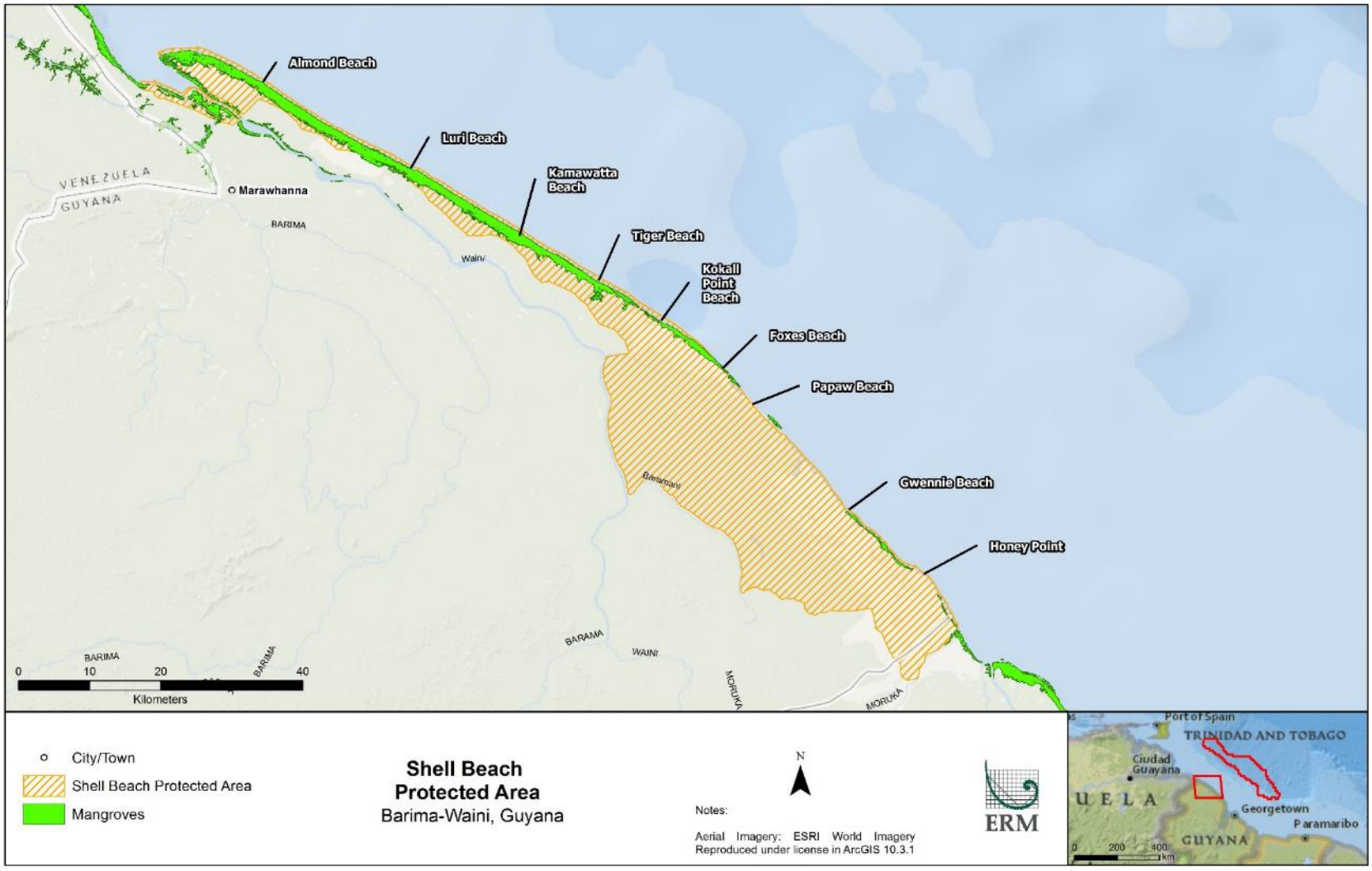


Figure A-2: Shell Beach Protected Area

Appendix B – Bird Species

Birds are by far one of the most diverse classes in the animal kingdom, owing their success to several adaptations over the course of evolution. Birds comprise of over 8600 species distributed among 27 orders.

Of the 27 orders, 20 are found in Guyana. Of these, 9 are shore birds. Both migrant and native shore bird species occupy important ecological niches, serve as important biological control agents and act as dispersers. Because of their importance in the ecosystem and their declining population numbers, the conservation and or protection of some species is vital for the promotion of a healthy and long living ecosystem.

Of the thirty-two families of waterfowl identified, twelve (12) are found along the coast of Guyana. Many of these bird species migrate from the Northern, Western and Eastern United States for the winter season. Millions of shorebirds make the annual 2000-mile journey from North America to winter in South America. Migratory routes of shorebirds follow three main flyways: Shorebirds appearing on the coast of Guyana utilize the Atlantic and Central Flyways for their migration (see Figure B-1). These migratory paths are influenced by winds and geography.

The beaches on the coast of South America provide the ideal wetland conditions for waterfowl. The wetlands on the South American coast provide mangrove forests for shelter and breeding, and mudflats, sandy beaches and open fishing areas for foraging. Shorebirds are found mainly on the seashore between the low and high water marks feeding on a variety of small invertebrates, clams, snails, larvae and insects. Due to the diversity of food supplies in the same wetland, large mixed flocks of shorebirds are usually observed.

Coastal bird populations consist of ibises, egrets, herons, gulls and other seashore species. Oceanic species such as frigatebirds and albatrosses spend most of their time at sea and are less common along the coast. Migratory seabirds occur in Guyana on a seasonal basis. Guyana's coastal mangroves are noted for being wintering grounds for migratory birds including austral and Nearctic migratory species. Austral migrants breed in temperate South America during the summer, but spend the remainder of the year in the tropics. Nearctic migrants migrate in the other direction, breeding in North America during summer and overwintering in tropical South America. Both groups spend winter in Guyana, which creates a peak in migratory waterbird abundance in Guyana from early October to late March. See Table B-1 for some common seabird species. All of the 30 species of seabirds known to occur in Guyana are currently listed on the IUCN Red List as LC (with the exception of Leach's Storm Petrel – VU), which means that the population status of the species does not meet the IUCN criteria for a threatened or NT designation (IUCN, 2016)

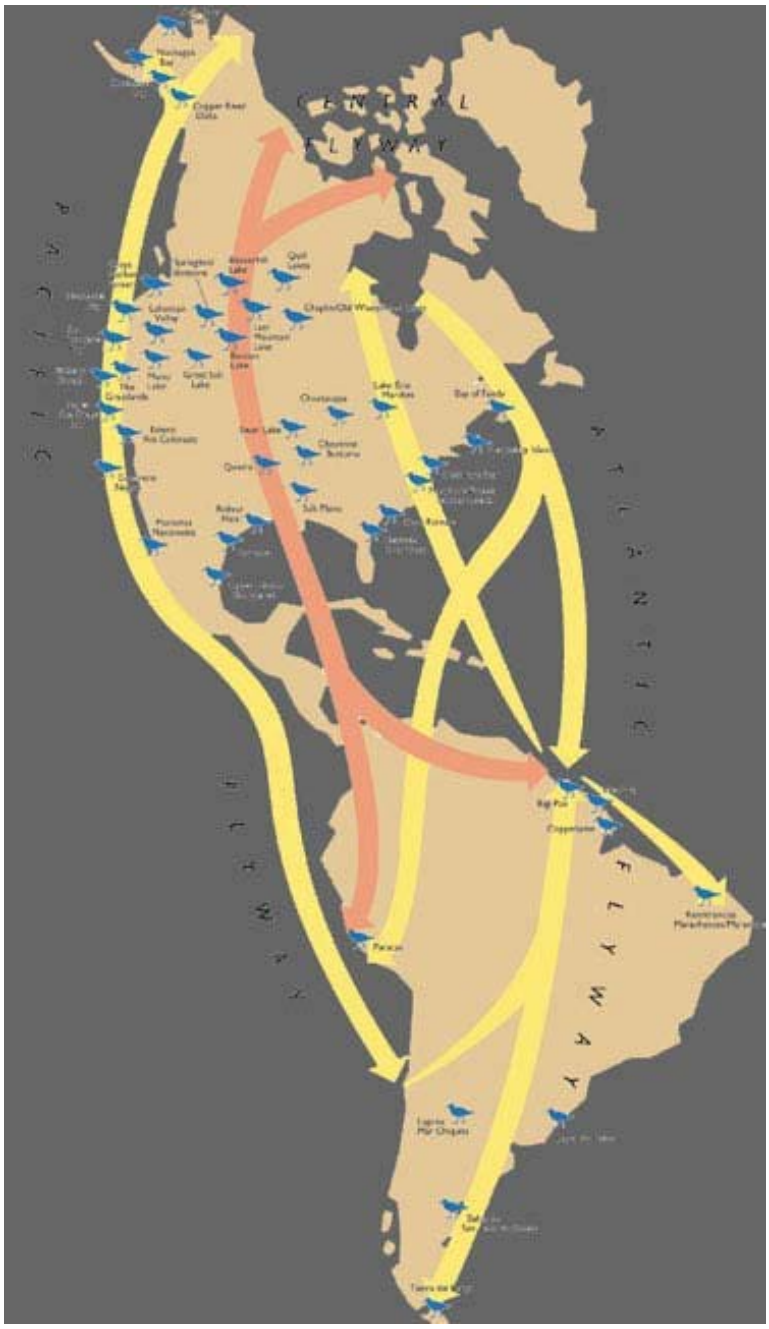


Figure B-1: Migratory Routes of Shorebirds

Migratory routes of shorebirds follow three main flyways: The Atlantic Flyway, The Pacific Flyway and The Central Flyway.

Table B-1: Common Seabird Species Known to Occur in Guyana

Common Name	Scientific Name
Magnificent Frigatebird	*Fregata magnificens*
Brown Booby	*Sula leucogaster*
Masked Booby	*Sula dactylatra*
Red-footed Booby	*Sula sula*
White-tailed Tropicbird	*Phaethon lepturus*
Leach's Storm-petrel	*Oceanodroma leucorhoa*
Audubon's Shearwater	*Puffinus lherminieri*
Wilson's Storm-petrel	*Oceanites oceanicus*
Cory's Shearwater	*Calonectris diomedea*
Barolo Shearwater	*Puffinus baroli*
Great Shearwater	*Ardenna gravis*
Arctic Jaeger [c]	*Stercorarius parasiticus*
Pomarine Jaeger	*Stercorarius pomarinus*
Parasitic Jaeger	*Stercorarius parasiticus*
South Polar Skua	*Stercorarius maccormicki*
Great Skua	*Catharacta skua*
Least Tern	*Sternula antillarum*
Royal Tern	*Sterna maxima*
Black Tern	*Chlidonias niger*
Common Tern	*Sterna hirundo*
Bridled Tern	*Onychoprion anaethetus*
Sooty Tern	*Onychoprion fuscatus*
Sandwich Tern	*Thalasseus sandvicensis*
Roseate Tern	*Sterna dougalli*
Brown Noddy	*Anous stolidus*
Gull Billed-tern	*Gelochelidon nilotica*
Northern Gannet	*Morus bassanus*
Laughing Gull	*Larus atricilla*
Brown Pelican	*Pelecanus occidentalis*
Neotropic Cormorant	*Phalacrocorax brasilianus*

Of the species observed in the Stabroek Block during the EEPGL seismic surveys, the most commonly observed species (in descending order of number of sightings (i.e., frequency of occurrence) were the Masked Booby (*Sula dactylatra*), Magnificent Frigatebird (*Fregata magnificens*), and Brown Booby *(Sula leucogaster*) (ERM, 2016; RPS, 2016).

Important Bird Areas (outside of the Stabroek Area of Operation)

Three Marine IBAs of global or regional importance to seabirds have been designated in neighboring countries: St. Giles Islands and Little Tobago, both located off the northeastern tip of Tobago, and Isla de Aves in Venezuela (Lentino and Esclasans, 2009; Birdlife International 2016b; Devenish et al., 2009). Figure B-2 depicts the location of these IBAs relative to the Stabroek Block.

St. Giles Islands IBA: includes one main island and several surrounding rock outcrops that support globally important numbers of breeding Red-billed Tropicbird (*Phaethon aethereus*) and regionally important numbers of breeding Audubon's Shearwater (*Puffinus lherminieri*), Magnificent Frigatebird (*Fregata magnificens*), Masked Booby (*Sula dactylatra*), and Red-footed Booby (*S. sula*). Other seabirds such as Brown Booby (*S. leucogaster*) and Brown Noddy (*Anous stolidus*) also breed there (White, 2008; Devenish et al., 2009).

Little Tobago IBA: supports globally important breeding populations of Red-billed Tropicbird and Laughing Gull (*Larus atricilla*), and regionally important breeding populations of Audubon's Shearwater, Brown Booby, Red-footed Booby, and Bridled Tern (White, 2008; Devenish et al., 2009).

Field surveys conducted as part of the coastal mapping of Trinidad and Tobago documented large colonies of seabirds at both St. Giles Island and Little Tobago, as well as along the northeastern cliffs of Tobago, from Corvo Point to Pedro Point (ERM, 2016).

The Isla de Aves IBA: in Venezuela supports the largest breeding colony of Brown Noddy known from the Caribbean (5,509 pairs), as well as the principal breeding colony of Sooty Tern (*Sterna fuscata*) in Venezuela (12,182 pairs) (Lentino and Esclasans, 2009).

Figure B-2: IBAs with Importance to Seabirds Relative to Stabroek Block

Appendix C – Marine Mammals

The equatorial waters of Guyana are home to several species of marine mammals. There have been no comprehensive studies on marine mammals offshore Guyana, but regional studies and bycatch reports provide some insight into the composition and distribution of the marine mammal community in the vicinity of the Project. Marine mammals whose distributions overlap with Guyana's Exclusive Economic Zone (EEZ) are listed in Table C-1.

Marine mammals are highly migratory and should be able to avoid a spill should one occur. The greatest danger to marine mammals is from collisions with vessels during operations. Marine mammals not directly impacted from a spill may also be impacted indirectly through food-chain related impacts.

The data from a 2012 Suriname survey strongly suggest that toothed whales (including dolphins, porpoises, pilot whales, and sperm whales) are more common offshore of Suriname than the baleen whales (including Bryde's and sei whales). The species with the highest abundance index was the melon-headed whale, while the lowest was the Bryde's whale. The most frequently sighted species was the spinner dolphin, and the least frequently sighted was the sei whale (Boer, 2012). The highest number of strandings reported were for sperm whales, and the lowest number were for sei whales (Boer, 2012). The 2012 Suriname study was conducted at similar depths and distances offshore as the Sorubim and Liza Areas of Interest, so such species could occupy similar ranges within the Project lead areas as well.

The West Indian manatee has been documented in the region, but is either now considered to be locally extinct or extremely rare and would not be expected to be encountered in coastal waters adjacent to the POA (ERM, 2016). However, the manatee may be encountered in nearshore and riverine settings.

Table C-1: Marine Mammals with Ranges that include Waters Offshore Guyana

Common name	***Scientific name***
Sei whale	*Balaenoptera borealis (EN)*
Bryde's whale *	*Balaenoptera brydei*
Blue whale	*Balaenoptera musculus (EN)*
Fin whale	*Balaenoptera physalu (EN)*
Short beaked common dolphin	*Delphinus delphis (LC)*
Minke whale	*Balaenoptera acutorostrata (LC)*
North Atlantic right whale	*Eubalaena glacialis (EN)*
Pygmy killer whale	*Feresa attenuate*
Short-finned pilot whale *	*Globicephala macrorhynchus*
Rissos dolphin *	*Grampus griseus (LC)*
Pygmy sperm whale	*Kogia breviceps*
Dwarf sperm whale	*Kogia simus*
Frasers dolphin *	*Lagenodelphis hosei (LC)*
Humpback whale	*Megaptera novaeangliae (LC)*
Blainvilles beaked whale	*Mesoplodon densirostris*
Gervais beaked whale	*Mesoplodon europaeus*
Trues beaked whale	*Mesoplodon mirus*
Melon-headed whale *	*Peponocephala electra (LC)*
Sperm whale *	*Physeter macrocephalus (VU)*
False killer whale	*Pseudorca crassidens*
Tucuxi	*Sotalia fluviatilis*
Pantropical spotted dolphin *	*Stenella attenuate (LC)*
Clymene dolphin	*Stenella clymene*
Striped dolphin	*Stenella coeruleoalba (LC)*
Rough-toothed dolphin	*Steno bredanensis (LC)*
Spinner dolphin *	*Stenella longirostris*
West Indian manatee	*Trichechus manatus*

LC = Least Concerned VU = Vulnerable EN = Endangered

Note: species marked with an asterisk (*) were confirmed sighted during EEPGL activities since 2014.

Appendix D – Marine Reptiles

Five sea turtle species are found in the wider Caribbean, all of which occur in Guyanese waters. Four of these species: green turtle (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and Olive Ridley turtle (*Lepidochelys olivacea*) nest on Guyana's beaches. Loggerhead turtles (*Caretta caretta*) also occur offshore Guyana but rarely come ashore. The primary nesting site for all these species is Shell Beach, located on the northwestern coast of Guyana. The exact location of secondary nesting sites changes due to coastal erosion which creates and destroys nesting areas continuously, but they are generally distributed along the northwest coast between the Pomeroon and the Waini river estuaries. Leatherback turtles are the most common species on the nesting beaches, while nesting green and hawksbill turtles are less common. Olive Ridley turtle populations have declined in recent times, but remain stable.

According to the Center for Rural Empowerment and the Environment (CREE), the primary nesting season for the leatherback, green, and olive ridley turtles in Guyana (Shell Beach) occurs during the cover of darkness from March to August (CREE, 2014). Hawksbill turtles nest primarily on Almond Beach in the northwest corner of the Shell Beach Protected Area. Large populations of the green and leatherback turtles are located in the Guianas (Suriname and French Guiana), while smaller nesting areas are located from northwestern Guyana (Shell Beach) to Venezuela and into the Caribbean Sea (which includes the Netherland, Lesser, and Greater Antilles); the Gulf of Mexico (Central America); and Atlantic Ocean (the Bahamas; and the southern coast of the United States) (Piniak, 2011).

The hawksbill turtles' range is primarily in the Caribbean Sea with small nesting areas in the Guianas and in eastern Brazil. The olive-ridley turtles primarily nest along the French Guiana coast with small nesting areas along the northeastern coast of Venezuela to the Suriname and in eastern Brazil (Piniak, 2011).

The primary threats to sea turtles are poaching of eggs and adults, intentional and accidental fishing, and habitat disturbance and degradation due to marine pollution, coastal zone development, shore erosion, lighting and debris. Population monitoring and conservation activities are limited, primarily due to the logistical challenges associated with the remoteness of primary nesting sites. Most marine turtle species are believed to move out of Guyanese waters as juveniles (Piniak, 2011).

Table D-1: Marine Reptiles with Ranges that include Waters Offshore Guyana

Common name	Scientific name	Nest
Green turtle	*Chelonia mydas*	*Shell Beach*
Leatherback turtle	*Dermochelys coriacea*	*Shell Beach*
Hawksbill turtle	*Eretmochelys imbricata*	*Almond Beach*
Olive Ridley turtle	*Lepidochelys olivacea*	*Shell Beach*
Loggerhead turtles	*Caretta caretta*	*Rare*

Appendix E – Marine Finfish

Most of what is known about the marine finfish off the coast of Guyana is through commercial fishing. Approximately 80 species of fish can be found in Guyanese waters (ERM, 2016), of which about 30 are ranked by the IUCN. The inshore finfish community is dominated by drums, croakers, and marine catfishes, and includes other species such as snooks and tarpon. Offshore, the community is dominated by migratory pelagic species such as tuna, jacks, groupers and mackerals. Several species of shark are also present.

Table E-1: Marine Finfish Offshore Guyana on IUCN Redlist

Common name	Scientific name	Species Status
Spotted Eagle Ray	*Aetobatus narinari*	*NT*
Common Thresher Shark	*Alopias vulpinus*	*VU*
Foureyed Flounder	*Ancylopsetta kumperae*	*DD*
Blackbelly Skate	*Breviraja nigriventralis*	*DD*
Blacknose Shark	*Carcharhinus acronotus*	*NT*
Spinner Shark	*Carcharhinus brevipinna*	*NT*
Silky Shark	*Carcharhinus falciformis*	*NT*
Bull Shark	*Carcharhinus leucas*	*NT*
Blacktip Shark	*Carcharhinus limbatus*	*NT*
Oceanic Whitetip Shark	*Carcharhinus longimanus*	*VU*
Dusky Shark	*Carcharhinus obscurus*	*VU*
Caribbean Reef Shark	*Carcharhinus perezi*	*NT*
Smalltail Shark	*Carcharhinus porosus*	*DD*
Night Shark	*Carcharhinus signatus*	*VU*
Frilled Shark	*Chlamydoselachus anguineus*	*NT*
Hookskate	*Dactylobatus clarkii*	*DD*
Southern Stingray	*Dasyatis americana*	*DD*
Sharpsnout Stingray	*Dasyatis geijskesi*	*NT*
Sickelfish Grouper	*Dermatolepis inermis*	*NT*
Atlantic Goliath Grouper	*Epinephelus itajara*	*CE*
Red Grouper	*Epinephelus morio*	*NT*
Nassau Grouper	*Epinephelus striatus*	*EN*
Tiger Shark	*Galeocerda cuvier*	*NT*
Nurse Shark	*Ginglymostoma cirratum*	*DD*
Albacore Tuna	*Thunnus alalunga*	*NT*
Yellowfin Tuna	*Thunnus albacares*	*NT*
Bigeye Tuna	*Thunnus obesus*	*VU*
Atlantic Bluefin Tuna	*Thunnus thynnus*	*EN*
Scalloped Hammerhead	*Sphyrna lewini*	*EN*
Squat-headed Hammerhead	*Sphyrna mokarran*	*EN*
Smalleye Hammerhead	*Sphyrna tudes*	*VU*

NT = Near Threatened VU = Vulnerable EN = Endangered CE = Critically Endangered DD = Data Deficient

Appendix F – Marine Fisheries

There are four main types of marine fisheries in Guyana (MOA, 2013) that can be defined by the species targeted, gear types used, and the depth of water where the fishery takes place. Table F-1 summarizes the characteristics of these fisheries.

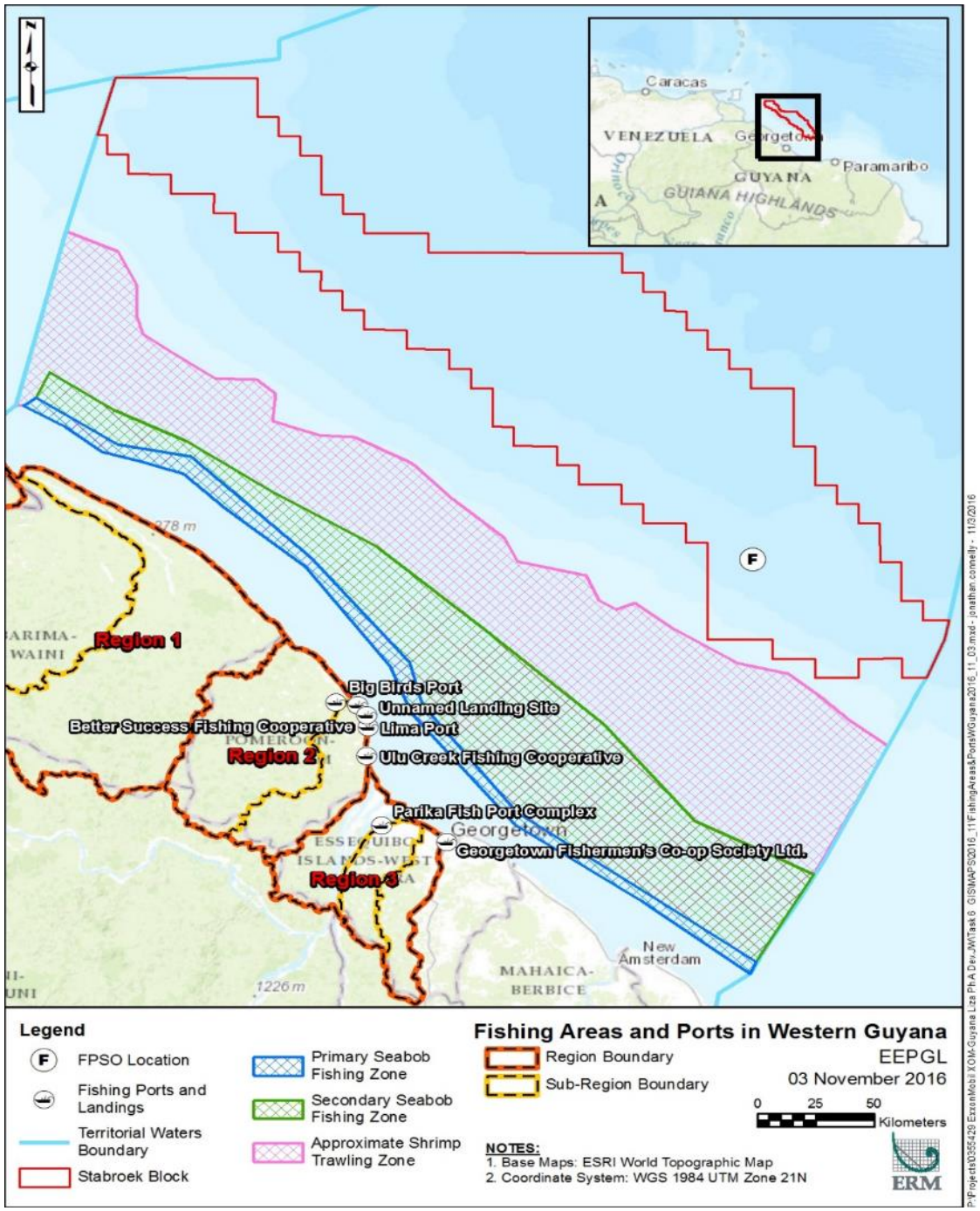
Table F-1: Primary Characteristics of Marine Fisheries in Guyana

Type of Fishery	Species	Gear	Depth
Industrial	Seabob, shrimps, and prawns	Trawls	Primarily between 13-16 m, but can occur from 0-75 m
Semi-industrial	Red snapper and vermillion snapper	Fish traps and lines	Edge of continental shelf
Artisanal	Mixed finfish and shrimp	Gillnets, seines, and others	0–18 m
Shark	Various	Trawls, gillnets, and hook and line	Throughout the continental shelf waters

The industrial seabob shrimp sector, as well as the artisanal finfish sector, are important commercial fisheries for Guyana that intersect the POA (see Figure F-1).

Guyana's marine finfish community exemplifies the ecological connectivity among the mangroves, estuaries, and offshore zones, because many fish species are dependent on different habitats at specific life stages or occur in more than one habitat type. Several species that occur in the inshore and offshore zones as adults are dependent on coastal mangroves as juveniles, particularly drums, croakers, and snappers. Catfishes occur in the mangroves, estuaries, and oceanic waters as adults (ERM, 2016). As a result, impacts in these areas may also have an impact on the fishery.

The Guyana Fisheries Department (a division of the Guyana Ministry of Agriculture), should be consulted on any potential impacts of an unplanned release.



** NOTE: Map does not represent a depiction of the maritime boundary lines of Guyana*

Figure F-1: Fishing Zones and Ports

Appendix G – Wildlife Branch Guidance

In the early hours of a spill response it is important to quickly estimate the scale of the event (relative to potential animal impacts) as best as possible and order the equipment and personnel. Estimating size and ordering resources should be the first priority as it will take some time to mobilize and deploy resources.

Wildlife Branch Objectives:

- Develop a Wildlife Plan for inclusion in the Incident Action Plan (IAP);
- Identify and mobilize equipment/facilities;
- Identify and mobilize personnel and support;
- Complete notifications: internal and external (phone list);
- Maintain communication: internal and external.

Staffing/Positions (depending on response level):

- Branch Director (BD):
  - Leads Wildlife Branch, develops incident specific wildlife plan;
- Deputy Branch Director (DBD):
  - Backup to the Director, compiles wildlife plan info, manages wildlife branch deadlines;
- Wildlife Reconnaissance Group Supervisor (WRGS):
  - Develops land, water, air reconnaissance plans;
  - Coordinates activities with Land, Water, and Air Operations;
- Bird Recovery and Rehabilitation Group Supervisor (BRRGS):
  - Coordinates bird handling issues, protocols, and hazing activities;
- Marine Mammal Recovery and Rehabilitation Group Supervisor (MMRRGS):
  - Develops and coordinates capture, handling, and rehabilitation of marine mammals;
  - Develop and coordinate efforts for handling marine reptiles;
- Wildlife Volunteer Coordinator (VC):
  - If necessary, will coordinate training, use, and deployment of volunteers for wildlife collection and rehab activities;
- Liaison (L):
  - Will coordinate communication between Environmental Unit in Planning, JIC, etc., and the Wildlife Branch in Operations;
  - Assist in maintaining communication with government agencies, NGOs, and other involved parties;
- IAP software specialist:
  - Enter forms into the IAP;
  - Assist in getting maps and updating the Common Operating Picture (COP);
- Documentation tracker (for larger events).

Initial steps (complete these in this order and on Day 1 when possible):

- Notify Command (as appropriate) that Wildlife Branch is up and running and making plans:
  - Notify Operations Section Chief;
  - Notify Environmental Unit;
  - Notify interested agencies, parties, or organizations.
- Begin Unit Log (ICS 214).
- Identify Branch staff and assignments. Use the list of positions and tasks above to identify tasks and who will be doing them. Remember, the number of personnel expands and contracts as appropriate to the event so it may be one person doing everything or there may be a full contingent of staff. (Provide an organization chart (ICS 207) and contact information to resources).
- Estimate equipment (facility) and personnel needed based on the estimated number and type of animals anticipated. Lean toward over responding as it's easier to send resources back than not have resources when needed.
- Identify deployment locations for equipment and personnel. Equipment locations need to be available for a long enough time to handle entire (anticipated) response AND rehabilitation to avoid having to move during the process.
- Develop reconnaissance plan or "animal location" needs (on Day 1 this will be a very brief plan, if one at all). Coordinate with EU and Flight Operations, etc.
- Develop search and collection and transportation plans (Day 1 there may not be formal plans, Day 2 will). Identify search areas, number of crews, support needs, etc. (ICS 204 and ICS 204a).
- Develop a wildlife rehabilitation plan.
- Begin drafting the Wildlife Plan for inclusion in the IAP. Templates are on the RRT Sharepoint page.
- Provide an Oiled Wildlife Statement to the JIC, listing phone numbers for reporting oiled wildlife and warning the public to stay away from oiled wildlife. A template is available on the RRT Sharepoint page.

Appendix F ENVIRONMENTAL IMPACT ASSESSMENT AND SUPPORTING PLANS: SUMMARY OF SPILL PREVENTION, MITIGATION MEASURES AND EMBEDDED CONTROLS

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
1	Engineering design and operations will be carried out according to applicable Guyana statutory requirements, applicable international design codes and standards, as well as the EEPGL Operations Integrity Management System (OIMS) and the EEPGL Safety, Security, Health, and Environment (SSHE) policies. EEPGL and its contractors will have structured management systems to verify the ongoing application of all necessary codes, standards, procedures, and SSHE management systems.	EIA Section 2.2.2
2	The planned development drilling program and its cuttings management approach is consistent with industry practices, considered protective of the environment, and has been the basis for the Liza-1, Liza-2 and Liza-3 exploration wells.	EIA Section 2.3.1
3	The size and strength of the casings to be used in the design of the development wells takes into account the peak reservoir temperature and pressure conditions that may be encountered during drilling and during production operations when the wells are flowing reservoir fluids. After each casing string cement job is completed, pressure testing will be performed to confirm integrity according to standard industry practices.	EIA Section 2.3.2
4	A drilling riser will be deployed to connect the conductor casing and the drill ship, and the blowout preventer (BOP) will be installed. Marine drilling risers with buoyant joints and tension will be used to connect the wells via the BOP to the drill ship. BOPs will be periodically tested during the well construction process.	EIA Section 2.3.2
5	The production tubing includes the subsurface safety valve (SSSV), which is designed to mitigate the uncontrolled release of fluids from the reservoir during the production process. The production tubing also protects the production casing from corrosion and deposition of by-products, such as sand, paraffins, and asphaltenes.	EIA Section 2.3.2
6	Based on wellbore stability analysis and experience gained from Liza-1 and Liza-2 drilling, NADF will be required to maintain borehole stability while drilling all well sections below the conductor casing.	EIA Section 2.3.3
7	The SURF system will be designed to withstand the full shut in pressure from the production wells, and the gas/water injection components will be designed to withstand the highest required injection pressures. Overpressure protection will be provided on the FPSO, in accordance with industry standards, to protect the subsea systems.	EIA Section 2.4
8	The production drill centers will be connected to the FPSO with round-trip piggable production flowlines. Pigging is performed to aid and assist in the maintenance, operations, cleaning, and inspection of flowlines.	EIA Section 2.4
9	Each subsea development well is capped by a subsea tree, which include several isolation valves and a choke valve to control production and water and gas injection.	EIA Section 2.4.1
10	The FPSO will be configured with back-up power, in the event primary power is lost.	EIA Section 2.4.2
11	The subsea trees and manifolds will be monitored and controlled through the subsea control system on the FPSO via a steel umbilical. Subsea control system will accommodate typical monitoring requirements such as pressure and temperature	EIA Section 2.4.2

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	measurement.	
12	Key FPSO design features include the following: • The FPSO will be designed to remain moored for at least 20 years without dry-docking and will include facilities to support in-water hull/structural surveys and repair and maintenance. • The FPSO will be designed to operate in extreme (100-year return period) environmental conditions (associated wind, waves, and current).	EIA Section 2.5.1
13	A flare system will be provided for the collection and safe disposition of produced hydrocarbon gases resulting from unplanned, non-routine relief and blowdown events. Relief events occur to prevent overpressure scenarios in the process equipment. Blowdown events occur to depressure the facilities in a controlled manner as a result of emergency shutdown events.	EIA Section 2.5.4.3
14	The required power for the FPSO will be generated by three systems as follows: • The main power generation system will be gas turbine driven generator sets with spares available in the case of unplanned downtime. All generator sets will be dual fuel (diesel, produced gas) capable to allow for restoring power to the facility (i.e., black start). • The essential services power generation system will be a diesel driven generator set. Essential services include systems required for facility restart and for flow assurance hydrate mitigation activities after an unplanned shutdown. • The vessel emergency power generator set will be diesel driven and will provide power to both the hull and topsides emergency systems (e.g., safety systems including emergency lighting, telecommunication). Additionally, for back-up power during emergency situations, the uninterruptible power supply (UPS) system will be provided to power equipment such as the Integrated Control and Safety System (ICSS) and subsea controls, among others.	EIA Section 2.5.5
15	Monitoring and control of the FPSO production operations will be performed by an Integrated Control and Safety System (ICSS). Located in the main control room of the FPSO, the ICSS will include process shutdown, emergency shutdown, and fire and gas systems to protect the facilities and personnel. These systems will interface to a public address and general alarm system (PA/GA) to provide distinct audible and visual alarm notification. The ICSS includes the Process Control System (PCS), Safety Instrumented System (SIS), the Fire and Gas (F&G) system, the Alarm Management System (AMS), the Operator graphics / consoles; and the third-party interfaces to packaged systems (such as compressors, subsea, and marine, among others).	EIA Section 2.5.6
16	Telecommunications equipment will be installed on the FPSO to enable safe operation of the facilities in normal and emergency conditions. This equipment will allow communication with the shorebase, support vessels, helicopters, and tankers as well as communication on the FPSO.	EIA Section 2.5.7
17	The FPSO cargo tanks will be blanketed with inert gas. As depicted on Figure 2-15, a tank vent system will be provided to release vapor and inert gas from the cargo tanks to a safe location, toward the bow of the FPSO, to prevent an overpressure event in the tanks.	EIA Section 2.5.8.1
18	The marine cargo system supports the following routine activities:	EIA Section 2.5.8.1

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	• Flushing of the crude oil offloading export hose; • Emergency and temporary ballasting of FPSO cargo tanks with seawater; and • Inspection and maintenance of FPSO cargo tanks and piping systems between offloading operations.	
19	FPSO safety systems will include: • Firewater System – The firewater system will have one pump each located at the fore and aft ends of the FPSO, with one pump serving as a redundant backup. • Fire and Gas Detection Systems – Fire and smoke detectors will be located throughout the topsides and living quarters and will be wired centrally with alarms sounding in the central control room (CCR), which will activate the general alarm system on the FPSO. Gas detectors will be placed in areas where gas might be released or could accumulate. • Blanket Gas Generation – To prevent fires, the cargo tanks will be operated with an inert gas blanket at all times except during tank entry. The inert gas for cargo tanks will be supplied by an inert gas system utilizing flue gas from the marine boilers. To provide gas blanketing for other spaces, including the methanol and xylene tanks, inert gas will be provided by routing compressed air through the nitrogen membrane package.	EIA Section 2.5.9
20	• Production, water injection, and gas injection flowlines and risers will be cleaned and tested to verify and ensure integrity after installation, and then staged on the seafloor until arrival of the FPSO. • Manifolds, manifold foundation piles, jumpers, Subsea Distribution Units, and flying leads at the drill centers will be integrity tested and verified following installation. • The connected, integrated FPSO and SURF production systems will be tested and commissioned, including testing and de-watering / displacing flowlines and umbilicals with commissioning fluids, and testing SURF control and shutdown systems.	EIA Section 2.6
21	Throughout production operations, EEPGL's personnel will perform oversight and monitoring of the FPSO contractor to ensure that management systems pertinent to safety, the environment, and operations integrity are properly implemented. To accomplish this, EEPGL plans to utilize an onboard representative (OBR) supported by operational and technical specialists to monitor, and direct as necessary, operation of the FPSO and SURF facilities.	EIA Section 2.7
22	Internal corrosion of the subsea facilities shall be managed by a combination of material selection and injection of inhibitor. Components in the production path upstream of the flowlines will be fabricated from corrosion-resistant alloys suitable for the intended service. The carbon steel flowlines and risers will be protected by the injection of corrosion inhibitor at the subsea production manifold headers.	EIA Section 2.7.1.4
23	For decommissioning phase, all risers, pipelines, umbilicals, subsea equipment, and topside equipment will be safely and properly isolated, de-energized, and cleaned to remove hydrocarbons and other hazardous materials to a suitable level prior to being taken out of service. Wells will be permanently plugged and abandoned (P&A) by restoring suitable cap rock to prevent escape of hydrocarbons to the environment. P&A barriers will be installed in the wellbore, of adequate length to contain reservoir fluids and deep enough to resist being bypassed by fracturing.	EIA Section 2.9
24	All chemicals will be stored, either at the shorebase(s) or on the drill ship or FPSO, in appropriate storage containers with either secondary containment or appropriate drainage control.	EIA Section 2.10.1

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
25	With respect to prevention of spills of hydrocarbons and chemicals during the drilling stage: • Change liquid hydrocarbon transfer hoses periodically; • Utilize dry-break connections on liquid hydrocarbon bulk transfer hoses; • Utilize a liquid hydrocarbon checklist before bulk transfers; • Perform required inspections and testing of equipment prior to deployment/installation; • Utilize certified Blowout Prevention (BOP) equipment; • Regularly test certified BOP equipment and other spill prevention equipment; • Utilize overbalanced drilling fluids to control wells while drilling; • Perform operational training certification (including well control training) for drill ship supervisors and engineers; • Regularly audit field operations on the drill ships, FPSO, and shorebase(s) to ensure application of designed safeguards; and • Controls for mitigating a failure of the dynamic positioning system on the drill ships and maintain station keeping, which include: – Use of a Class 3 Dynamic Positioning (DP) system, which includes numerous redundancies; – Rigorous personnel qualifications and training; – Seatrials and acceptance criteria; – Continuous DP proving trials; – System Failure Mode and Effects Analysis; – Continuous DP failure consequence analysis; and – Establishment of well-specific operations guidelines.	EIA Table 2-7 and Table 11-1
26	Maintain marine safety exclusion zones with a 500 m (~1,640 ft) radius around drill ships and major installation vessels to prevent unauthorized vessels from entering potentially hazardous areas.	EIA Figure 2-2, Section 2.73, Figure 2-17, Table 2-7, and Table 11-1
27	Utilize a Mooring Master from the FPSO located onboard the offloading tanker to support safe tanker approach/departure and offloading operations.	EIA Table 2-7 and Table 11-1
28	Utilize support tugs to aid tankers in maintaining station during approach/departure from FPSO and during offloading operations.	EIA Table 2-7 and Table 11-1
29	Utilize a hawser with a quick release mechanism to moor the FPSO to the tanker at a safe separation distance during offloading operations.	EIA Table 2-7 and Table 11-1
30	FPSO offloading to tankers will occur within an environmental operating limit that is established to ensure safe operations. In the event that adverse weather occurs during offloading operations that is beyond the environmental operating limit the tanker will cease the offloading operations, and may disconnect and safely maneuver away from the FPSO as appropriate.	EIA Table 2-7 and Table 11-1
31	Utilize a marine bonded, double-carcass floating hose system certified by Class or other certifying agency that complies with the	EIA Table 2-7 and

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	recommendations of OCIMF Guide to Manufacturing and Purchasing Hoses for Offshore Moorings (GMPHOM) 2009 Edition or later.	Table 11-1
32	Utilize breakaway couplers on offloading hose that would stop the flow of oil from FPSO during an emergency disconnect scenario.	EIA Table 2-7 and Table 11-1
33	Utilize a load monitoring system in the FPSO control room to support FPSO offloading.	EIA Table 2-7 and Table 11-1
34	Utilize leak detection controls during FPSO offloading which include: • Leak detection for breach of the floating hose that complies with the recommendations of OCIMF GMPHOM 2009 Edition or later; • Utilization of instrumentation/procedures to perform volumetric checks during offloading.	EIA Table 2-7 and Table 11-1
35	Utilize marine safety exclusion zone of 2 nautical miles around the FPSO to prevent unauthorized vessels from entering potentially hazardous areas.	EIA Figure 2-2, Section 2.73, Figure 2-17, Table 2-7, and Table 11-1
36	Regularly inspect and service shorebase cranes and construction equipment in order to mitigate the potential for spills and to maintain air emissions at optimal levels.	EIA Table 2-7 and Table 11-1
37	Utilize secondary containment for bulk fuel storage, drilling fluids, and hazardous materials, where practical.	EIA Table 2-7 and Table 11-1
38	Regularly check pipes, storage tanks, and other equipment associated with storage or transfer of hydrocarbons/chemicals for leaks.	EIA Table 2-7 and Table 11-1
39	Perform regular audits of field operations on the drill ship, FPSO, and shorebase to ensure application of designed safeguards.	EIA Table 2-7 and Table 11-1
40	Observe standard international and local navigation procedures in and around the Georgetown Harbour and Demerara River, as well as best ship-keeping and navigation practices while at sea.	EIA Table 2-7 and Table 11-1
41	Maintain an OSRP to ensure an effective response to an oil spill, including maintaining the equipment and other resources specified in the OSRP and conducting periodic training and drills.	EIA Table 2-7 and Table 11-1
42	EEPGL is using the most appropriate industry-proven technology in developing the Project in terms of well drilling, drilling fluids, equipment selection, development concepts, and environmental management.	EIA Section 2.16.3
43	Adhere to the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, which confirms the right of coastal member states to take specific actions when necessary to prevent pollution from oil following a maritime casualty. This convention would protect Guyana's rights to respond to an oil spill if such an event were to occur.	EIA Table 3-2
44	Adhere to the International Convention on Civil Liability for Oil Pollution Damage, which establishes vessel owners' liability for	EIA Table 3-2

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	damages caused by pollution from oil spills and provides for compensation would be available where oil pollution damage was caused by maritime casualties involving oil tankers. This convention would not apply directly to EEPGL's activities, but would apply to potential spills from tankers that had received oil from the FPSO.	
45	Adhere to the International Convention on Oil Pollution Preparedness, Response and Cooperation, which establishes measures for dealing with marine oil pollution incidents. This convention requires ships to have a shipboard oil pollution emergency plan.	EIA Table 3-2
46	The Company and its affiliates (including EEPGL) are committed to conducting business in a manner that is compatible with the environmental and economic needs of the communities in which it operates, and that protects the safety, security, and health of its employees, those involved with its operations, its customers, and the public. These commitments are documented in its Safety, Security, Health, Environmental, and Product Safety policies. These policies are put into practice through a disciplined management framework called OIMS. EEPGL's OIMS Framework establishes common expectations used by Company affiliates worldwide for addressing risks inherent in its business. The term Operations Integrity (OI) is used to address all aspects of its business that can impact personnel and process safety, security, health, and environmental performance. Application of the OIMS Framework is required across all Company affiliates, with particular emphasis on design, construction, and operations. Management is responsible for ensuring that management systems that satisfy the OIMS Framework are in place. Implementation will be consistent with the risks associated with the business activities being planned and performed.	EIA Section 3.4
47	The interaction between the EIA team and the design and decision-making process was one of the key areas in which the EIA influenced how the Project would be developed. It included involvement in defining the Project and identifying those activities with the potential to cause physical, biological, or socioeconomic impacts. Project planning, decision making, and refinement of the Project description continued throughout the assessment process in view of identified impacts and proposed mitigation measures. During the EIA process, there was extensive communication between the impact assessment team and the Project design team with regard to identifying alternatives, potential impacts, and mitigation measures.	EIA Section 4.4
48	Hydrocarbon releases under Scenarios 1 through 4 (per EIA Table 7-82) would all be small and under control quickly, and would be managed with locally available spill control equipment.	EIA Section 7.4.1.1
49	A hydrocarbon release under Scenario 6 (per EIA Table 7-82) would be quickly controlled and contained because of the relatively small volumes and the ready access to spill control equipment.	EIA Section 7.4.1.1
50	Oil spill modeling and coastal sensitivity mapping have been conducted to identify and characterize the resources/receptors with the potential to be exposed to oil.	EIA Section 7.4.1.1
51	Oil spill modeling was used to simulate spill events using the best available characterization of the wind and hydrodynamic (marine currents) forces that drive oil transport, and quantify the potential consequences from a spill, which can then be used to guide response planning and prioritize response asset deployment.	EIA Section 7.4.1.4
52	Coastal sensitivity mapping was conducted for the entire coastal area identified in the oil spill modeling as being potentially exposed to hydrocarbons as a result of a Tier III Marine Oil Spill (Scenario 9). The mapping included the following resources and receptors:	EIA Section 7.4.1.6

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	• Environmental – protected areas, wetlands, mangroves, beach types, seagrass beds, coral reefs, and other sensitive habitats; and • Socioeconomic – coastal and/or indigenous peoples communities (e.g., location and socioeconomic characteristics), coast-dependent commercial and artisanal activities (e.g., fishing, foraging), other industrial activities, and infrastructure (e.g., water intake facilities). This information enables EEPGL to prioritize the mobilization of emergency response resources (manpower and equipment) to those areas most sensitive to a spill. These maps are included in the OSRP.	
53	Regarding spill prevention controls associated with Scenario 9 (well control release), EEPGL's well control philosophy is focused on spill prevention using safety and risk management systems, management of change procedures, global standards, and trained experienced personnel. EEPGL has a mature OIMS that emphasizes attention to safety, well control, and environmental protection. Measures to avoid any loss of well control include proper preparation for wells (well design, well control equipment inspection and testing), automatic detecting of the influx of reservoir fluids entering the well during drilling, the use of physical barriers including automatic BOPs, personnel training and proficiency drills for well control, and the use of drilling fluids to control pressures within the well.	EIA Section 7.4.1.7
54	Regarding spill prevention controls associated with Scenario 8 (FPSO offloading spill), the major spill prevention controls associated with FPSO offloading include: FPSO and tanker collision avoidance controls described in Section 7.1.4.8; use of a certified engineered floating double carcass hose system; use of emergency disconnect controls on the floating double carcass hose system; use of load monitoring systems in FPSO control room; and use of leak detection controls including infrared leak detection, flood lighting for night operations, and volumetric checks during offloading.	EIA Section 7.4.1.7
55	EEPGL also has developed a detailed Oil Spill Response Plan (OSRP), which is included in the Project's ESMP, to ensure an effective response to an oil spill, if one were to occur. The OSRP: • Describes the response measures which are dependent on the magnitude and complexity of the spill; • Clearly delineates the responsibilities of each entity that would take part in a response; • Describes how EEPGL and its contractors would mobilize local oil spill response resources, which would be complemented by the regional and international resources provided by its oil spill response contractors; and • Describes the EEPGL process for notifying the government of Guyana with respect to mobilizing its resources.	EIA Section 7.4.1.7
56	During offloading of crude oil for export, the offloading tanker must approach at a controlled, safe speed within about 120 m (~390 ft) of the FPSO. To minimize the risk of collision during the approach to the FPSO and during offloading, EEPGL will utilize a Mooring Master onboard the offloading tanker. The Mooring Master will guide the offloading tanker to the FPSO for offloading, remain on board during offloading, and then guide the offloading tanker away from the FPSO upon completion of offloading. Up to three assistance tugs will assist in positioning the offloading tanker during the approach to the FPSO to maintain a safe separation from the FPSO. During offloading, these tugs along with a hawser (taunt line connecting the FPSO and tanker) will help ensure the offloading tanker maintains a safe distance from the FPSO at all times (see Figure 2-17). Offloading will only occur when weather and sea conditions allow for safe operations. If the environmental conditions prior to the commencement of offloading are not suitable, the tanker will standby at a safe distance away until conditions are within acceptable limits. If unexpected adverse weather	EIA Section 7.4.1.8

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	(e.g., a squall) occurs during offloading operations, the offloading operation will be stopped, and the tanker disconnected and moved away from the FPSO until conditions are again within approved safe limits.	
57	A number of controls will be implemented to prevent collision near shore between a Project supply vessel and another (non-Project) vessel or structure (e.g., due to navigation error or temporary loss of power). EEPGL has comprehensive contractor selection guidelines to ensure contractors are qualified and have robust safety, health, and environmental management systems. EEPGL will provide active oversight over its contractors to verify they are complying with its requirements. Contractors are required to perform regular inspections of their vessels which address marine safety and maintenance considerations, which should reduce the risk of loss of power incident scenario. In addition, vessels operating within the Georgetown Harbour or other coastal areas will be adhering to speed restrictions and navigation aids.	EIA Section 7.4.1.8
58	EEPGL will utilize a Simultaneous Operations procedure to safely manage Project marine vessels which are performing work in the same vicinity of each other, which will include considerations to avoid vessel collisions.	EIA Section 7.4.1.8
59	Marine vessels will have industry proven station-keeping systems (e.g., FPSO mooring system, dynamic position systems on drill ship, support vessels) to maintain station in the offshore environment.	EIA Section 7.4.1.8
60	A Wildlife Response Program would be established at the onset of an oil release from a large Marine Oil Spill to minimize impacts on ecological balance and ecosystems.	EIA Section 7.4.3.9
61	The coastal sensitivity mapping that supports the OSRP includes mangroves as a sensitive coastal resource and in the unlikely event of an oil spill; EEPGL will deploy emergency response equipment to protect these sensitive resources, as appropriate.	EIA Section 7.4.4.1
62	A claims process would be established at the onset of a large Marine Oil Spill incident to compensate for loss of sustenance and income (e.g., fisherfolk for loss of harvest due to regional fisheries closures) that were attributed to the oil spill.	EIA Section 7.4.4.1, Section 7.4.4.7, Section 7.4.4.8
63	Implementation of the OSRP would help minimize transboundary impacts just as it would minimize impacts within the Guyana EEZ. EEPGL will work with representatives for the respective countries to be prepared for the unlikely event of a spill by: • Establishing operations and communication protocols between different command posts. • Creating a transboundary workgroup to manage waste from a product release – including identifying waste-handling locations in the impacted region and managing commercial and legal issues. • Identifying places of refuge in the impacted region where vessels experiencing mechanical issues could go for repairs and assistance. • Determining how EEPGL and the impacted regional stakeholders can work together to allow equipment and personnel to move to assist in a spill response outside the Guyana EEZ. • Assigning or accepting financial liability and establishing a claims process during a response to a transboundary event. • Informing local communities regarding response planning.	EIA Section 7.4.5
64	Implement an ESMP, which describes the measures EEPGL will implement to manage the Project's potential environmental and	EIA Chapter 9.0 and

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	socioeconomic risks and reduce impacts to the environment and communities.	attached ESMP
65	EEPGL will perform regular oil spill response drills, simulations, and exercises, document the availability of appropriate response equipment on board the FPSO, and demonstrate that offsite equipment could be mobilized for a timely response.	EIA Chapter 11.0
66	The Project will issue Notices to Mariners via MARAD, the Trawler's Association, and fishing co-ops for movements of major marine vessels (including the FPSO, drill ship, and installation vessels) to aid them in avoiding areas with concentrations of Project vessels and/or where marine safety exclusion zones are active.	EIA Table 11-2
67	Augment ongoing stakeholder engagement process to identify commercial cargo, commercial fishing, and subsistence fishing vessel operators who might not ordinarily receive Notices to Mariners, and where possible communicate Project activities to those individuals to aid them in avoiding Project vessels.	EIA Table 11-2
68	Promptly remove damaged vessels (associated with any vessel incidents) to minimize impacts on marine use, transportation, and safety.	EIA Table 11-2
69	Implement the OSRP in the unlikely event of an oil spill, including: • Conduct air quality monitoring during emergency response; • Require use of appropriate PPE by response workers; • Implement a Wildlife Oil Response Program, as needed; and • Implement a claims process for damage caused by an oil spill, as needed.	EIA Table 11-2
70	EEPGL will proactively obtain additional support and resources to reduce the impact of a spill in the unlikely event it shows potential to exceed Tier I capabilities. The ERT will manage Tier I spill responses using the site-specific ERP and resources located on vessels and in port facilities in Guyana and Trinidad. Such resources as well as dispersant application from vessels will also be used for larger Tier II spills until supplemental OSR resources arrive on-scene. For incidents that may exceed Tier I capabilities, EEPGL would notify Oil Spill Response Ltd (OSRL) in Southampton, UK1 (Refer to forms in Appendices C.3 and C.4), to provide immediate incident management support as well as OSRL's global oil spill technical response teams and equipment.	OSRP Section 2.3
71	Given the limited resources in-country, company will consider setting up a cooperative with a regional OSRO (e.g., Trinidad) to support Tier 2+ oil spill response prior to offshore execution.	OSRP Section 2.3
72	The EEPGL OSRP is supported by the EEPGL Emergency Response Plan (ERP) which provides a structured and systematic process for responding to incidents, and outlines plans and procedures for engagement between the incident site, EEPGL, and ExxonMobil management and the relevant authorities in Guyana.	OSRP Section 2.3
73	EEPGL will initiate a systematic search with vessels and aircraft (weather permitting) to locate the spill and determine its coordinates. EEPGL will estimate spill size and movement using coordinates, photographs, drawings, and other information received from vessels, aircraft and satellite imagery. Spotters will photograph the spill from aircraft as often as necessary for operational purposes, and determine its movement based on existing reference points, such as vessels and familiar shoreline features. Modeling of the oil release may be utilized to predict the oil slick's surface movement or trajectory. Modeling will help to identify shorelines that may be	OSRP Section 3.5

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	at risk from oil stranding, predict the probable timing of that stranding, and provide information regarding how the oil is changing with time.	
74	In the event of a release, EEPGL and ExxonMobil technical experts will complete a revised NEBA in real-time predicated on the current metocean conditions, location and nature of the release for review and discussion withthe Guyana EPA and Civil Defense Commission (CDC) as soon as practical.	OSRP Section 5.1
75	During EEPGL's operations, the on-site Emergency Response Team (ERT) will endeavor to contain any spill at the source, whether it be onshore (shorebase or port) or onboard a vessel (i.e. PSV, FSV, installation, drillship, tug, tanker or FPSO) and minimize any impacts to the environment, using the equipment available at the worksite. In the event of an on-water release, EEPGL will ensure the required notifications are made, initial response actions are implemented and monitor the incident and consider all appropriate response strategies, including containment and recovery as well as dispersants to appropriately respond to the incident.	OSRP Section 5.1
76	If released oil is predicted to reach a shoreline, EEPGL will continue to leverage all available resources to stop the release at the source, utilizing provided containment, mechanical recovery, open burning, surface and subsurface dispersant application. EEPGL will also consider and evaluate shoreline protection measures (based on consultation with the appropriate government authorities) and outcomes from the NEBA to identify the combination of key response strategies that would be appropriate, given the specific situation, fate, and trajectory of the oil spill and weather conditions. Local regulatory approval and the ExxonMobil Oil Spill Dispersant Guidelines will govern the application of dispersants.	OSRP Section 5.1
77	EEPGL will use the Net Environment Benefit Analysis (NEBA) process as a key input to the overall Incident Response Planning. NEBA compares the impacts of available response options, and selects the option or combination of options that minimizes overall harm to environmental and socioeconomic resources. The use of NEBA will ensure that EEPGL selects the most appropriate response techniques available to minimize overall environmental impact based on the conditions and sensitivities of an actual incident.	OSRP Section 5.2
78	EEPGL will respond to a release as far offshore as possible, using all appropriate tools and tactics to minimize shoreline impact. In consultation with the Guyana EPA, EEPGL will develop Incident Response Plans that could respond with aerially applied dispersants, which can be quickly deployed and treat large surface areas rapidly and efficiently.	OSRP Section 5.3
79	The safety of responders also needs to be considered in the evaluation of response strategies. Response tactics depend upon a variety of environmental conditions. • Implement subsea dispersant application as soon as possible, if warranted, to treat most if not all oil spilled at the source before it encounters surface water resources; • Deploy in situ burning equipment to burn thick oil near the source; • Continue to use aerially applied dispersant as a primary response tool for oil further from the source where mechanical recovery/in situ burn operations are less effective; • Utilize aerial dispersant application during calm seas on emulsified oil; and • Outfit vessels of opportunity (VOO) with dispersant delivery and mechanical containment and recovery systems to provide a fleet	OSRP Section 5.3

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	of vessels that can be a line of defense against surface oil approaching shorelines. Shoreline protection and cleanup may be potentially needed for some scenarios, in which case, sensitive shorelines will receive prioritization for protective booming.	
80	In the event that there is an incident that impacts areas outside the Guyana Exclusive Economic Zone (EEZ), EEPGL will work with representatives for the respective locations to: • Coordinate operations and communication between different command posts; • Create a trans-boundary workgroup to manage waste from a product release – including pinpointing waste-handling locations in the impacted region and managing commercial and legal issues; • Identify places of refuge in the impacted region where vessels in mechanical trouble could go for repairs and assistance; • Determine how EEPGL and the impacted regional stakeholders can work together to allow equipment and personnel to move to assist in a spill response outside the region while still retaining a core level of response readiness within the two jurisdictions; • Work with local communities within the impacted area to raise awareness of oil spill planning and preparations.	OSRP Section 5.4
81	Utilize surveillance and monitoring teams, which can fulfill the following response objectives: • Verify oil spill scale and location; • Monitor effectiveness of applied response strategies; • Visually quantify spill volume; • Direct operations – dispersant application, containment and recovery, shoreline assessment, in situ burning; and • Monitor wildlife.	OSRP Section 6.1
82	At a minimum, surveillance and monitoring personnel will take visual observations, and vessel owners/operators will implement their ER/SOPEP's, deploying the Tier I response equipment they have onboard.	OSRP Section 6.1
83	For Tier II or Tier III incidents EEPGL will scale up to a full surveillance plan using helicopters, fixed wing aircraft and satellite imagery.	OSRP Section 6.1
84	The IMT will assign an Air Operations Branch as part of the Operations Section for large or complex incidents. The Air Operations Branch will coordinate aerial support according to operational needs and document operational assignments in an ICS-220 Air Operations Summary form, which will be included in the Incident Action Plan (IAP).	OSRP Section 6.1
85	To assist the natural dispersion process techniques such as prop washing or water hoses can be implemented to introduce energy and agitate the hydrocarbons, thereby assisting with the break up of a surface slick and promoting biodegradation.	OSRP Section 6.2
86	For operational spills: • Shorebases in Guyana and Trinidad have site specific ER Plans and are equipped with Tier I spill response kits; • Vessels maintain a Shipboard Oil Pollution Emergency Plan (SOPEP) and associated equipment onboard the vessel.	OSRP Section 6.3
87	EEPGL will use harbor containment and recovery should a PSV or FSV release hydrocarbons in Port. The harbor response team will employ a strategy that considers tides, currents, wind, vessel traffic, and local infrastructure and stakeholder input. EEPGL will	OSRP Section 6.4.1

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	deploy equipment available on site and in the Port (such as or similar to the equipment and trained personnel at the Guyana Fuel Terminals and resources held by NRC for Trinidad) immediately following a release.	
88	EEPGL will implement a shoreline response if released hydrocarbons show the potential to affect a shoreline, prioritizing environmentally or socio-economically sensitive areas (ESAs). This will consist of using vessel dispersant application to prevent approaching slicks from impacting ESAs and using shoreline booming to protect sensitive areas and provide collection points for hydrocarbon recovery.	OSRP Section 6.4.2
89	EEPGL will only apply dispersants if there is a direct advantage to protecting environmental or socio-economical sensitivities (determined using NEBA, Section 5.2, Appendix G) and they have obtained regulatory approval.	OSRP Section 6.5
90	Vessel mounted systems will be used to apply dispersant in small-scale incidents and aircraft will apply dispersant on large oil slicks. Dispersant (and associated vessel spray equipment) will be kept at the shorebase or other easily accessible location where it can be easily loaded on vessels for application. OSRL will conduct aerial dispersant application and will likely base the operation out of the Georgetown airport. In the unlikely event of a well blowout, dispersant is injected subsea at the wellhead location on the seafloor using specialized equipment and Remotely Operated Vehicles (ROVs).	OSRP Section 6.5
91	EEPGL is using the OSRP as the instrument for pre-approval to use dispersants. Requesting approval at the time of an incident delays the response, potentially increasing environmental damage.	OSRP Section 6.5
92	EEPGL will use the Dispersant Spraying Considerations Flowchart (OSRP Appendix B) as a guide for whether to use dispersants. Dispersant will be applied according to manufacturers' guidelines and the operating procedures of the spray applicators. EEPGL will work with the EPA to develop a dispersant application, monitoring and evaluation strategy.	OSRP Section 6.5
93	EEPGL will source Vessels of Opportunity (VOOs) to provide platforms for the containment and recovery systems.	OSRP Section 6.6
94	A Wildlife Response Plan (WRP) specific to Guyana has been developed and provided as Appendix E to the OSRP to allow for a timely, coordinated and effective protection, rescue, and rehabilitation of wildlife to minimize any negative impacts of a spill. Should a wildlife response be required, EEPGL will call upon the Sea Alarm Foundation via OSRL to provide specialist advice and assistance with carrying out a response.	OSRP Section 6.7
95	EEPGL is may use in situ burning for large-scale Tier III incidents. OSRL will provide the resources required.	OSRP Section 6.8
96	EEPGL will manage hazardous waste resulting from clean-up activities and ensure appropriate disposal.	OSRP Section 6.9
97	The Tanker Owner/Operator will implement an ERP should any spill occur during tanker offloading and the FPSO ERP will have similar details on the surface and subsea response for a spill from either the FPSO, during tanker offloading or SURF (Subsea umbilical, riser, flowline) equipment during production operations.	OSRP Section 6.10
98	If a Tier III well control incident occurs involving the release of wellbore fluids into the sea, EEPGL will perform a site survey, conduct debris removal operations (as required), evaluate and execute well intervention options, install subsea dispersant application hardware, and mobilize and install a capping device/auxiliary equipment as required. If a relief well is required, it will be drilled to	OSRP Section 6.10

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	intersect the original well and address specific issues encountered in the original wellbore.	
99	EEGP will utilize OSRL's Subsea Well Intervention Service (SWIS), which provides access to a Subsea Incident Response Toolkit (SIRT), Global Dispersant Stockpile (GDS) and multiple Capping Stack Systems (CSS). The CSS and SIRT includes equipment that can be mobilized directly to the well site: • Survey & debris clearance equipment; • Intervention equipment; • Dispersant hardware application system*; and • Capping stack systems and auxiliary equipment. *Dispersant will be mobilized simultaneously through the OSRL GDS service via the EEPGL IMT. For detailed information on the implementation of a subsea response, refer to the Drilling ERP.	OSRP Section 6.10
100	In the event of a spill, an incident-specific Decontamination Plan will be developed by EEPGL relevant with the nature and extent of the spill to prevent further oiling through secondary contamination.	OSRP Section 6.11
101	The Tier I equipment held at EEPGL's onshore and offshore operations, including shorebases, fueling terminal, support vessels, drill ship, tankers and FPSO will be available for rapid deployment in the event of an incident.	OSRP Section 7.1.1
102	Equipment and trained personnel are available through the terminals and shorebases to initiate an onshore/nearshore response to a Tier II incident. Vessel dispersant spray operations will be initiated from the PSVs and supported from the shorebases or other accessible locations as needed to supplement other Tier II response actions.	OSRP Section 7.2
103	The RRT can be partially or fully activated, and includes trained individuals and specialists, with assigned roles and responsibilities, who can be deployed at short notice to address a broad range of emergency situations.	OSRP Section 7.3.1
104	EEPGL is a Participant member with OSRL, and therefore has immediate access to Tier III technical advice, resources and expertise 365 days a year on a 24 hour basis.	OSRP Section 7.3.2
105	EEPGL has access to the Global Dispersant Stockpile (GDS), which is an additional 5,000 m^3 of dispersant located across the OSRL bases and in France.	OSRP Section 7.3.3
106	EEPGL has access to the OSRL Subsea Well Intervention Service (SWIS), Oceaneering, Wild Well Control, Trendsetter Engineering and Halliburton Boots & Coots Services for subsea well response. SWIS holds and maintains four CSSs and two SIRTS globally: • 15k PSI Subsea Well Capping Stack – Norway and Brazil; • 10k PSI Subsea Well Capping Stack – South Africa and Singapore; • Subsea Incident Response Toolkit – Norway and Brazil.	OSRP Section 7.3.4
107	EEPGL conducts oil spill training courses and exercises (desktop and in-field) for operations offshore Guyana. The training, drills, and exercises familiarize response personnel with their duties and responsibilities in an oil spill.	OSRP Section 8.0
108	EEPGL ERT and IMT members, which includes the Regional Response Team, will receive oil spill response training listed in the	OSRP Section 8.1

#	Embedded Control / Spill Prevention Measure	Reference in EIA / ESMP / OSRP
	OSRP Table 10 (or equivalent training such as XOM ICS 100/200 CBT and University of Spill Management) based on their response position.	and Table 10
109	ERT and IMT members will receive appropriate Incident Command System (ICS) Training listed in OSRP Table 11 based on their roles and responsibilities.	OSRP Section 8.2 and Table 11
110	EEPGL will conduct oil spill response exercises to test incident response personnel function and responsibilities, in line with OSRP Table 12.	OSRP Section 8.3 and Table 12
111	EEPGL will implement a Wildlife Response Plan as a supplement to the OSRP to serve as general guidance for wildlife deterrence (hazing), capture, and rehabilitation during an oil spill response.	Wildlife Response Plan Section 1.

Appendix G OIL SPILL SCENARIOS AND NET ENVIRONMENTAL BENEFIT ANALYSIS (NEBA) FOR SELECTION OF RESPONSE TECHNOLOGIES

The principal objective of oil spill response is the collection of the maximum amount of oil or the elimination of oil in order to prevent its approach to the coast and subsequent stranding on the shoreline. In case of large spills of oil, the use of all available resources for oil spill response (OSR), including dispersants, is recommended. The decision to use dispersants may utilize a NEBA. This is an analysis based upon results of modeling of the spilled oil behavior on water and the efficiency of various response technologies as well as information about the oil's environmental impact. The analysis can determine the combination of response technologies that can best prevent stranding of oil on shorelines.

Data obtained in the course of the NEBA are used to develop recommendations for the use of available response technologies. In order to conduct the modeling, various scenarios of potential oil spill on facilities are utilized. These scenarios are selected from the possible releases that represent the risk of spills from a project.

Oil Spill Scenarios

During the development of oil spill scenarios and response measures, the following input data are taken into account:

- Locations of potential oil spills and volumes of the spills determined on the basis of the project's risks.
- Hydrodynamic and meteorological conditions that best represent the region and conditions under which the spills take place.
- Information on OSR technologies, the resources available, their performance parameters, and timing to implement them.

Spill Sources and Volumes

Oil spill scenarios were for this NEBA were developed for the following releases:

- A Tier III crude release from loss of well control at the FPSO – 20,000 BBL/day, for two seasons
- A Tier II crude release at the FPSO resulting from a loading hose malfunction – 2500 BBL, for two seasons

This approach ensures that the NEBA results would also be applicable to any potential smaller spills. The duration of the Tier III well control release at the FPSO was 30 days for Monitor and Observe (Unmitigated) analysis, and 21 days for the Full Response (Mitigated) analysis. The Response analysis considered the shut-in of the well at 21 days. The model runs for the Tier III analysis was 45 days. The duration of the release for the Tier II loading hose malfunction was less than 1 hour and the model was run for 8 days.

Seasons of the Year and Met Ocean Conditions

A technical report commissioned by ExxonMobil Upstream Research Company (Berek, et al., 2015) describes the results of an analysis of the regional wind time series data and characterizes the prevailing winds offshore Guyana:

- Winter – Winds from the east-northeast during the months December through May
- Summer – Winds from the and east during the months June through November

Wind data used in the oil spill model simulations were taken from two global models, NOGAPS and NAVGEM. These global models define wind speed and direction time series over the region. Data from the two models cover the same 10-year period as the hydrodynamics (2005-2014).

The hydrodynamics or currents in the upper water column off the Guyana coast are strong and flow towards the northwest along the coast of South America over the entire year. The Guiana Current is part of the regional flow between South America, Africa and the Caribbean Sea, extending from Guyana to the Caribbean. Current data produced by the SAT-OCEAN model covering the area around the Stabroek block were used in combination with currents extracted from the U.S. Navy HYCOM global hind cast model as inputs to the spill simulations.

Oil Spill Response Resources and Limitations on Their Use

The following oil spill response technologies were studied:

- Monitor and Observe – This unmitigated spill has no active OSR measures beyond the organization of monitoring;
- Full Response – The mitigated response represents joint in-situ burning, mechanical recovery of oil, the use of dispersants, and installation of a capping stack.

EEPGL has various oil-recovery and response devices and watercraft at its disposal for use in recovering and removing spilled oil from the sea surface. This equipment is maintained and provided to EEPGL upon demand for spill response by Oil Spill Response Limited (OSRL). OSRL is a world-wide provider of response equipment funded by the oil industry. In addition, OSRL also has a supply of oil dispersants and the appropriate equipment needed for application at the water surface by vessels and aircraft, and for subsea application at the well head. A list of the oil spill response resources used in the modeling simulations is presented below. This equipment list excludes any equipment intended for onshore or on land response, as this NEBA effort is only focused on offshore spill response only.

Table G1: Equipment Used during Modeled OSR Operations

Location	Response type	Mechanical oil recovery and burning	Dispersant Application
Downstream of FPSO	Oil Burning	Vessels-1 Project PSV and tug Vessels-2 Project PSV and tug Vessels-3 Project PSV and tug Vessels- 4 VOO* and other VOOs	
Water Surface Above Well	Dispersants		Project PSV

Location	Response type	Mechanical oil recovery and burning	Dispersant Application
Subsurface at Well Head	Dispersants		Project MPV
Downstream of FPSO	Aerial dispersant application		Boeing 727 – 1 Boeing 727 – 2
Downstream of FPSO	Mechanical Recovery	Vessels-1 VOO and other VOOs Vessels-2 VOO and other VOOs Vessels-3 VOO and other VOOs Vessels- 4 VOO and other VOOs	
Well Head	Capping Stack		

PSV – Project Support vessel
MPV - Multi-purpose vessel equipped with geo-locators and ROV
*VOO – Vessels of Opportunity

Information collected from modeling of Oil Spill Scenarios

The following information is collected to compare the results of the Monitor and Observe (Unmitigated) scenarios with the Full Response (Mitigated) scenarios:

- Shoreline area where oil has stranded (m^2)
- Volume of oil stranded on shorelines (BBL)
- Volume of oil dispersed by aircraft (BBL)
- Volume of oil burned (BBL)
- Volume of oil recovered mechanically (BBL)
- Volume of oil evaporated (BBL)
- Volume of oil remaining on the surface of the sea (BBL)

Modeling of the Behavior of Spilled Oil and Response Performance

Modeling of oil spills was performed with the aim of assessing the efficiency of various response technologies available to EEPGL via OSRL. The results of this assessment are the basis of the NEBA. The modeling was conducted by RPS ASA using the SIMAP model, developed for the purpose of predicting the impact and behavior of spilled oil. This model makes it possible to quantitatively study the changes that occur with spilled oil under the action of natural factors (spreading, evaporation, dispersion). The model also predicts the possible areas of oiling of the water and the oiling of the coastal zone. Finally, the model predicts the amount of oil removed using burning, mechanical recovery, and the amount of oil dispersed using dispersants. The reliability of the model was confirmed by comparing the results obtained from modeling to actual observed oil spill behavior during actual oil and oil product spills, a list of which is presented in Table G2.

Table G2: List of Spills Used to Validate the SIMAP Model

Spill source, name of ship	Spill mass, tonnes	Duration of spill (hours)	Type of oil	Date of spill	Ambient temperature, °C
American Trader	1317	1	Crude, Alaska	July 1980	15
Apex Houston	83	27	Crude, Alaska	January 1986	13
Puerto Rican	3473	1	Heavy fuel oil	November 1984	14
Command	11	1	Heavy fuel oil	September 1988	14
Cape Mohican	150	16	Medium viscosity fuel oil	October 1986	13
Arco Anchorage	830	4	Crude, Alaskan	December 1985	10
Bouchard Barge #155	1208	0.25	Heavy fuel oil	August 1980	30
Exxon Bayway	1837	3	No. 2 fuel oil	January 1980	8
Exxon Valdez	34800	10	Crude, Alaskan	March 1988	2
North Cape	2682	26	No. 2 fuel oil	January 1986	2
New Carissa	252	102	No. 6 and No. 2 fuel oils	February 1988	8
Buochard Barge #120	208	3	Heavy fuel oil	April 2003	7
Macondo	600,000	2064	Louisiana Light	April 2010	20

In preparing information for this NEBA, a number of potential oil spill scenarios (Table G3) have been analyzed. These scenarios characterize the conditions for hypothetically more severe scenarios in terms of oil spilled volumes. The selection of these scenarios with large volumes of spilled oil was dictated by the need for developing response measures that might be applied to any smaller spills.

For each release and wind regime, the effects of various response strategies were modeled for their predicted ability to treat oil on the water surface and subsequently reducing the amount of oil stranded on shore. The response strategies included the following: Monitor and Observe or no active mitigation, and Full Response or mitigation with the combined use of in-situ burning, mechanical recovery, dispersant application both at the surface and in subsurface waters, and the installation of a capping stack.

The modeling provides the ability to evaluate and compare response results for a variety of quantitative parameters: oil stranded on shorelines, oil remaining on the surface of the sea, oil burned and recovered mechanically, and dispersed into the water as a result of both natural factors and after dispersant application.

Table G3: List of Oil Spill Scenarios Analyzed

No.	Wind regime	Spill Source	Response options	Spill mass, BBL	Spill duration
1	Summer	Loading Hose	Monitor and Observe	2500	1 hour
2	Summer	Loading Hose	Burning, Dispersants, and Mechanical Recovery	2500	1 hour
3	Winter	Loading Hose	Monitor and Observe	2500	1 hour
4	Winter	Loading Hose	Burning, Dispersants, and Mechanical Recovery	2500	1 hour
5	Summer	Well Control Loss	Monitor and Observe	600,000	30 Days
6	Summer	Well Control Loss	Burning, Dispersants, and Mechanical Recovery	420,000	21 Days
7	Winter	Well Control Loss	Monitor and Observe	600,000	30 Days
8	Winter	Well Control Loss	Burning, Dispersants, and Mechanical Recovery	420,000	21 Days

For each set of scenarios, a comparison of predicted oil volumes was made for the following model parameters:

- Monitor and Observe – when no actions are taken to recover, remove, or disperse the oil, and it is broken down only by natural factors such as wind and waves;
- Full Response – Utilization of In-situ burning, mechanical recovery, the use of dispersants both at the water surface and in subsurface waters, and installation of a capping stack.

The SIMAP Model was used to determine the potential performance of response equipment used for in-situ burning, mechanical oil recovery, capping stack installation and dispersant application. The potential capacities were determined for the equipment deployed and these were taken into account in the modeling analysis. The environmental limits of the various types of equipment were used to account for conditions in which the equipment could not be operated safely or effectively.

Response Conditions and Limits

Mechanical oil recovery, surface application of dispersants with a vessel at the well site, aerial dispersant application, and subsurface dispersant application at the well head were simulated utilizing the capabilities presented in Tables G4 to G9. The timing of the initiation of those responses are presented in Table G10.

Table G4: Mechanical Recovery Parameters and Limitations

Mechanical Recovery
Vessel based recovery using boom and skimmer systems – VOO Based operations
4 vessels conduct oil collection
Recovery rates or skimmer ratings-200gpm
Maximum vessel speed 15 knots
Staffed with 2 crews
Daylight operations only
Winds < 20 Knots
Waves < 1.5 m
Boom swath width 50m
Temporary storage 25 m^3 (6,604.3 gal) per vessel system unloaded
Times for transit to offload and offload = 2 hours
No need to return to port nightly

Table G5: In-Situ Burning Parameters and Limitations

In-Situ Burning
Vessel based burning operations utilizing burn boom – Project vessels with VOO assist, 4 burning operations total
Maximum vessel speed 15 knots
Staffed with 2 crews
Daylight operations only
Oil weathering 24 to 72 hours
Emulsification <25% water
Burn location >3 NM from well head and populated areas
Winds < 20 Knots
Waves < 1.5 m
Currents – adjusted to < 1 knot with vessels and positioning
Boom swath width 50m
Assume 2 burns/day per vessel pair, 300 BBL/burn
No need to return to port daily

Table G6: Surface Dispersant Application Parameters and Limitations

Surface Dispersant Application
Vessel with spray arms – 1 Project vessel
Dispersant spraying of oil surfacing above well-head
Staffed with 2 crews
Vessel Dispersant Capacity – Restock offshore in evening
Maximum vessel speed 20 knots
Vessel Dispersant Application Speed – Average 5 knots
Unlimited dispersant access for daylight operations
Daylight operations only
No minimum sea state
No spraying above 35 mph wind speed
Spray arms are 6 m and attached to both sides of vessel
Desired dispersant to oil ratio (DOR) 20:1

Table G7: Aerial Dispersant Application Parameters and Limitations

Aerial Dispersant Application
Boeing 727 – 2 identical aircraft
15,000 L dispersant capacity
Cruising speed 930 kmh (577 mph)
Dispersant Application Speed- 150 mph
DOR 20:1
Based in Trinidad
Unlimited dispersant access
Staffed with 2 crews
Daylight operations only
No minimum sea state
No spraying above 35 mph wind-speed

Table G8: Wellhead Dispersant Parameters and Limitations

Wellhead Dispersant Injection
Coil tubing delivery at well head – Project Multi-purpose vessel equipped with geolocation system and a dedicated ROV.
No minimum or maximum operating limits, limits are defined by safe operating conditions.
No limitations from gas flux at the surface.
24/7 Operations
Staffed with 2 crews
Unlimited dispersant access
DOR determined with sensitivity analysis
Assume 100% of discharged oil is treated

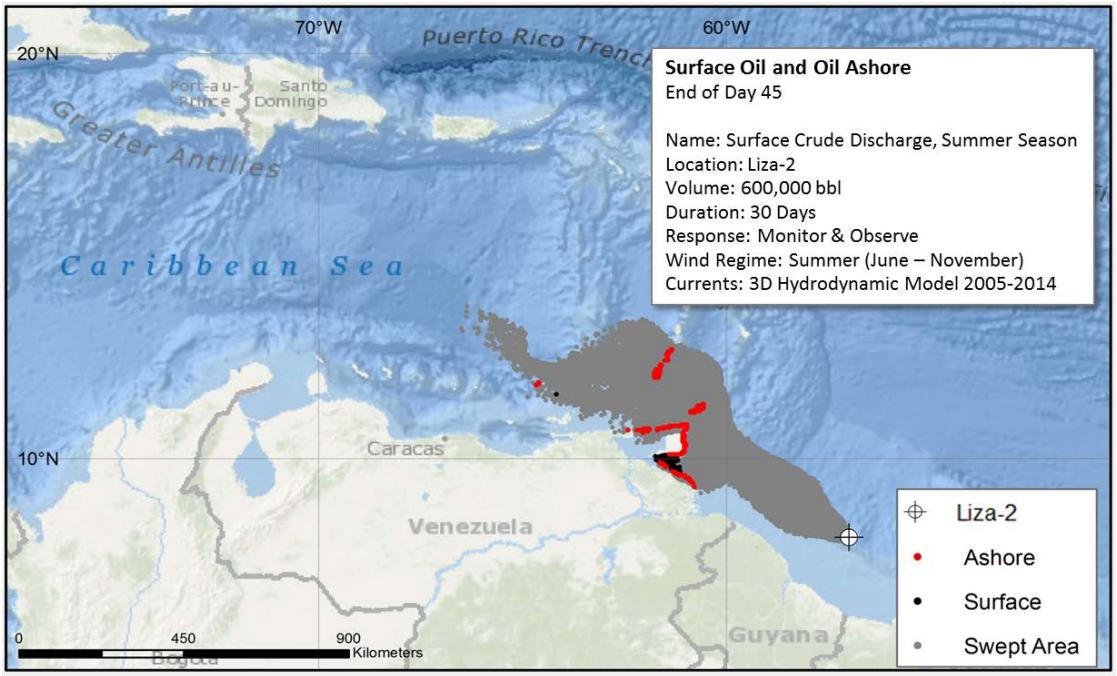
Table G9: Timing of Response Activities

	Day	1	2	3	4	5	6	7	10	12	14	21
Aircraft 1			x									
Aircraft 2					x							
Well-Head Dispersants							x					
Vessel with Spray Arms							x					
Burn Boat 1							x					
Burn Boat 2							x					
Burn Boat 3								x				
Burn Boat 4								x				
Mechanical Boat 1									x			
Mechanical Boat 2									x			
Mechanical Boat 3										x		
Mechanical Boat 4										x		
Capping Stack												x

Results of the NEBA Analysis

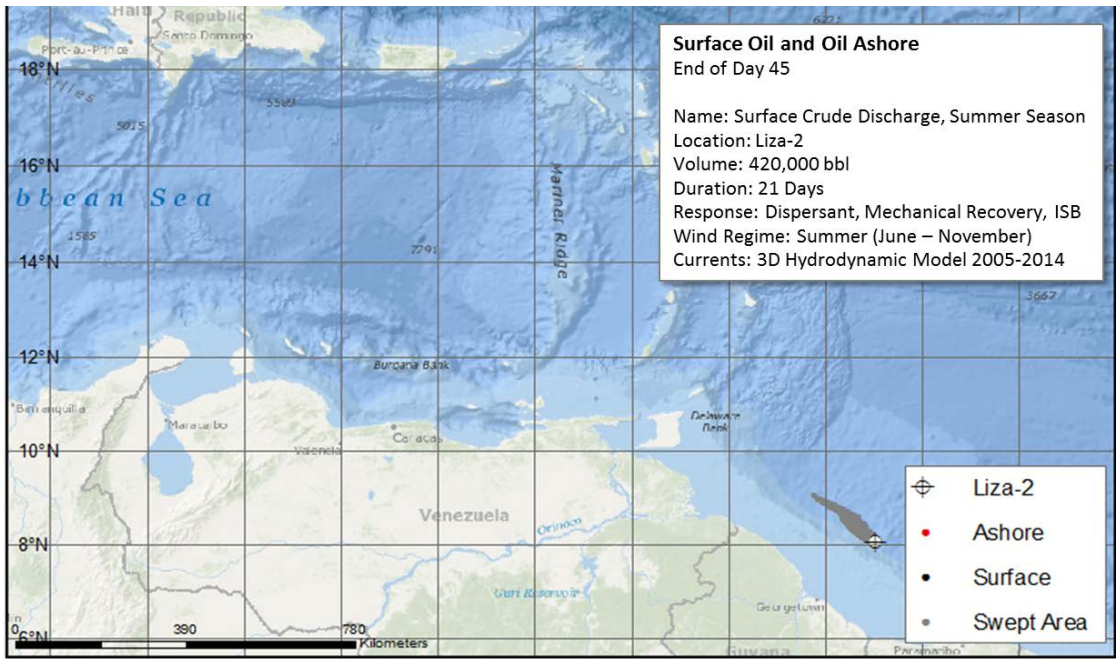
The results of the NEBA analyses has been presented in the following manner:

- Maps representing the releases as “unmitigated” or Monitor and Observe only without active oil spill response measure being implemented; followed by
- Map representing the releases with “mitigation” or a Full Response with all response activities being implemented jointly.
- These are then followed by summary tables, which show the difference between these model runs and associated performance parameters for both unmitigated and mitigated releases that were depicted in the maps earlier.



Areas colored gray show the sea surface area swept by oil. Red indicates where oil has stranded on the shoreline. Areas colored black show the presence of oil on the sea surface.

Figure G1: Model Predicted Unmitigated Oil at the End of a 45-day Simulation Originating at the Liza Well Site in the Summer Season



Areas colored gray show the sea surface area swept by oil. There is no shoreline oiling and no surface oil remains. ISB = in-situ burning.

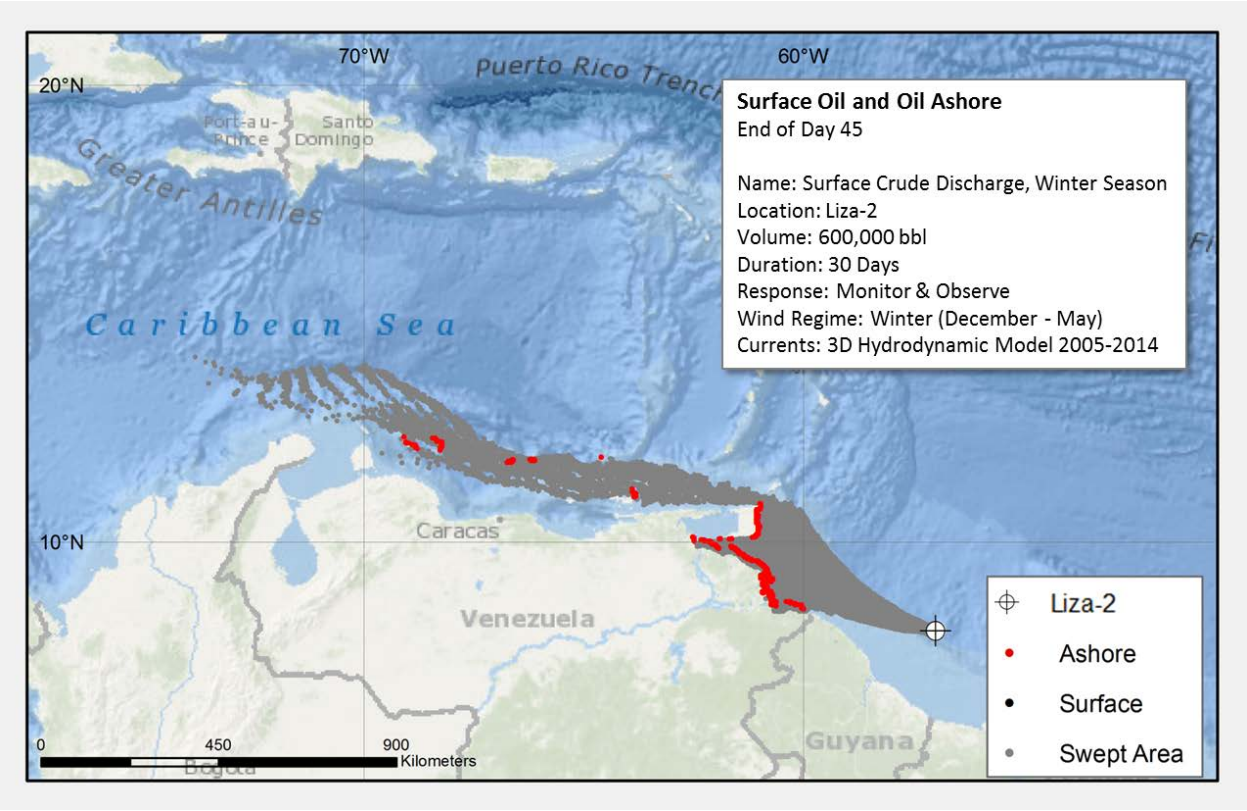
Figure G2: Model Predicted Mitigated Oil Surface Oil at the End of a 45-day Simulation Originating at the Liza Well Site in the Summer Season

Table G10: Comparison of Key Model Output Parameters for the Liza 20 KBD Summer Season Release for Mitigated (Full Response) and Unmitigated (Monitor and Observe)

	Monitor and Observe 600,000 bbl	Full Response* 420,000 bbl
Shoreline area oiled (m^2)	5,500,930	0
Oil washed ashore (bbl)	18,347	0
Oil in water column (bbl)	110,726	274,914**
Oil dispersed from vessels and aircraft (bbl)	0	61,989
Oil burned (bbl)	0	86
Oil mechanically recovered (bbl)	0	0
Oil biodegraded (bbl)		109,283
Oil evaporated (bbl)	354,530	35,719

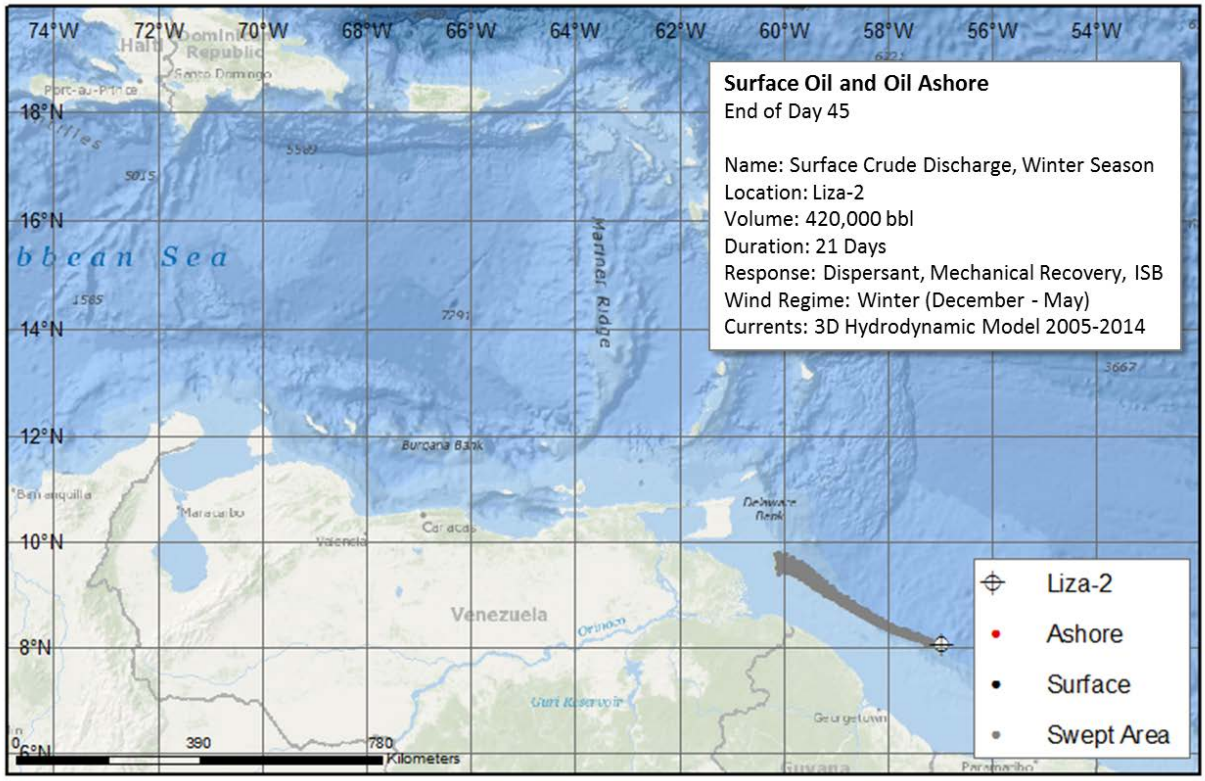
** Full Response includes installation of a capping stack on Day 21 that reduces volume*

*** Includes dispersant application at wellhead*



Areas colored gray show the sea surface area swept by oil. Red indicates where oil has stranded on the shoreline. Areas colored black show the presence of oil on the sea surface.

Figure G3: Model Predicted Unmitigated Oil at the End of a 45-day Simulation Originating at the Liza Well Site in the Winter Season



Areas colored gray show the sea surface area swept by oil. No shoreline oiling occurred and no surface oil remained.

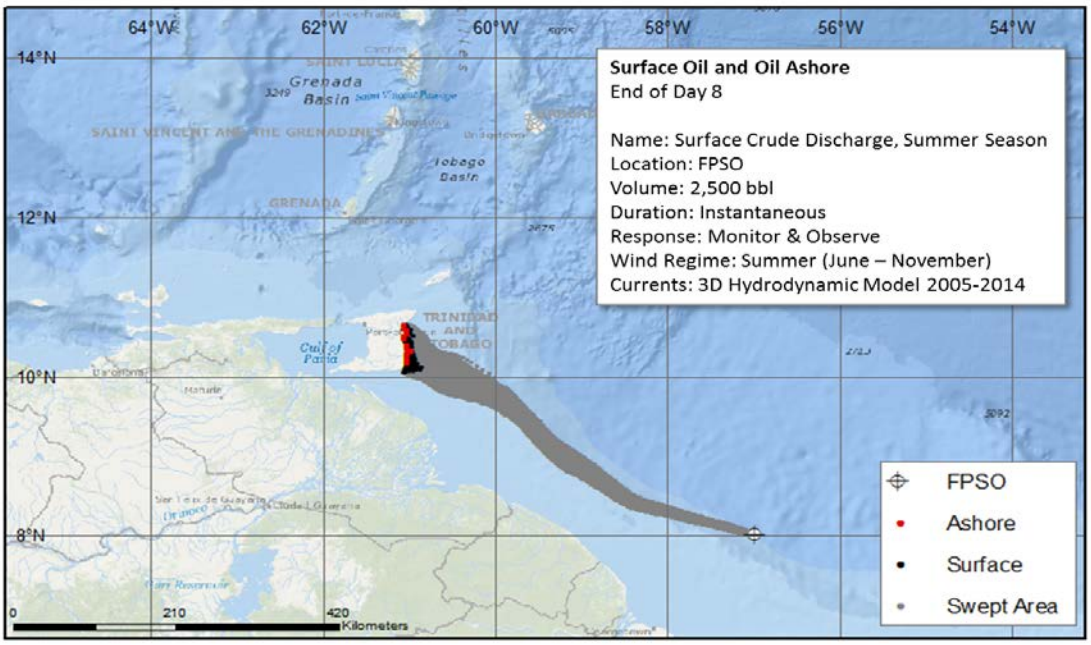
Figure G4: Model Predicted Mitigated Oil at the End of a 45-day Simulation Originating at the Liza Well Site in the Winter Season

Table G11: Comparison of Key Model Output Parameters for the Liza 20 KBD Winter Season Release for Mitigated (Full Response) and Unmitigated (Monitor and Observe)

	Monitor and Observe 600,000 bbl	Full Response * 420,000 bbl
Shoreline area oiled (m^2)	8,413,814	0
Oil washed ashore (bbl)	181,261	0
Oil in water column (bbl)	15,077	274,953**
Oil dispersed from vessels and aircraft (bbl)	0	60,848
Oil burned (bbl)	0	11
Oil mechanically recovered (bbl)	0	0
Oil biodegraded (bbl)	72,479	109,305
Oil evaporated (bbl)	330,532	35,733

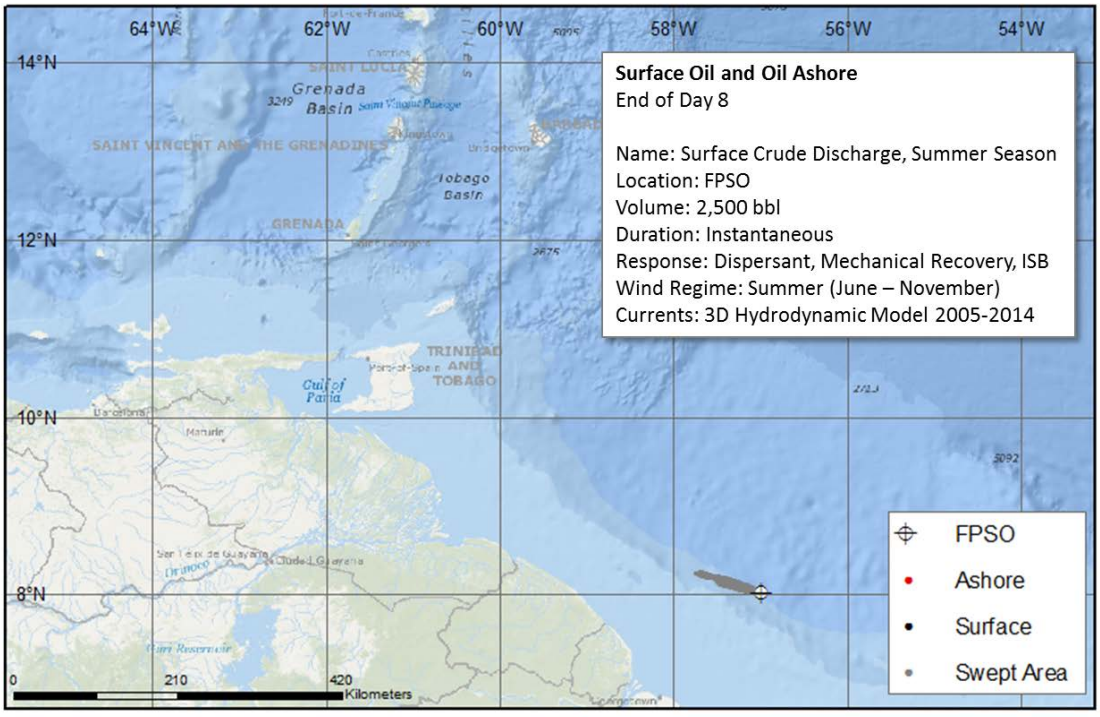
** Full Response includes installation of a capping stack on Day 21 reducing flow*

*** Includes dispersant application at wellhead*



Areas colored gray show the sea surface area swept by oil. Red shows areas of shoreline oiling and black represents remaining surface oil.

Figure G5: Model Predicted Unmitigated Oil at the End of an 8-day Simulation Originating at the Liza Well Site in the Summer Season

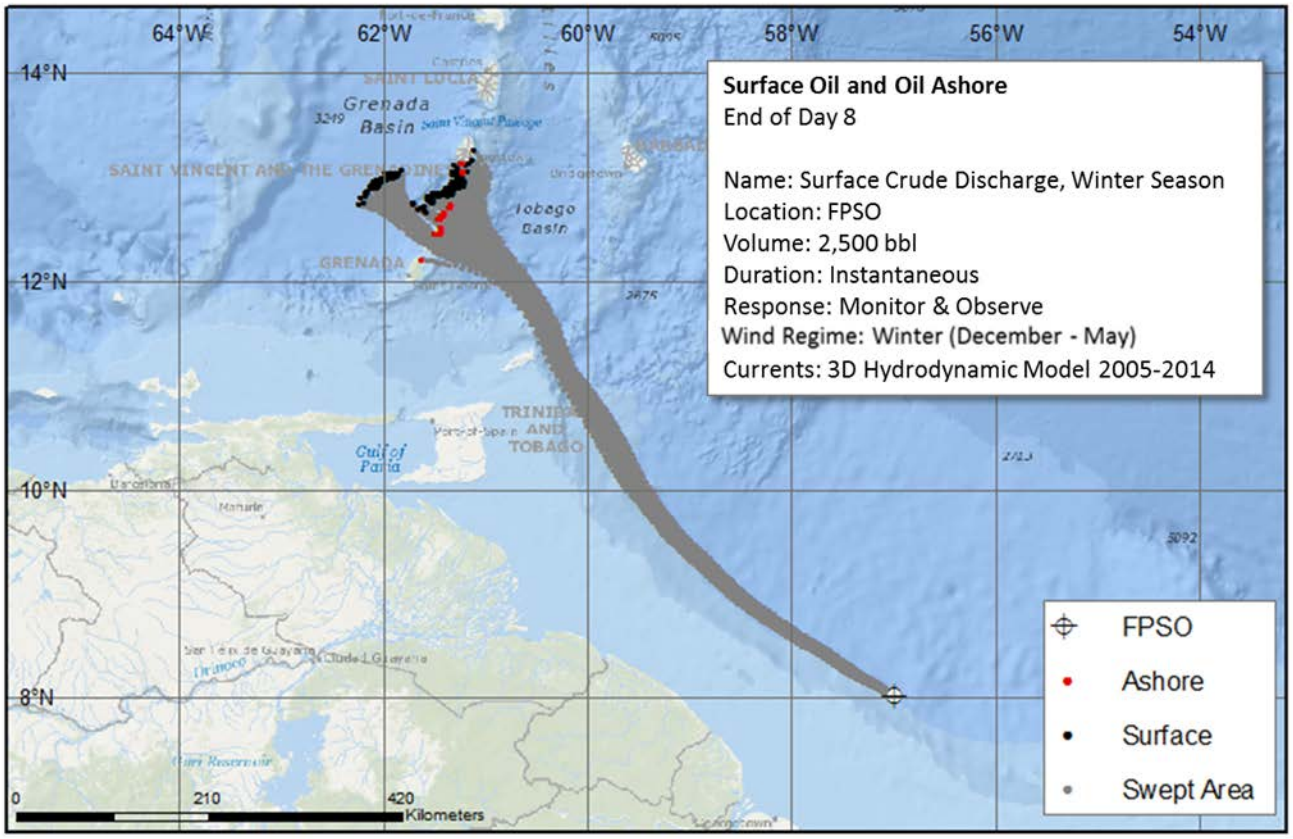


Areas colored gray show the sea surface area swept by oil. No shoreline oiling occurred and no surface oil remained.

Figure G6: Model Predicted Mitigated Oil at the End of an 8-day Simulation Originating at the Liza Well Site in the Summer Season

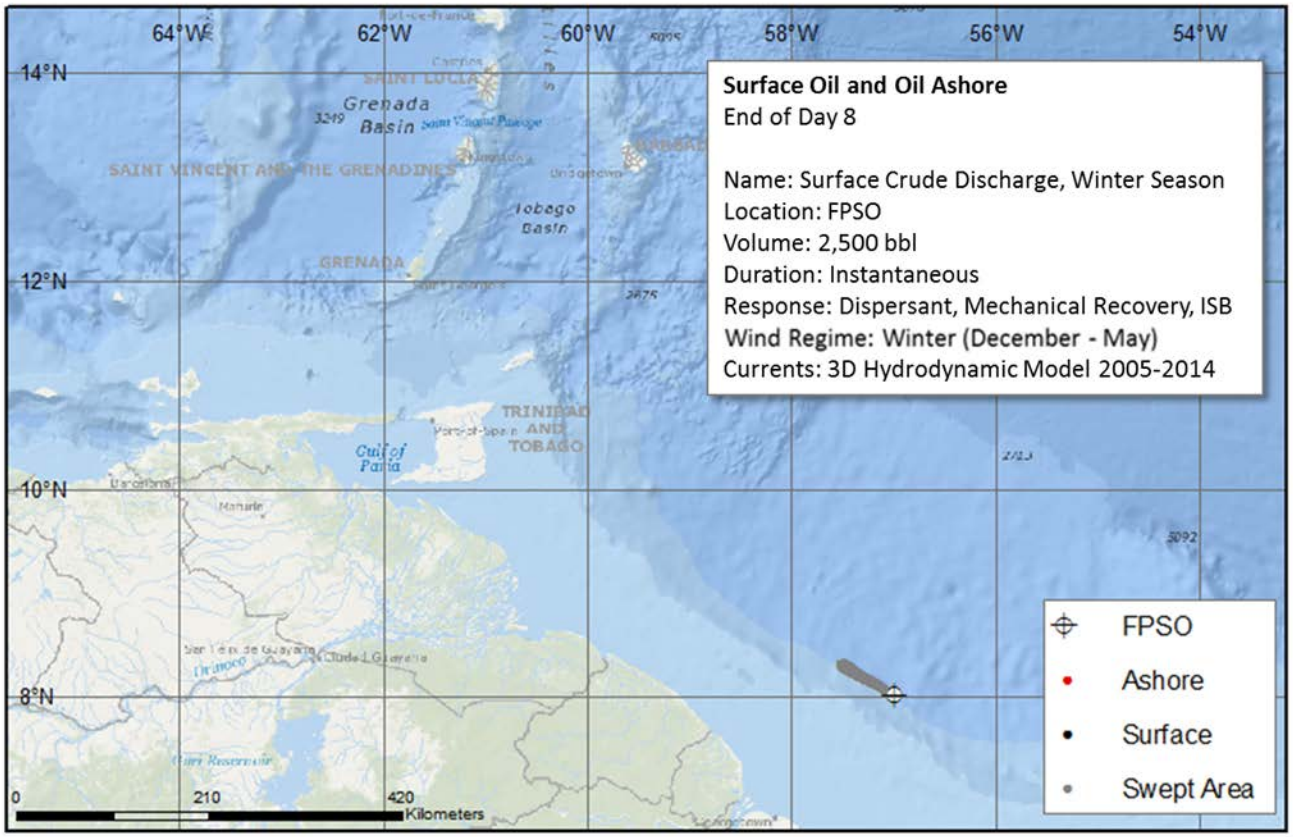
Table G12: Comparison of Key Model Output Parameters for the Liza 2500 BBL Summer Season Release for Mitigated and Unmitigated

	Monitor and Observe	Full Response
Shoreline area oiled (m^2)	565,808	0
Oil washed ashore (bbl)	372	0
Oil in water column (bbl)	38	1,309
Oil dispersed from aircraft (bbl)	0	1,417
Oil burned (bbl)	0	0
Oil mechanically recovered (bbl)	0	0
Oil biodegraded (bbl)	133	139
Oil evaporated (bbl)	1,185	1,052



Areas colored gray show the sea surface area swept by oil. Red shows areas of shoreline oiling and black represents remaining surface oil.

Figure G7: Model Predicted Unmitigated Oil at the End of an 8-day Simulation Originating at the Liza Well Site in the Winter Season



Areas colored gray show the sea surface area swept by oil. No shoreline oiling occurred and no surface oil remained.

Figure G8: Model Predicted Mitigated Oil at the End of an 8-day Simulation Originating at the Liza Well Site in the Winter Season

Table G13: Comparison of Key Model Output Parameters for the Liza 2500 BBL Winter Season Release for Mitigated and Unmitigated

	Monitor and Observe	Full Response
Shoreline area oiled (m^2)	419,117	0
Oil washed ashore (bbl)	466	0
Oil in water column (bbl)	32	1,316
Oil dispersed from aircraft (bbl)	0	1,407
Oil burned (bbl)	0	0
Oil mechanically recovered (bbl)	0	0
Oil biodegraded (bbl)	134	139
Oil evaporated (bbl)	1,182	1,044

NEBA Summary

The analysis of oiling parameters in the Monitor and Observe vs. Full Response oil spill responses demonstrates that the timing and response approach was effective in avoiding shoreline impacts. The reduction or elimination of shoreline impact is critical to successful spill response because oil can collect in quantities on shorelines and near shore environments that may cause significant environmental damage and persist for years. The response to shoreline stranding may require invasive cleaning technologies to eliminate bulk oil. In some cases these invasive technologies can be harmful and like oiling can produce long-lasting environmental effects.

A risk analysis that considers environmental effects and the time to recovery is presented in the Figure G9.

Risk Matrix		Consequence/Severity		
		Low	Medium	High
Likelihood	Unlikely	Minor	Minor	Moderate
	Possible	Minor	Moderate	Major
	Likely	Moderate	Major	Major

Figure G9: Risk Assessment for Environmental Effects

This risk analysis can be utilized to help understand the benefits of oil dispersant utilization in a response. The goal of the spill response is to shift the amount and duration of environmental effects from a higher severity to a lower severity. In the above figure, that shift would be represented by moving the consequence and severity from the right to the left.

The environmental effects of an oil spill on the coastline of Guyana can be represented in Figure G10. An unmitigated oil spill that impacts the shoreline will affect vegetation and organisms living in the intertidal zone. This is the area of the coastline between high tide and low tide. In Guyana, much of the coastline is vegetated by mangroves, an ecosystem that is rich in diversity because it provides a protective environment for fish, crabs, and shellfish. When mangrove forests are impacted by oil, the roots that are important for respiration are smothered and the plants die. The recovery time for mangroves may be decades. The recovery time for fish, crabs, and shellfish may be 1 to 3 years, however, the loss of protective habitat makes them more vulnerable to predation which ultimately affects species diversity. Therefore the effects from an oil spill with no active mitigation are represented by the red zones in Figure G9.

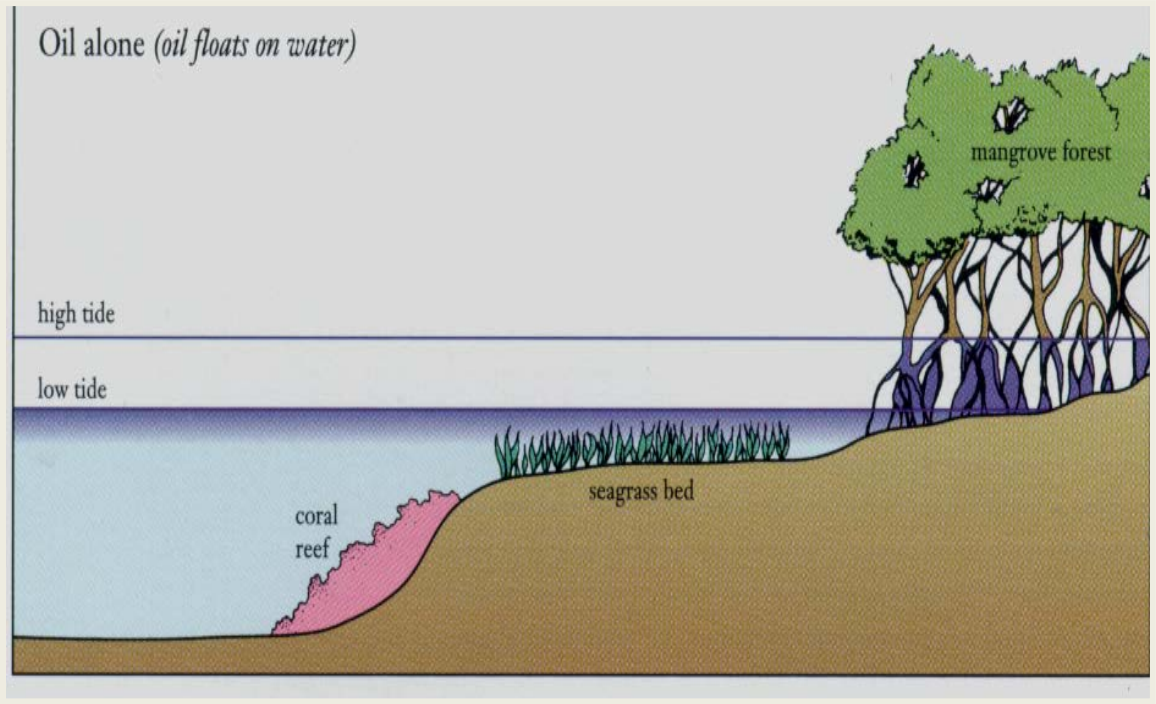


Figure G10: Intertidal Zone between Low and High Tide at Risk From Floating Oil

Figure G11 represents the shoreline affected by an oil spill that has been mitigated with dispersants in order to avoid shoreline impact.

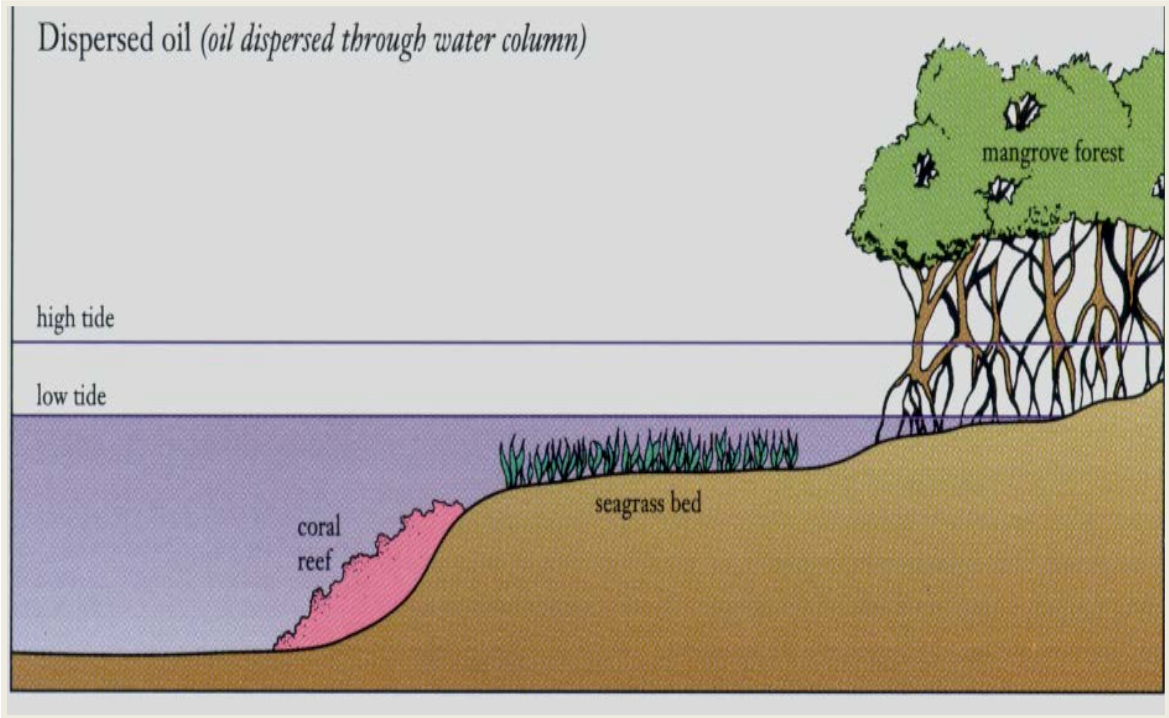


Figure G11: Shallow Sub-Tidal Zone at Risk from Dispersed Oil

In this case, the spill response that includes dispersant utilization has prevented shoreline stranding in the intertidal zone so that the mangrove forests and the species inhabiting them remain intact. However, in this case, there is a trade-off between the potential effects in the intertidal zone with potential effects in the shallow sub-tidal zone below low tide. In this case the oil that was floating on the water is now dispersed into very small droplets in the top of the water column. During the brief period, generally < 1 day, that high concentrations of oil droplets are present, these sub-tidal organisms may be at risk. Therefore, near-shore shallow sub-tidal sea grass beds, the fish and other organisms that inhabit them and shallow corals may be at risk. However, the exposure times are brief and the duration of the impacts are limited. Therefore if we consider the risks in Figure G9, the damages and recovery times are limited and risks are reduced (i.e., shifted to the left on the risk matrix) representing lower consequences.

This NEBA analysis examined both Tier II and Tier III releases from the Liza Project. The response analyses that were utilized in the mitigated results represent the types of equipment and timing of a response that can be mounted at this time. In the event of an actual release in the future, these presentations may serve as the underlying basis for an updated NEBA. The goal of this analysis has been to present large releases so that they would encompass the response to smaller, more probable releases. In consideration of their success in eliminating surface oiling and shoreline stranding, they represent the extent of EEPGL's full resources. EEPGL's goal is to have no spill releases at all and that remains the primary focus at all times. However, if an accidental release does occur, spill response experts and technical specialists will be available to provide NEBA updates and analyses as necessary for consideration by the corresponding Guyana authorities.