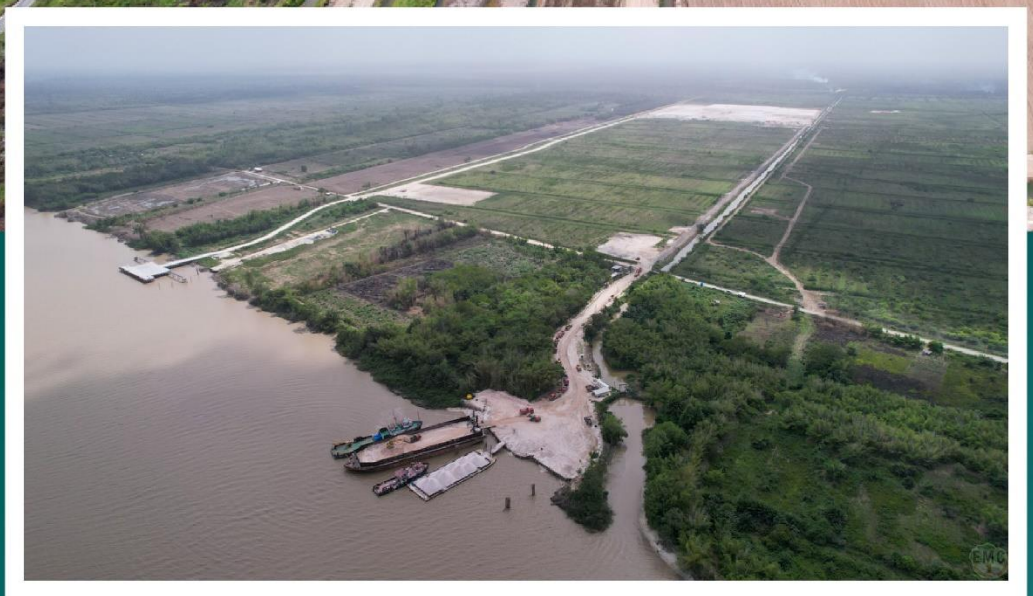
Gas to Energy Project

Ecosystem Services and Dependencies Study (ESS)

FINAL REPORT

OCTOBER 2024



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ACRONYMS

AoI	Area of Influence
EIA	Environmental Impact Assessment
EMC	Environmental Management Consultants Inc.
EMGL	ExxonMobil Guyana Ltd.
EPA	Environmental Protection Agency
ESS	Ecosystem Services and Dependencies Study
FPSO	Floating Production Storage and Offloading
GASTOP	Guyana Association of Private Trawler Owners and Seafood Processors
GLSC	Guyana Lands and Surveys Commission
GTE	Gas -to-Energy
GTE-ESS	Ecosystem Services and Dependencies Study for the GTE Project
IFC	International Finance Corporation
MARAD	Maritime Administration Department
MOF	Materials Offloading Facility
NAREI	National Agricultural Research and Extension Institute
NDC	Neighbourhood Democratic Council
NGL	Natural Gas Liquids
RoW	Right-of-Way
T&HD	Transport and Harbours Department
TOR	Terms of Reference
UAV	Unmanned Aerial Vehicle

1.0 INTRODUCTION

1.1 Overview

In November 2022, the Environmental Protection Agency (EPA) issued an Environmental Permit to ExxonMobil Guyana Ltd. (EMGL) for the Gas-to-Energy (GTE) Project. The Permit required EMGL to prepare an updated environmental and social baseline, including ecosystem services and dependencies. It also required that the updated baseline on ecosystem services and dependencies be conducted by an independent consultant approved by the EPA. In 2023, EMGL prepared a Terms of Reference (TOR) for an Ecosystem Services and Dependencies Study for the GTE Project (GTE-ESS). This was approved by the EPA. Subsequently, in 2024, EMGL contracted Environmental Management Consultants Inc. (EMC) to execute the GTE-ESS. EMC has experience conducting Ecosystem Services Studies by virtue of having supported the execution of ecosystem services studies along the shoreline of the six (6) coastal regions of Guyana in 2017 and 2019, and leading a subsequent round of that survey in 2022.

The purpose of the GTE Project is to utilize a portion of the associated gas produced as part of the Liza Phase 1 and Liza Phase 2 development operations to produce natural gas liquids (NGL) and dry natural gas for use and consumption by third parties. Dry natural gas will also be supplied to the Government of Guyana, which plans to use it to support electricity generation.

There are three key components of the GTE Project: an offshore subsea pipeline, an onshore pipeline, and an NGL plant with associated infrastructure. Additionally, during the construction phase of the GTE Project, a temporary Materials Offloading Facility (MOF) will be used to support transporting construction materials to the NGL Plant site. The offshore subsea pipeline starts from the Destiny (Liza Phase 1) and Unity (Liza Phase 2) Floating Production Storage and Offloading (FPSO) vessels and goes to the shoreline of Crane village in Region 3, where it is tied-in to the onshore pipeline. From Crane, the onshore pipeline passes through the backlands of Region 3 until it is tied-in to the NGL Plant, located at Free and Easy village, West Bank Demerara. The MOF and a permanent docking site to support NGL Plant operations are located on the western bank of the Demerara River, at Free and Easy village.

The GTE-ESS aimed to identify and map the ecosystem system services within the project's direct area of influence (AoI), as defined in the EPA-approved Environmental Impact Assessment (EIA). This Survey Report presents the findings of the mapping and verification of ecosystem services occurring within the GTE Project's AoI. Specifically, it provides:

i. the methodology that guided fieldwork and mapping;
ii. a summary of the ecosystem services identified in the Project's AoI; and
iii. the detailed findings on the relationship between local communities and the natural environment in the study area.

A separate mapbook is prepared which presents the maps generated by the survey.

1.2 Definition of Ecosystem Services

Ecosystem services are typically defined as the benefits people obtain from the natural environment, including natural resources that underpin basic human health and survival needs, support economic activities and provide cultural fulfilment.

There are four standard categories of ecosystem services, namely *provisioning, regulating, cultural and supporting* services. These categories are defined as follows:[1]

- **Provisioning services:** The goods or products obtained from ecosystems such as food, freshwater, timber, fiber and other goods.

- **Regulating services:** The benefits obtained from an ecosystem's control of natural processes such as climate, water flow, disease regulation, pollination, and protection from natural hazards.

- **Cultural services:** The non-material benefits obtained from ecosystems such as recreation, spiritual values, and aesthetic enjoyment.

- **Supporting services:** The natural processes such as erosion control, soil formation, nutrient cycling, and primary productivity that maintain other services.

Additional details about the types of services under each category are provided in the Screening Checklist presented in Appendix A.

[1] Millennium Ecosystem Assessment (MA). 2005. Synthesis Report. Island Press, Washington DC.

2.0 METHODOLOGY

2.1 Defining the ESS Scope

In the EPA-approved TOR for this ESS, the study area was identified as the GTE Project's direct AoI as defined in the EIA comprising the offshore pipeline, the onshore pipeline, the NGL Plant and the temporary MOF. A description of the direct AoI for the construction and operation of the GTE Project, as it was defined in the EIA, is presented in Table 2-1. The onshore AoI can be observed in Figure 2-1 and the onshore AoI is shown in Figure 2-2.

Table 2-1: Description of the Direct AoI for the GTE Project Construction as Defined in the EIA[2]

Offshore Pipeline	▪ The AoI extends from the tie-in points of each FPSO to the subsea tie-in infrastructure on the seabed through to the tie-in with the onshore pipeline. ▪ Approximately a 30-metre-wide corridor that is 220 kilometres long, centred in the tie-in infrastructure and the offshore pipeline.
Onshore Pipeline	▪ The AoI extends from the tie-in points with the offshore pipeline and to the tie-in with the NGL Plant. ▪ Approximately a 23-metre wide by 27-metre-long construction corridor. During construction, it also includes additional areas used as temporary work spaces along the construction corridor and the areas where access roads and bridges will be developed or improved.
NGL Plant	▪ The AoI comprises the 50-hectare footprint, including construction laydown areas.
Temporary MOF and the Lower Demerara River	▪ The AoI comprises the footprint of the MOF on the west bank of the Demerara River. This includes the in-water area of impact, the onshore MOF and the area used to transport materials from the temporary MOF to the NGL Plant site. ▪ This also includes portions of the lower Demerara River that might be used for transporting heavy equipment and facility modules to the MOF (the full width of the Demerara River from its mouth to the MOF).

The AoI for the offshore and onshore pipeline encompasses the construction zones. At the time of commencement of this ESS, construction had already commenced and construction of all project components was ongoing. Therefore, identifying ecosystem services in the AoI was challenging as construction activities largely characterized the area, especially for the onshore pipeline.

Based on the information provided by project personnel, the offshore pipeline was laid in phases. Consequently, there were no simultaneous restrictions regarding using the area along its entire 220-kilometre length. When the offshore pipeline is completed, marine traffic in the waters above it is not anticipated to be restricted. However, a no-anchorage buffer zone will be established. According to information provided by the Maritime Administration Department (MARAD) in March 2024, the width of the no-anchorage zone was not yet determined. Based on these considerations, the study team opted to scope the entirety of the areas offshore Regions 3 and 4 into the survey, including the AoI.

A permanent 12-meter-wide right-of-way (RoW); a designated corridor above the pipeline where other land uses are prohibited) will be established for the onshore pipeline when it is operational. The AoI extends 11 metres wider than the RoW around the onshore pipeline alignment. Although the study area is narrow, it facilitates identifying the ecosystem services in the lands immediately contiguous to

[2] Esso Exploration and Production Guyana Ltd. 2022. Environmental Impact Assessment Gas to Energy Project. Volume 1. Page 3-2.

the pipeline alignment. Ecosystem services identified in the AoI may serve as a point of comparison with the baseline description outlined in the Project's EIA, Section 9.8 Ecosystem Services. Given that construction/installation activities were ongoing on some sections of the pipeline during the survey, ecosystem services (particularly cultivating crops for food) in the areas immediately adjacent to the boundaries of the AoI were mapped if it was the opinion of the study team that these services might extend into the AoI when installation is complete.

Regarding the NGL Plant and the temporary MOF, the ESS also expanded beyond the AoI to consider ecosystem services in the neighbouring lands since their areas of influence were defined as the footprints of these facilities. For the Lower Demerara River, ecosystem services were mapped along the western bank from the mouth of the River to the location of the temporary MOF. Additionally, the study team also scoped the shoreline area from the mouth of the River to the tie-in location for the offshore and onshore pipelines to the survey.

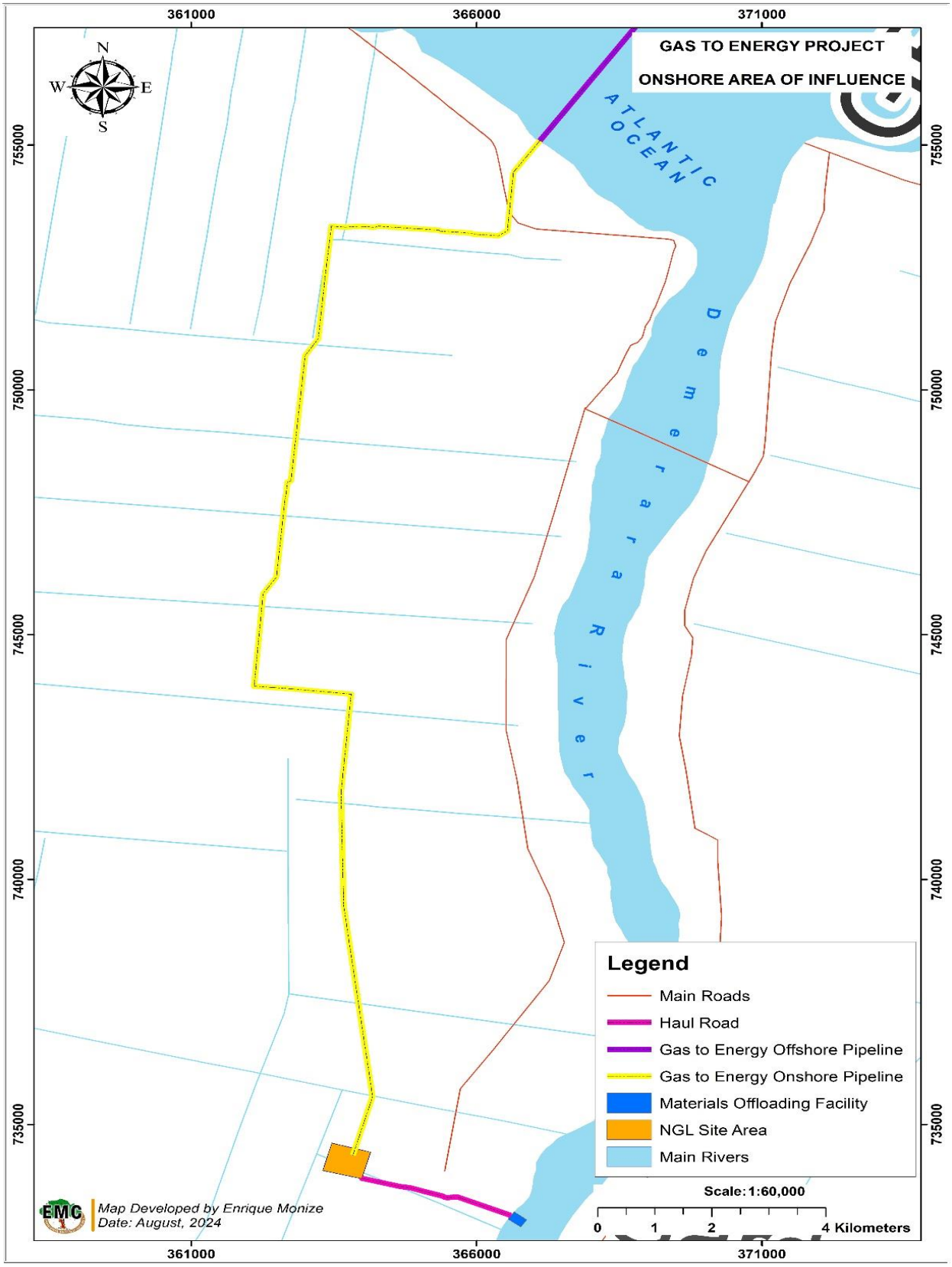

Figure 2-1: Onshore Area of Influence

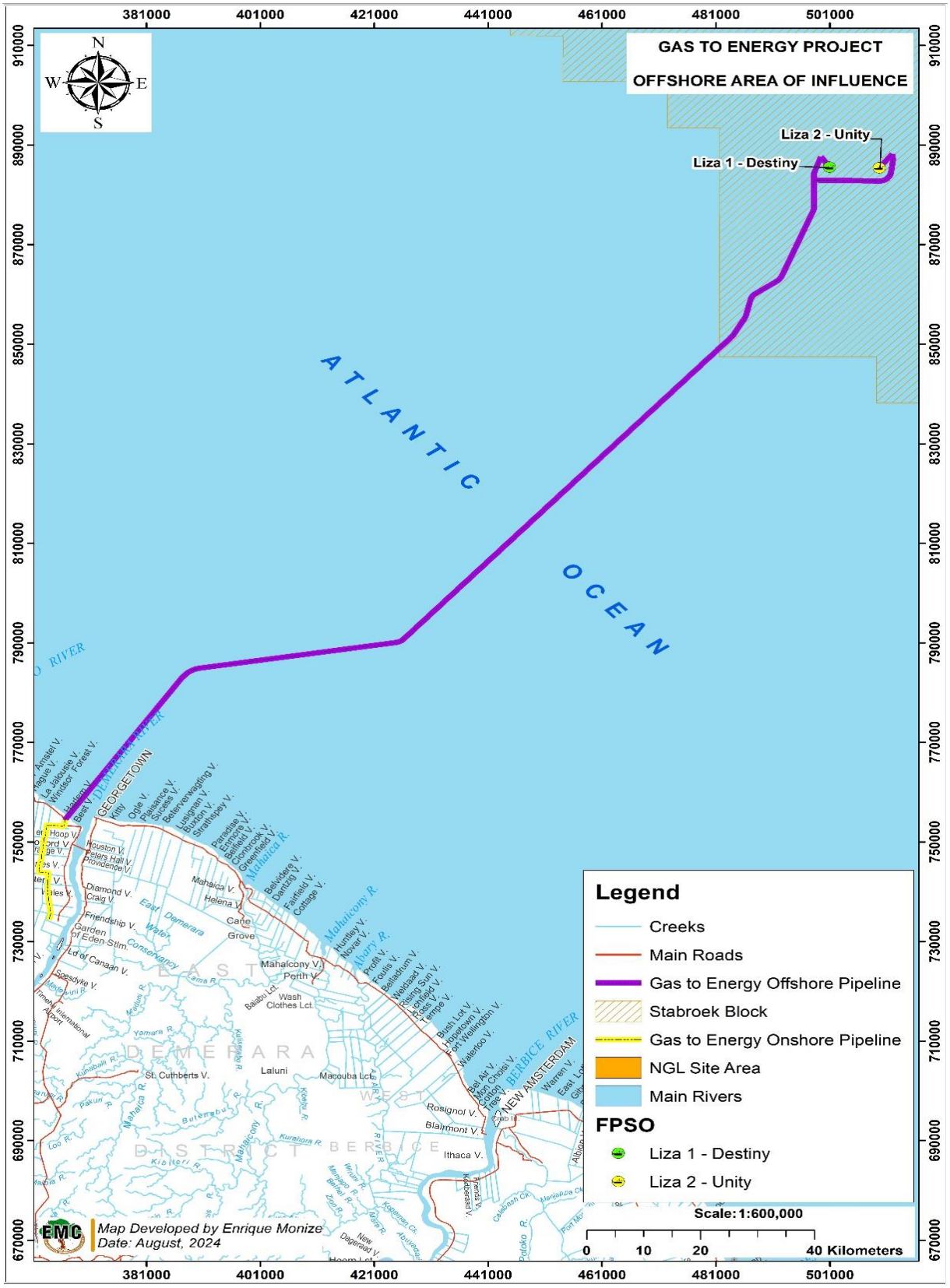

Figure 2-2: Offshore Area of Influence

2.2 Screening of Ecosystem Services

Ecosystem services screening involved two activities. First, EMGL's project personnel facilitated a reconnaissance visit to the survey area on March 01, 2024. This allowed the study team to understand how the project's infrastructure fits on the ground (including how the onshore pipeline may be accessed using public dams and roadways) and gain preliminary insights into the ecosystem services that are located in the AoI. The reconnaissance visit included a visit to the tie-in location and traversing along the pipeline alignment: entering at Crane turn and exiting on the Coglan Dam, entering on Canal No. 1 (Bordeaux Street) and exiting at Canal No. 2 (Alliance Street), and finally, entering in Belle West and exiting at the tie-in with the NGL Plant and then to the MOF.

Second, the study team undertook a desktop review of recent reports, maps and data to identify ecosystem services in the offshore AoI; finalized stakeholder mapping which informed the preparation of discussion points for the stakeholder engagements; and identified gaps in data and information required for the mapping exercise. The main elements of this desktop review were the approved GTE-EIA, the results of the recent coastal ESS (conducted in 2022), the maps prepared and data collected for fisheries studies initiated by EMGL to fulfil Permit conditions, and the websites of key stakeholders in Guyana's shipping industry. The screening exercise helped to identify ecosystem services and contextualize their importance to local stakeholders.

There were two objectives of the desktop review, namely identifying ecosystem services in the offshore AoI, and reviewing the ecosystem services in the onshore AoI that were mapped and prioritized during the coastal ESS in 2022. The latter was used to preload the GIS tools for the field survey which is discussed in detail below. The former entailed a screening process guided by several considerations including the most important economic benefits in the AoI, any cultural activities occurring in the AoI, and any other benefits humans derive in the AoI.

The desktop screening revealed two ecosystem services in the offshore AoI that were certainly known, i.e., fishing and marine transport, and one potential ecosystem service, i.e., the location of fibre optic cables in the AoI. Regarding fishing, data collected by fisherfolk over a period of four years onboard fishing trips were used to establish fishing ranges for different methods of artisanal fisheries. Similarly, data collected by fisherfolk onboard red snapper trap vessels over two years were used to establish the semi-industrial fisheries ranges. Based on the literature review and engagements with fisheries sector stakeholders, the industrial fisheries zone was mapped. Although the screening revealed that marine transport was growing in the AoI and the wider area (given its proximity to the mouth of the Demerara River, which leads to the Port of Georgetown – Guyana's main seaport), there were no recent sources of information on the intensity or frequency of use.

GIS Approach

GIS was a key tool in the pre-fieldwork screening to identify areas of focus for ground verification. The study team used the ArcGIS web platform and tools (Survey123 and Field Maps). The study area was delineated on base maps of the ArcGIS web platform. Thereafter, data points and attributes for sections of the study area surveyed in 2022 were pre-loaded to an iPad.

Prior to meetings with local stakeholders, maps were prepared to show the pipeline alignment within the constituency's boundaries. This helped stakeholders visualize the study area and guided engagements on the ecosystem services that may be present in the AoI. Figure 2-3 depicts where the onshore project component falls within the Neighbourhood Democratic Councils (NDCs) within which the project's AoI falls. Based on this, these NDCs were identified as key stakeholders and were engaged during the study.

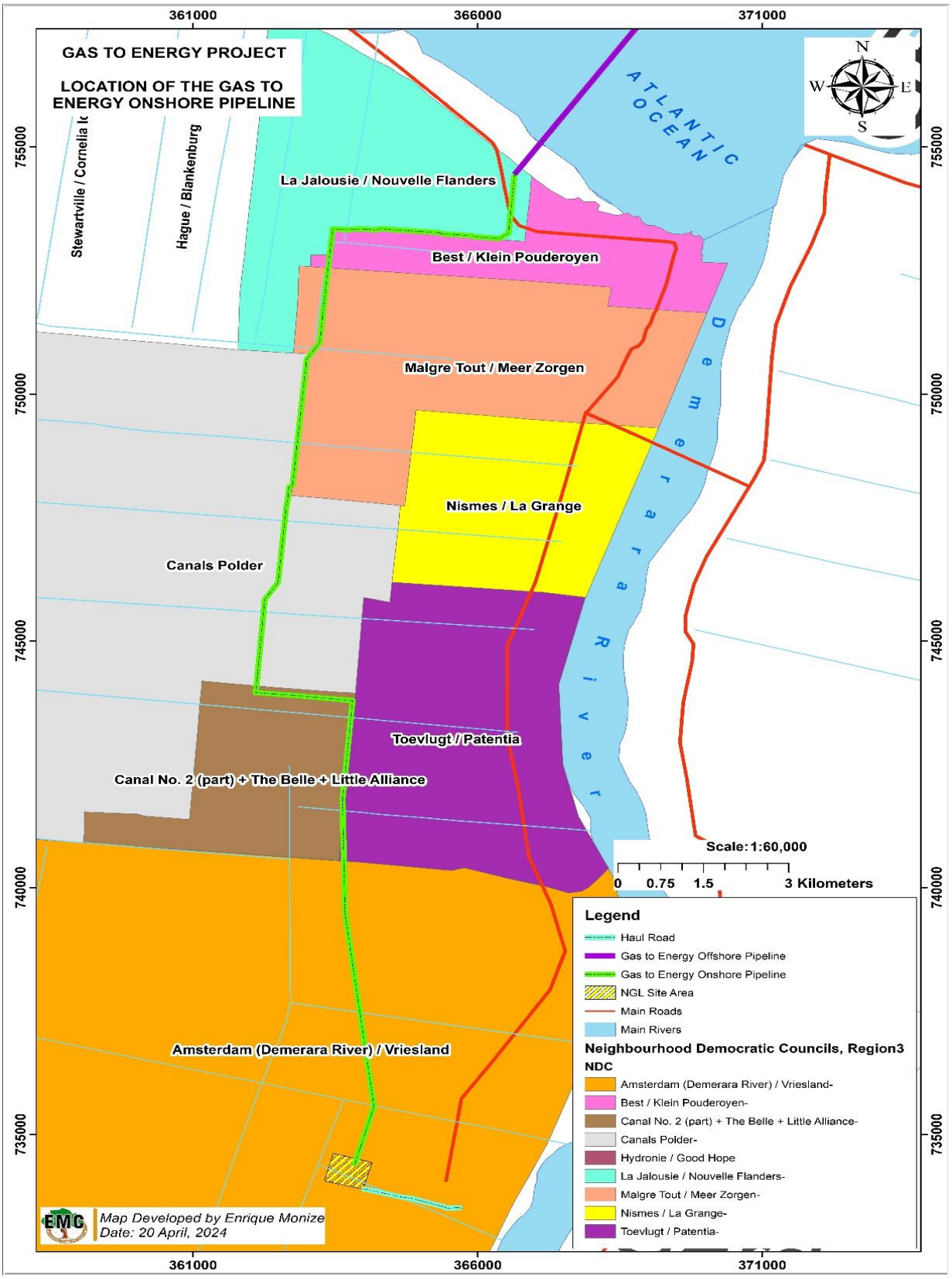

Figure 2-3: NDCs within the Project's onshore AoI

2.3 Mapping and Verifying Ecosystem Services

The Offshore Pipeline

The ecosystem services were identified during the screening exercise and validated during engagements with key stakeholders. The stakeholders with whom the study team met and the dates of the engagements are presented in Table 2-2 below. Photographs of the engagements are included in Appendix B.

Table 2-2: Stakeholders engaged to validate and map ecosystem services in the offshore AoI and the dates of the engagements

Agency	Dates
Guyana Association of Trawler Owners and Seafood Operators (GATSOP)	March 13, 2024
Guyana Coast Guard	March 13, 2024
MARAD	March 14, 2024
Department of Fisheries	March 14, 2024

Taking consideration the findings of the literature review and widening the scope of the study area to facilitate the discussion, the following guiding questions were used in the engagements with the key stakeholders to discuss the ecosystem services:

- How are the study area and the areas offshore the Regions 3 and 4 coastlines used by stakeholders in your industry?
- How many persons or entities use the offshore environment in this way? How often are these areas used for this purpose?
- Is there available data on these uses that can be shared with the study team?
- What general trends have you observed in the use of the offshore environment? How have the uses changed in recent years?
- Aside from the stakeholders in your industry, based on your experience, are there other ways people use the offshore environment, e.g., for religious or recreational purposes, ecotourism, etc.?

The Onshore Components

Mapping and verifying the ecosystem services around the onshore components involved a dual approach by the study team of stakeholder engagements and ground observations. The stakeholders engaged included two central-level stakeholders with mandates including agriculture and agricultural lands, and meetings with local stakeholders of the NDCs where the pipeline was located and which include the portions of the western bank of the Demerara River in its jurisdiction. All NDCs had both areas with one exception; no section of the onshore pipeline passed through the La Grange/Nismes NDC. The stakeholders with whom the study team met and the dates of the engagements are presented in Table 2-3. Photographs of the engagements are available in Appendix B.

Table 2-3: Stakeholders engaged to identify ecosystem services for the onshore components and the dates of those engagements

Agency	Dates
Central Stakeholders	
National Agricultural Research and Extension Institute	March 14, 2024
Guyana Lands and Surveys Commission	March 27, 2024
Neighbourhood Democratic Councils (NDCs)	
La Jalousie/Nouvelle Flanders	April 23, 2024
Best Klien/Pouderoyen	April 23, 2024
Malgre Tout/Meer-Zorgen	April 24, 2024
La Grange/Nismes	April 24, 2024
Canals Polder	April 25, 2024
Toevlugt/Patentia	April 25, 2024

During the meetings with the central-level stakeholders, questions similar to those asked of the central level stakeholders related to ecosystem services in the offshore environment were posed. These questions were asked for four areas, namely, the onshore pipeline corridor, the shoreline area from the mouth of the Demerara River to the tie-in of the offshore and onshore pipelines, the western bank of the Lower Demerara from the mouth to the MOF, and the area from the MOF to the NGL Plant. The questions were:

- How is the study area used by stakeholders in your industry?
- How many persons, entities or businesses use the AoI for the study area in this way? How often are these areas used for this purpose?
- What general trends have you observed in the uses of the study area? How have the uses changed in recent years?
- Has there been any change (loss or growth) of mangroves?
- Is there any data available on these uses that can be shared with the study team?

The study team informed local stakeholders of the objectives of the meeting in advance, thereby allowing them the opportunity to prepare for the meeting. During each meeting, the study team presented a map of the onshore pipeline alignment within the boundaries of each NDC to frame the AoI and optimize the information. Since all constituencies encompass a section of the shoreline or river bank that fall within the study area, the study team also engaged the local stakeholders on the uses of these AoI sections guided by the coastal ESS findings. The screening checklist provided in Appendix A was used in all meetings as a point of reference. During the engagement, the study team asked stakeholders the following questions for all sections of the AoI that fell within the boundaries of their constituencies:

- How do locals use the study areas?
- Has there been any notable growth or decline in any particular sector? What sector? What has changed?
- Has there been any increase in the use of environmental resources in the study area in recent years? What purpose and where?
- Has there been a change (growth or loss) of mangrove cover?
- Have there been changes to the sea defences in the NDC, such as new sea defence structures or damaged/breached structures?
- Are there any other notable socioeconomic data that you wish to have documented?

Following the stakeholder engagements, the study team conducted a ground verification exercise to ascertain that the ecosystem services found during the screening process and those reported by the

NDCs were accurate. For the onshore pipeline, the study team traversed along the sections of the alignment that were accessible as follows:

- Visiting the shoreline area near the tie-in location for the offshore and onshore pipelines.
- Driving along the pipeline alignment accessed by entering Coglan Dam and exiting at Crane Turn.
- Entering Westminster and traversing north to the A-Line, a back dam connected to the southmost dam in the Schoonard village.
- Entering the Canal No. 1 public road, heading north along the pipeline alignment in Lust-en-Rust and then south along the pipeline alignment from Bordeaux Street. During the reconnaissance visit, there was an earthen dam that connected Bordeaux Street to the Canal No. 2 public road (exiting at Alliance Street), but some sections of this dam could not be accessed during ground verification due to pipeline laying works. Therefore, during the mapping exercise, the study team only traversed the dam as far as it was accessible.
- Entering Alliance Street from Canal No. 2 public road and travelling north towards Bordeaux Street. Similarly, some sections of this dam were inaccessible due to construction work.
- During the reconnaissance visit, the study team visited the pipeline sections starting in Belle West and heading to the NGL Plant and ascertained that lands were abandoned and that no ecosystem services were occurring or likely in this area. The engagements with the Canals Polder NDC and the Toevlugt/Patentia NDC confirmed this. Therefore, the study team did not revisit the area.

During the ground verification exercise, the study team also attempted to access the alignment from other locations reported by the NDC personnel, such as Samaroo Street in the Malgre-Tout/Meer Zorgen NDC and Independence Street in the La Grange/Nismes NDC, but these did not lead directly to the backlands where the pipeline was being installed.

In order to verify the ecosystem services at the NGL plant, the study team visited its boundaries, which were accessed by a dam located north of the facility. They also visited the temporary MOF and permanent GTE docking facility locations. To verify the ecosystem services occurring along the western bank of the Demerara River, the study team traversed the entire length of the area, stopping at locations where services were reported by the NDCs and at other areas where activities were observed. The study team further engaged with local stakeholders on the ground at the locations where services were being mapped to support the priority ranking of the services identified. At each location, the study team members completed the Survey123 Form designed to support field data collection for this survey. Figure 2-4 shows the study team marking location-specific points and completing the Survey123 data collection form.

Ground verification was supported by unmanned aerial vehicle (UAV) flights and aerial photography conducted by a licenced and experienced UAV pilot. UAV flights and aerial photography had several uses. UAV flights helped identify potential access points to the onshore pipeline alignment that were not visited during the reconnaissance. For example, a UAV flight helped to ascertain the access point to the A-Line dam through Westminster village. In addition, UAV flight helped to determine whether there were any ecosystem services in areas which could not be accessed by the study team (e.g., the boundaries of the temporary MOF, the NGL Plant and the dam connecting Bordeaux Street to Alliance Street) and aerial photography of the area helped the study team assign priority rankings to a service that was observed. Figure 2-5 shows the use of the UAV to support the ground verification exercise.

Figure 2-4: The EMC study team marking a location-specific point and completing the Survey123 Data Collection Form at Nismes, on the Western Bank of the Demerara River

Figure 2-5: Pre-flight UAV checks being conducted by the UAV Pilot

2.4 Prioritizing Ecosystem Services

The ecosystem services prioritization was designed to be consistent with the framework employed for the coastal ecosystem services assessment and with international best practice, using the 2012 International Finance Corporation (IFC) Performance Standards (PS) as guidance. The prioritization process focuses on identifying services that are important to local stakeholders and difficult to replace and where loss or degradation of the service could adversely affect local communities. The prioritization of ecosystem services considers the importance of the ecosystem service and the availability of spatial alternatives.

Importance of Ecosystem Services

The importance of ecosystem services to beneficiaries was assessed according to the following criteria and assigned a rating from **Low** to **Essential** based on the intensity of use, the scope of use, the degree of dependence, the cultural and/or historical importance and the importance expressed by stakeholders. The definitions for rating importance are provided in Table 2-4 below.

Table 2-4: Definitions for rating the importance of ecosystem services

Rating	Definition
Low	A service that is used seasonally or less frequently by one stakeholder group. The service does not support livelihoods. The service may have a cultural or historical value.
Moderate	A service that is used weekly or seasonally by one or more stakeholder groups. The service may be used to support commercial and/or subsistence activities. The service may have cultural or historical value.
High	A service that is used weekly by one or more stakeholder groups to support commercial and/or subsistence activities. The service may have cultural or historical value.
Essential	The service is used daily by one or more stakeholder groups to support commercial and/or subsistence activities. The service may also have cultural or historical value.

The weight given to each component varied depending upon the service, but the importance to stakeholders and beneficiaries took precedence. When a service was of greater or lesser importance to different stakeholder groups, two (or more) ratings were assigned to assess these groups' impacts individually.

Replaceability

The replaceability (availability of alternative locations) was assessed to the extent to which a community will be adversely impacted if that service declines. A service's 'replaceability' was assessed according to the existence of spatial alternatives (natural replacements and man-made substitutes), the accessibility, cost, and sustainability of potential alternatives, and the preference and cultural appropriateness of alternatives. The service's replaceability were rated from **Low** to **High**, as defined in Table 2-5 below.

Table 2-5: Definitions for Rating Replaceability of Ecosystem Services

Rating	Definition
Low	No spatial alternatives
Moderate	Few spatial alternatives
High	Many spatial alternatives

After compiling information on the importance and replaceability of each service, these ratings were combined to assign a priority rating to the service (see Figure 2-6). The study team assigned priority ratings to each location-specific ecosystem service based on feedback provided by the NDC, observations during ground verification, and interactions with other local stakeholders present at the site.

		Replaceability of Service		
		High	**Moderate**	**Low**
Importance of Service to Beneficiaries	**Essential**	*High*	*Critical*	*Critical*
	High	*Medium*	*High*	*Critical*
	Moderate	*Low*	*Medium*	*High*
	Low	*Low*	*Low*	*Medium*

Figure 2-6: Matrix for assigning priority ratings to ecosystem services

3.0 SUMMARY OF FINDINGS

The findings of the GTE-ESS indicated that provisioning services were the primary type of existing ecosystem services in the study areas where ecosystem services were identified. No existing ecosystem services were recorded in the study areas for the NGL Plant, the temporary MOF and the permanent GTE wharf facility. The only activities in these areas are associated with the GTE-Project as the lands were abandoned following the closure of the Wales Sugar Estate in 2017. Previously, these lands were plantations used for cultivating sugar cane. This section summarizes the ecosystem services observed in the study areas and includes high-resolution aerial imagery to illustrate the services identified. This section also presents a Detailed Findings Table (Table 3-1) in which additional details of the ecosystem services and their priority rankings are presented.

3.1 Ecosystem Services in the Offshore Pipeline Study Area

Provisioning Services

Two provisioning services were identified in the offshore study area: fishing and marine transportation. All of Guyana's marine fishing industry subsectors are active in the offshore study area. Fishing grounds used by artisanal fisherfolk utilizing a range of gear types start in the nearshore, generally with a minimum distance of 0.1 kilometres from the shoreline, and typically extend no farther than 50 kilometres offshore. Generally, semi-industrial fishing occurs as far as the continental shelf with vessels that use red snapper traps travelling as far as 102 kilometres offshore to fish. Industrial fishing activities are only permitted in a regulated zone at depths of 8 to 18 fathoms.

Marine transportation comprises a range of vessel types transporting cargo locally and internationally. MARAD classifies the area up to 16 kilometres offshore as the 'inshore zone' where small cargo vessels and ferry services operate. Farther offshore, about 80.5 kilometres, is the 'intermediate zone' for international marine traffic. The 'offshore zone' is farther offshore than 80.5 kilometres and typically comprises marine traffic that is not destined for Guyana. The main marine traffic originating in Guyana and passing through the inshore and intermediate zones are Platform Supply Vessels transiting to and from the FPSOs.

Supporting Services

The offshore marine environment provides critical habitats for various species, including breeding, feeding, and nursery areas for fish and other marine organisms. This is evidenced by the rich species diversity in commercial fishery catches, particularly in artisanal fishing. In addition, phytoplankton and other marine plants form the base of the marine food web, supporting this biodiverse range of marine life.

3.2 Ecosystem Services in the Onshore Pipeline AoI

Provisioning Services

Crop cultivation for food was the most prominent ecosystem service in the onshore pipeline's AoI. The most common crop cultivated was rice, with the pipeline passing through rice fields in Crane, Versailles and Westminster to Lust-en-Rust. According to local stakeholders, challenging weather conditions in the previous five years (particularly prolonged dry spells) resulted in the cessation/stoppage of rice cultivation, presumably temporarily, in some areas of the AoI. The rice crop was harvested before the ground verification exercise, and the lands were being fallowed. Therefore, the study team could not estimate the percentage of the fields in the AoI that were being actively cultivated. Figures 3-1 and 3-2 show rice fields in the backlands of Nouvelle Flanders to Versailles, with some sections of the pipeline which were yet to be laid being visible on the surface. Crop cultivation of fruits, tubers and

other crops was also observed in Lust-en-Rust (Figure 3-3), and along the dam connecting Canal No. 1 (Bordeaux Street) to Canal No. 2 (Alliance Street), as seen in Figure 3-4. In addition, lands previously used as sugar cane plantations but are now abandoned are also within the AoI from Belle West to the tie-in to the NGL Plant (Figures 3-5 and 3-6).

There was also the use of lands to support livestock grazing in the Canals Polder. According to local stakeholders, livestock is allowed to graze seasonally along the dams of rice fields during the out-of-crop season. There was also reportedly livestock grazing on abandoned lands previously used for sugar cane cultivation in the Patentia/ Toevlugt NDC. However, the study team could not verify whether this activity occurred within the range of the onshore pipeline AoI. There is limited grazing of small livestock on the sea defence reserve in La Union and Crane, near the onshore and offshore pipelines tie-in, but this activity is declining.

Another provisioning service was inland fishing. Local stakeholders reported inland fishing for commercial and subsistence use in the drainage and irrigation canals within the AoI, including in Crane, Lust to Rust, and Belle West. In the back dams of Wales (particularly in the canals of the abandoned sugar plantations), inland fisheries are a primary source of livelihood for several people. The study team could not confirm whether these inland fisheries activities were occurring within the range of the AoI, and therefore, they were not mapped.

Other provisioning services reported by stakeholders included hunting animals for meat (particularly iguana), trapping birds for trade and crabbing along the Crane shoreline. Stakeholders reported that farmers use rice fields' drainage and irrigation canals to deliver important supplies to their fields during the rainy seasons if the earthen dams are impassable by tractors.

Regulating Services

The network of drainage and irrigation canals in the AoI, particularly those adjacent to the rice fields, can collect, absorb, store and slow down water flow during periods of intense rainfall, thereby regulating erosion and flooding.

Cultural Services

The highest-priority cultural service was the use of the beach and shoreline in La Union by local communities for recreational purposes. Based on the findings of the recent coastal ESS (conducted in 2022), hundreds of people use seawalls for picnics and kite flying during special holidays like Easter. In addition, along the pipeline alignment in Crane are several silk cotton trees. Although they were not within the boundaries of the study area, they were marked given their cultural significance.

Supporting Services

Drainage and irrigation canals provide a reliable water source for crop irrigation, thereby supporting crop cultivation and the provision of food. In addition, the agricultural lands, the canals and the scrublands occurring along different sections of the AoI provide habitats for fish, birds, and other biodiversity.

Figure 3-1: Aerial imagery of the rice fields in the backlands of Nouvelle Flanders to Versailles oriented north with onshore pipeline installation distantly visible (Blue Arrow)

Figure 3-2: Aerial Imagery of the rice fields in the backlands of Phoenix Park oriented south with onshore pipeline installation visible; distant settlement is the Parfait Harmonie community

Figure 3-3: Fruits and root vegetables cultivated in Lust-en-Rust; prepared beds to which cultivation may be extended are in the onshore pipeline AoI

Figure 3-4: Fruits and root vegetables cultivated in Canal No. 1; aerial image oriented north in the earthen dam connected to Bordeaux Street

Figure 3-5: Aerial image oriented northeast showing a section of the NGL Plant and the tie-in location to the onshore pipeline; abandoned sugar cane plantations surround the onshore pipeline

Figure 3-6: Aerial Image oriented North showing the continuation of the onshore pipeline alignment surrounded by abandoned lands and scrubs

3.3 NGL Plant, Temporary MOF and Permanent GTE Wharf Facility

There are no settlements close to the study areas for the NGL Plant, the temporary MOF and the permanent GTE wharf. No ecosystem services were mapped in this area. The lands surrounding the NGL Plant were previously under sugar cane cultivation but were abandoned when the Wales Sugar Estate was closed in 2017. At the time of conducting the survey, the only existing uses of these lands were to support project activities. Figure 3-7 shows the study areas for these project components.

Figure 3-7: Aerial image of the MOF (Right), the permanent docking facility (Left) and the construction site of NGL Plant (in the Background) surrounded by abandoned and unoccupied lands

3.4 Lower Demerara River

Provisioning Services

Landing sites for artisanal vessels engaged in marine fisheries were among the most common provisioning services in the Lower Demerara River study area, with nine such sites recorded between Crane and the temporary MOF. The intensity of activities varied at these landing sites, with the largest two being Good Fortuin and Good Intent. In addition, local stakeholders reported that several persons are engaged in crabbing in the mangroves along the river banks (particularly south of the Demerara Harbour Bridge) for recreation and sale. Commercial crabbing is typically done during the July to September crabbing season. Moreover, a few persons also catch iguanas and waterbirds in the mangroves for subsistence and sale. Local stakeholders indicated that these activities were also more intensive south of the Demerara Harbour Bridge.

Socio-economic activities were also intensive along the river bank. Two new shorebase facilities, one operational and the other still under construction were within the study area. Additionally, seven smaller wharfing facilities were located along the river bank, south of the Demerara Harbour Bridge. The GTE project's MOF and permanent docking facility will add to the small wharfs in the study area. Other

socio-economic activities include the commercial district in Vreed-en-Hoop (including in the Vreed-en-Hoop stelling) comprising small vendors, wholesale and retail enterprises, restaurants and entertainment; sawmills along the river bank that utilize the Demerara River to transport logs, and boat building on the river dam in Vreed-en-Hoop.

The final significant ecosystem service was using the river banks to support aquatic transportation. Thousands of passengers use the Vreed-en-Hoop Stelling daily for transportation between Regions 3 and 4 via small privately owned vessels called “speed boats.” A small speed boat stelling was also constructed in Wales. In addition, a new bridge crossing the Demerara River is being constructed at Schoonard. In the Demerara River, loaded vessels traverse closer to the eastern bank to access the channel en route to the Port of Georgetown or to farther inland ports such as Linden. Fisherfolk from all subsectors and local farmers also use the Demerara River for transportation (Figure 3-8 shows an artisanal fishing vessel in the Demerara River). Finally, vessels transport sand and other materials for the GTE Project to the MOF.

Regulating Services

Mangrove cover supports carbon sequestration, and mangrove forests support hard sea defence structures to protect local communities from the sea's impacts. According to the NDC, mangrove growth is increasing along the Crane shoreline.

Cultural Services

The main cultural services were using the riverbank for Hindu ritual/religious activities and recreational activities in local parks.

Supporting Services

Mangroves provide habitats for several species of birds, crabs, and other animals, which in turn support the provision of food and sustenance for local communities.

Figure 3-8: Artisanal fishing vessel in the Demerara River

Table 3-1: Detailed Findings of the GTE-ESS

Service	Type of Service	Description and Examples in the Study Area Based on Stakeholder Input	Relevant Land Use / Habitat Categories	Beneficiaries and ES Linkages	Importance to Beneficiaries (Low- Essential)	Replaceability (Low-High)	Priority Rating (Importance x Replaceability)
Offshore Pipeline							
Fishing Grounds	Provisioning	▪ Artisanal fishing grounds typically start nearshore, generally with a minimum distance of 0.1 km from the shoreline. The maximum distance offshore depends on the type of fishing gear used. Based on data collected onboard, artisanal fishing grounds are typically within 50 km of the shoreline, with significant variations based on the type of fishing gear used. ▪ Artisanal fisherfolk who use Cadell lines go farther offshore than any other artisanal method, with a maximum distance of 47.5 km. ▪ Artisanal fisherfolk who use drift seines (with a range of mesh sizes) typically stay within 32 km of the shore. ▪ Artisanal fisherfolk who use Chinese seines set up their fishing 'pens' within 10 km of the shoreline. ▪ Artisanal fisherfolk who use pin seines travel the least distance (a maximum of 1 km) from shore. ▪ Fishing grounds used by semi-industrial operations are typically farther offshore than artisanal fishing activities. Vessels using red snapper traps have reported fishing grounds at minimum and maximum distances of 31 to 102 km from shore, respectively. ▪ Fishing grounds used by industrial operations to target seabob and prawns are regulated to occur between 8 to 18 fathoms by the Ministry of Agriculture, Department of Fisheries. Trawlers are not allowed to operate outside this regulated zone.	Ocean	Fisherfolk utilizing fishing grounds with the offshore direct AoI **ES Linkages**: Marine Transportation	Essential	High	**High**
	Provisioning	▪ MARAD categorizes Guyana's marine environment into three zones, namely: the inshore zone (up to 16	Ocean	Shipping industry operators (local and international),	Essential	Moderate	**Critical**

Service	Type of Service	Description and Examples in the Study Area Based on Stakeholder Input	Relevant Land Use / Habitat Categories	Beneficiaries and ES Linkages	Importance to Beneficiaries (Low- Essential)	Replaceability (Low-High)	Priority Rating (Importance x Replaceability)
Marine Transportation		km offshore), the intermediate zone (16 to 80.5 km offshore), and the offshore zone (80.5 km and beyond). ▪ The main traffic in the **inshore zone** (between the mouths of the Demerara and Essequibo Rivers) is tugs and barges transporting sand, stone, lumber, logs, and rice paddies. Three ferry vessels, operated by the Transport and Harbours Department (T&HD), traverse the coastline between Georgetown and Region 1 along the northern section of the inshore zone. Miscellaneous cargo vessels, like small coastal tankers, also operate in this area. International marine traffic is also expected to cross the pipeline in the inshore zone to access the Port of Georgetown. ▪ Trawlers and fishing vessels are among the types of marine traffic commonly found in the **intermediate zone**. Vessels from Guyana and the Caribbean bound for Suriname and French Guiana also travel in the intermediate zone. All international vessels travelling to the Port of Georgetown must also cross the pipeline alignment in the intermediate zone. ▪ Traffic moving east-west in the **offshore zone** is not destined for Guyana but is heading to Brazil or originates from the East Coast of South America bound for the United States. Internal traffic in the offshore zone typically features the Platform Supply Vessels transiting to and from the FPSOs.		persons relying on the ferry services. **ES Linkages:** Marine Fisheries			
Primary Production and Habitat Provision	Supporting	▪ The marine environment provides critical habitats for various species, including breeding, feeding and nursery areas for fish and other marine organisms.	Ocean	Communities relying on the resources provided by marine habitats for livelihoods and food.	Essential	Low	**Critical**

Service	Type of Service	Description and Examples in the Study Area Based on Stakeholder Input	Relevant Land Use / Habitat Categories	Beneficiaries and ES Linkages	Importance to Beneficiaries (Low- Essential)	Replaceability (Low-High)	Priority Rating (Importance x Replaceability)
		▪ Phytoplankton and marine plants form the base of the marine food web which supports a marine biodiversity.					
Onshore Pipeline							
Crop Cultivation – Rice Farming	Provisioning	▪ Large-scale rice cultivation in Crane, Versailles, and between Lust to Rust and Westminster. The lands under rice cultivation are irrigated and drained by an extensive network of canals that typically surround the rice fields. ▪ According to local stakeholders, challenging weather conditions in the previous five years (particularly prolonged dry spells) resulted in the cessation/stoppage of rice cultivation, presumably temporarily, in some areas. ▪ Some rice farmers are engaged in other agricultural activities such as cultivating cash crops and grazing livestock on the dams of the rice fields when the rice crop is not in season.	Cultivated lands	Farmers engaged in rice cultivation and other agricultural activities in the cultivated lands. **ES Linkages:** Agriculture (Livestock Grazing), Inland Fishing, Hunting/Trapping	High	Low	**Critical**
Crop Cultivation – Fruit and cash crops	Provisioning	▪ Cultivation of bananas and other fruits in Westminster/Parfait Harmonie. ▪ Cultivation of cash crops, root crops and pineapple in Recht Door Zee, Lust to Rust and Canal No. 1. ▪ According to the officials from the Best/Klien Pouderoyen NDC, an area known as “Mango Dam” in the Phoenix Park backlands was widely used to harvest mangoes for commercial and sustenance purposes about three years previously. However, the study team could not verify the status of the use of this area as it was not accessible.	Cultivated lands	a) Farmers and community members engaged in the cultivation of bananas and other fruits in Westminster/Parfait Harmonie. b) Farmers cultivating cash crops and pineapple in Recht Door Zee, Lust to Rust and Canal No. 1. **ES Linkages:** Rice Cultivation	a) Low b) High	a) High b) Moderate	**a) Low** **b) High**
Livestock Grazing and Rearing	Provisioning	▪ Small-scale livestock grazing in the Canals Polder. ▪ According to local stakeholders, there is rotational grazing of cattle, sheep and goats, particularly on	Cultivated lands, abandoned	a) Local communities engaged in livestock grazing in the Canals Polder and the	a) Moderate b) Low c) Low	a) Moderate b) High c) Moderate	**a) Low** **b) Low** **c) Low**

Service	Type of Service	Description and Examples in the Study Area Based on Stakeholder Input	Relevant Land Use / Habitat Categories	Beneficiaries and ES Linkages	Importance to Beneficiaries (Low- Essential)	Replaceability (Low-High)	Priority Rating (Importance x Replaceability)
		lands previously used for sugar cane cultivation in the backlands of the Patentia/Toevlugt NDC. ▪ Small-scale livestock rearing and grazing (during the out of crop season) in rice fields in Crane and Westminster. ▪ Grazing of sheep and goats along the sea defense reserve from La Union and Crane by a few persons. Grazing along the sea walls and on sea defence reserves has decreased. The NDC actively discourages grazing in these areas because livestock, particularly cattle, damage the parapets and cause erosion.	sugar cane plantations	backlands of the Patentia/Toevlugt NDC b) Local communities engaged in small-scale livestock rearing and grazing in Crane and Westminster c) Local communities grazing livestock along the La Union shoreline **ES Linkages:** Crop Cultivation			
Hunting/Trapping	Provisioning	▪ Trapping of wild birds such as 'towa towa' and 'fire red' in Crane, Versailles, Canals Polder, and Belle West. Some persons also visit these areas to collect wild seeds to feed birds.	Cultivated lands, canals	Community members engaged in capturing song birds in back dams, and other animals for meat **ES Linkages:** Inland fishing, Crop Cultivation	Moderate	High	**Low**
Socio-Economic: Commercial and Residential Areas	Provisioning	▪ Residential areas comprising housing schemes developed by the Government are within the AOI. These areas include Crane, Westminster, Lust to Rust and the Canals Polder. Some unregulated housing activity is also present. ▪ New housing and commercial schemes by private developers are planned in Versailles and Malgre Tout.	Residential lands	Local communities residing in the residential areas	Essential	Low	**Critical**
Fishing	Provisioning	▪ Inland fishing in the canals of Crane, Lust to Rust and Belle West for recreation and sustenance.	Shoreline, river banks, canals	Local communities engaged in inland fisheries for recreation and sustenance **ES Linkages:** Crop Cultivation, Trapping/Hunting	Low	High	**Low**

Service	Type of Service	Description and Examples in the Study Area Based on Stakeholder Input	Relevant Land Use / Habitat Categories	Beneficiaries and ES Linkages	Importance to Beneficiaries (Low- Essential)	Replaceability (Low-High)	Priority Rating (Importance x Replaceability)
Crabbing	Provisioning	▪ A few persons are engaged in crabbing along the Crane shoreline throughout the year.	Mangroves, beach, shoreline	Local communities engaged in crabbing in Crane **ES Linkages:** Marine Fisheries	Low	Moderate	**Moderate**
Aquatic Transportation	Provisioning	▪ Rice farmers use the drainage and irrigation canals to transport supplies to their farms when earthen dams are impassable.	Cultivated lands, canals	Local rice farmers **ES Linkages:** Inland fishing, Crop Cultivation	Low	Moderate	**Low**
Erosion and Flood Regulation	Regulating	▪ Drainage and irrigation canals, particularly surrounding the rice fields, can absorb and slow down water flow during periods of intense rainfall, thereby regulating erosion and flooding.	Cultivated lands, canals	Local rice farmers **ES Linkages:** Inland fishing, Crop Cultivation	Moderate	Moderate	**Medium**
Tourism and Recreation	Cultural	▪ The beach in La Union is used by persons who live near the shoreline. Hundreds of persons use seawalls for picnics and kite flying in La Union during special holidays like Easter.	Beach, shoreline, sea defences	Local communities using beaches and river defences in La Union for recreation **ES Linkages:** Fishing, Ritual/Religious	Moderate	Moderate	**Medium**
Heritage	Cultural	▪ Silk cotton trees are present in the AOI. According to local folklore, silk cotton trees are places where supernatural beings reside. They are also known as “Jumbie Trees”. As such, there are efforts locally to avoid harvesting these trees.	Cultivated lands	Local communities who consider the silk cotton tree as an important heritage sites **ES Linkages:** Crop Cultivation	Low	Low	**Medium**
Habitat Provision	Supporting	▪ Agricultural lands, canals, and scrublands along different sections of the AoI provide habitats for fish, birds, and other biodiversity. ▪ Drainage and irrigation canals provide a reliable water source for crop irrigation, thereby supporting crop cultivation and the provision of food.	Cultivated lands, canals	Communities benefiting from crop cultivation **ES Linkages:** Crop Cultivation, Inland Fishing	Essential	Low	**Critical**
Lower Demerara River							

Service	Type of Service	Description and Examples in the Study Area Based on Stakeholder Input	Relevant Land Use / Habitat Categories	Beneficiaries and ES Linkages	Importance to Beneficiaries (Low- Essential)	Replaceability (Low-High)	Priority Rating (Importance x Replaceability)
Fishing	Provisioning	▪ Landing site for fewer than 5 artisanal fishing vessels in Crane. Fisherfolk in this area commonly use various seine types, including pin seines, to fish along the shoreline. When pin seines are used, catamarangs are utilized to retrieve the catch. ▪ Landing site for approximately 6 artisanal fishing boats at Vreed-en-Hoop. ▪ Landing site for approximately 2 artisanal fishing vessels at Coglan Dam. ▪ Landing site for approximately 40 artisanal fishing vessels at Goed Fortuin. ▪ Landing site for about 6 artisanal fishing vessels at La Grange. ▪ Landing site for approximately 5 artisanal fishing vessels at Stanleytown. ▪ Landing site for approximately 15 to 20 artisanal fishing vessels at Good Intent (locally called the 'sawpit' koker). ▪ Landing site for approximately 5 artisanal fishing vessels at the Vriesland koker. ▪ Inland fishing in the canal at a Patentia koker.	River dam, river habitat, marine habitats, mangroves	a) Fisherfolk utilizing the landing site at Crane b) Fisherfolk utilizing the landing site at Goed Fortuin c) Fisherfolk utilizing the landing sites at Vreed-en-Hoop, La Grange, Stanleytown and the Vriesland Koker d) Fisherfolk utilizing the landing sites at Good Intent e) Fisherfolk utilizing the landing site at Phoenix Park f) Community members fishing in the Patentia Canal for recreation and sustenance **ES Linkage:** Crabbing, Socio/Economic, Hunting/Trapping	a) Low b) Essential c) Moderate d) High e) Low f) Moderate	a) Moderate b) Low c) Moderate d) Moderate e) Moderate f) High	**a) Low** **b) Critical** **c) Medium** **d) High** **e) Low** **f) Low**
Crabbing	Provisioning	▪ Several people are engaged in crabbing in the mangroves along the river banks (particularly south of the Demerara Harbour Bridge) for recreation and sale. Commercial crabbing is typically done during the July to September crabbing season.	Mangroves, beach, river bank	a) Local communities engaged in crabbing throughout the year b) Local communities engaged in crabbing seasonally **ES Linkage:** Fishing, Socio/Economic, Hunting/Trapping, Mangroves	a) Moderate b) Moderate	a) Low b) Moderate	**a) High** **b) Medium**
Crop Cultivation	Provisioning	▪ Crop cultivation along the Demerara River Bank at Stanleytown and Vive La Force.	Sea defence reserves	Local communities engaged in the cultivation of crops for sustenance and sale.	Moderate	High	**Medium**

Service	Type of Service	Description and Examples in the Study Area Based on Stakeholder Input	Relevant Land Use / Habitat Categories	Beneficiaries and ES Linkages	Importance to Beneficiaries (Low- Essential)	Replaceability (Low-High)	Priority Rating (Importance x Replaceability)
Agriculture: Livestock Grazing	Provisioning	▪ Grazing of approximately 30 heads of cattle and sheep on the sea dam in Best Village. In addition, 2 persons rear pigs on the sea dam in Best Village.	Sea dam, sea defence reserves	Local communities grazing livestock and rearing pigs in Best Village **ES Linkages:** Fishing, Tourism and Recreation	Moderate	Moderate	**Medium**
Hunting/Trapping: Wild Meat	Provisioning	▪ A few persons catch iguanas and waterbirds for sale and for sustenance in the mangroves along the river banks (particularly south of the Demerara Harbour Bridge).	Mangroves	Local communities (general population) hunting in the mangroves **ES Linkage:** Crabbing, Socio/Economic, Hunting/Trapping	Moderate	Moderate	**Medium**
Socio-Economic: Shorebases and Wharfs	Provisioning	▪ Shorebase facilities at Vreed-en-Hoop and Versailles to Malgre Tout to support the offshore oil and gas industry. ▪ Wharfing facilities location along the western bank of the Demerara River at Schoonard, Stanleytown, Nismes , La Retreat , Vriesland, and Free and Easy. ▪ The GTE Project's temporary MOF and permanent docking facility are located in Free and Easy.	River bank	a) Operators of the shorebase facilities to support offshore oil and gas activities b) Operators of wharfing facilities on the banks of the Demerara River c) Beneficiaries of the GTE Project **ES Linkages:** Residential and commercial areas, marine transportation, riverine transportation	a) High b) High c) High	a) Low b) Moderate c) Low	**a) Critical** **b) High** **c) Critical**
Aquatic Transportation	Provisioning	▪ Vreed-en-Hoop Stelling used daily by thousands of passengers for transportation between Regions 3 and 4 by small privately owned vessels called "speed boats".	River dam, shoreline, commercial and housing areas	a) Local communities using speed boats b) Local farmers, fisherfolk and other artisans using the Demerara River to transport produce	a) Essential b) Essential c) Essential d) Moderate e) Essential	a) Low b) Low c) Low d) Moderate e) Low	**a) Critical** **b) Critical** **c) Critical** **d) Medium** **e) Critical**

Service	Type of Service	Description and Examples in the Study Area Based on Stakeholder Input	Relevant Land Use / Habitat Categories	Beneficiaries and ES Linkages	Importance to Beneficiaries (Low- Essential)	Replaceability (Low-High)	Priority Rating (Importance x Replaceability)
		▪ Loaded vessels traverse closer to the eastern bank of the Demerara River to access the channel en route to the Port of Georgetown. ▪ Artisanal fisherfolk and industrial fishing operations (Pritipaul Singh Investments, Gopie Investments, and R&S) are also active in the Demerara River. ▪ South of the Demerara Harbour Bridge, ships and tankers transport bauxite from Linden and fuel to Linden. Local farmers utilize small boats in the river. ▪ Vessels transport sand and other materials for the GTE Project to the MOF. ▪ Stelling for speed boat landing in Wales. ▪ Construction of a new bridge crossing the Demerara River at Schoonard with construction base on the Western Bank.		c) Operators of cargo vessels (including for support of the GTE project) and industrial fishing vessels d) Local communities using the speed boat landing in Wales e) Local communities set to benefit from a new Demerara Harbour Bridge. **ES Linkages:** Fishing, Crop Cultivation, Residential and Commercial Areas			
Socio/Economic: Sawmill	Provisioning	▪ Sawmill in Pouderoyen utilizes the Demerara River to transport logs to the mill.	River dam, commercial and housing areas	Sawmill owner, workers and local communities (general population) **ES Linkage:** Transportation	Moderate	Moderate	**Medium**
Socio/Economic: Boat Building and Repairs	Provisioning	▪ Boat building and repairs by one group on the river dam in Vreed-en-Hoop. This group works on wooden vessels to be used as fishing boats or speed boats.	River dam	Boat builders, fisherfolk and speed boat operators	High	Low	**Critical**
Socio/Economic: Markets and Commerce	Provisioning	▪ Commercial activities in Vreed-en-Hoop (including in the Vreed-en-Hoop stelling) comprising small vendors, wholesale and retail enterprises, restaurants and entertainment among others.	River bank and lands used for commercial purposes	Businesses and consumers relying on the commercial activities in Vreed-en-Hoop **ES Linkages:** Tourism, Transportation	Essential	Low	**Critical**
Mangrove Materials	Provisioning	▪ A few households harvest mangroves for construction of fences and for fishing, primarily in squatting areas.	Mangroves	Local communities (general population) harvesting mangroves	Low	High	**Low**

Service	Type of Service	Description and Examples in the Study Area Based on Stakeholder Input	Relevant Land Use / Habitat Categories	Beneficiaries and ES Linkages	Importance to Beneficiaries (Low- Essential)	Replaceability (Low-High)	Priority Rating (Importance x Replaceability)
Tourism and Recreation	Cultural	▪ Joe Vieira Park is a park for rest and recreation which is located in Schoonard. On special holidays, such as Easter, thousands of persons visit the park to fly kites. The grounds are currently under rehabilitation. ▪ A small park in La Retreat, including an area along the Demerara River Bank, is used for relaxation and recreation.	River bank, mangroves	a) Local communities visiting the Joe Vieira Park b) Local communities using the park and river defences in La Retreat for recreation **ES Linkages:** Ritual/religious, Socio-Economic, Residential and Commercial Areas	a) Moderate b) High	a) Low b) Moderate	**a) High** **b) High**
Ritual/Religious	Cultural	▪ Hindu religious observed along the river bank in Pouderoyen, Schoonard, Wales, Patentia, Stanleytown river bank, and Stanleytown koker.	River bank, mangroves	Local Hindu communities **ES Linkages:** Tourism and Recreation	Moderate	Moderate	**Medium**
Global Climate Regulation	Regulating	▪ Mangrove cover shoreline supports carbon sequestration.	Mangroves	Local communities **ES Linkages:** Habitat Provision, Shoreline Protection, Crabbing, Fishing	Moderate	Moderate	**Medium**
Shoreline Protection and Erosion Regulation	Regulating	▪ Mangrove forest supports hard sea defence structures to protect the local communities from the impacts of the sea. According to the NDC, mangroves growth has increased along the Crane shoreline.	Mangroves	Local communities **ES Linkages:** Habitat Provision, Global Climate Regulation, Crabbing, Fishing	Essential	Moderate	**High**
Primary Production and Habitat Provision	Supporting	▪ Mangroves provide habitats for several species of birds, crabs monkeys, raccoons, and wild ducks.	Mangroves	Local communities **ES Linkages:** Habitat Provision, Shoreline Protection, Crabbing, Fishing	High	Moderate	**High**

APPENDIX A: ECOSYSTEM SERVICES SCREENING CHECKLIST

Ecosystem Service	Description and Examples
Provisioning Services	
Food: wild-caught fish and shellfish & aquaculture	Fish caught for subsistence or commercial sale; Fish, shellfish, and/or plants that are bred and reared in ponds, enclosures, and other forms of freshwater or saltwater confinement for harvesting.
Food: wild plants, nuts, mushrooms, fruit, honey	Fruit, nuts, wild plants, etc. collected in natural areas for consumption or sale.
Food: wild meat	Animals hunted primarily for food (recreational hunting is covered separately under cultural services); extent of wildlife trapping and trade.
Food: cultivated crops	Annual and permanent crops grown for subsistence use and commercial sale.
Biomass for livestock production	Sedentary and nomadic livestock grazing supported by native forage plants.
Biomass fuel	Wood, dung and plant matter collected for charcoal or fuel.
Timber and wood products	Wood collected for local use or for sale as timber, wood pulp, paper – wood is used in house construction (N.B.: The importance varies by community).
Non-wood fibers and resins	For example, cane, palm, straw, cotton, hemp, twine and rope, and natural rubber.
Freshwater - household use	Freshwater for bathing, drinking, laundry, and household use.
Freshwater - irrigation & industry	Freshwater for irrigation or industrial use.
Natural medicines, pharmaceuticals	Natural medicines, biocides, food additives, pharmaceuticals and other biological material for commercial or domestic use.
Ornamental resources	For example, pelts, carved or decorative animal products, and live animal trade.
Genetic resources	Genes and genetic information used for animal breeding, plant improvement, and biotechnology.
Transportation	In remote areas no alternative methods of transport; commercial transportation facilities such as wharfs, ferry stellings, etc.
Social / Economic	Income generators or services supporting income generation (e.g., boat building, repairs, transportation services).
Regulating Services	
Regulation of air quality	The effect of ecosystems on air quality by extracting chemicals from the atmosphere (i.e., serving as a “sink”) or emitting chemicals to the atmosphere (i.e., serving as a “source”).
Climate regulation: global	Vegetated areas sequester CO_2, with implications for global climate change.
Climate regulation: local	Regulation of temperature, shade air, and quality by vegetated areas.
Regulation of water timing and flows (including flood regulation)	The effect of ecosystems on the timing and magnitude of water runoff, flooding, and aquifer recharge.

Ecosystem Service	Description and Examples
Water purification and waste treatment	The role played by vegetation in the filtration and decomposition of organic wastes and pollutants and the assimilation and detoxification of compounds.
Shoreline protection	The role of natural habitats (e.g., wetlands, beaches and reefs) in protecting crops, buildings, recreation areas from waves, wind and flooding from coastal storms.
Fire regulation	Regulation of fire frequency and intensity (e.g., dense forest can provide firebreaks).
Pest regulation	Predators from forests, grassland areas, etc. may control pests attacking crops or livestock.
Disease regulation	The effect of ecosystems on the incidence and abundance of human pathogens.
Erosion regulation	The role of vegetation in regulating erosion on slopes and riparian areas.
Pollination	Birds, insects and some small mammals pollinate certain flora species, including some agricultural crops.
Cultural Services	
Spiritual or religious value	Natural spaces or species with spiritual or religious importance
Traditional practices	Cultural value placed on traditional practices such as hunting, fishing, crafts and use of natural resources.
Tourism and recreation	Use of natural spaces and resources for tourism or local recreation (e.g., swimming, boating, and fishing).
Aesthetic value	Cultural value placed on the aesthetic value provided by landscapes, natural landmarks.
Educational and inspirational values	Information derived from ecosystems used for intellectual development, culture, art, design, and innovation.
Non-use value of biodiversity (e.g., existence, bequest value)	Species and areas valued globally as of high conservation value.
Supporting Services [a]	
Habitat provision	Natural spaces that maintain species populations and protect the capacity of ecological communities to recover from disturbances.
Primary production	Formation of biological material by plants through photosynthesis and nutrient assimilation.
Nutrient cycling	Flow of nutrients (e.g., nitrogen, sulphur, phosphorus, and carbon) through ecosystems.
Water cycling	Flow of water through ecosystems in its solid, liquid, or gaseous forms.
Soil formation	Natural soil-forming processes throughout vegetated areas.

APPENDIX B: PHOTOGRAPHS OF STAKEHOLDER ENGAGEMENTS

Appendix B.1: Engagements with Central Stakeholders

Figure A-1: Engagements with representatives of the Guyana Association of Trawler Owners and Seafood Processors (GATSOP) on March 13, 2024

Figure A-2: Engagements with representatives of the Coast Guard on March 13, 2024

Figure A-3: Engagements with representatives of the National Agricultural and Research Institute (NAREI) on March 14, 2024

Figure A-4: Engagements with representatives of the Maritime Administration (MARAD) on March 14, 2024

Figure A-5: Engagements with representatives of the Fisheries Department on March 14, 2024

Figure A-6: Engagements with representatives of the Guyana Lands and Surveys Commission on March 27, 2024

Appendix B.2: Engagements with Local Stakeholders

Figure A-7: Engagement with representatives of the La Jalousie/Nouvelle Flanders NDC on April 23, 2024

Figure A-8: Engagement with representatives of the Best Klien/Pouderoyen NDC on April 23, 2024

Figure A-9: Engagement with representatives of the Malgre Tout/Meer-Zorgen NDC on April 24, 2024

Figure A-10: Engagement with representatives of the La Grange/Nismes NDC on April 24, 2024

Figure A-11: Engagement with representatives of the Canals Polder NDC on April 25, 2024

Figure A-12: Engagement with representatives of the Toevlugt/Patentia NDC on April 25, 2024

APPENDIX C: LIST OF PARTICIPANTS IN STAKEHOLDER MEETINGS

Appendix C.1: Central Stakeholders

Agency	Names	Designation
GATSOP	Reuben Charles	President
Guyana Coast Guard	Luther Singh	Lieutenant Commander
	Roul Williams	Lieutenant Commander
	Rodwin Paul	Lieutenant Commander
NAREI	Jagnarine Singh	Chief Executive Officer
	Kene Moseley	Project Coordinator
	Kim Chan-Bagot	Research Officer
	Zola Narine	Monitoring Officer/GIS Specialist
	Rudolph Adams	Monitoring Officer
	Luan Gooding	Assistant Monitoring Officer
MARAD	Capt. Stephen Thomas	Director General
	Courtney McDonald	Director of Safety
	Troy Clarke	Superintendent of Survey
	Anastasia Jessency Lynch	Offshore Coordinator
Fisheries Department	Denzil Roberts	Chief Fisheries Officer
	Mikhail Amsterdam	Senior Fisheries Officer
GLSC	Enrique Monize	Commissioner
	Andrea Mohammad	Head, Land Use Planning Policy & Projects
	Roland Austin	Senior Land Use Planner

Appendix C.2: Local Stakeholders

NDC	Names	Designation
La Jalousie/Nouvelle Flanders	S. Deoraj	Overseer
	T. Yaidat	Councillor
	N. Basdeo	Assistant Overseer
	Melissa Reddy	Monitor/ Part-time worker
	H. Sridat	Part-time worker
	Faneeza Nazirudun	Part-time worker
	D. Lonhan	Chairman of the Water Users Association
Best Klien/Pouderyoen	Umesh L. Balram	Chairman
	Shanita Churaman	Overseer
	Swarswattie Harripersaud	Assistant Overseer
	Natasha Neblett	Coordinator
	Dr. Judy Huna	Medical Superintendent
	Dr. E. Persaud	General Medical Consultant
Malgre Tout/ Meer-Zorgen	Paul Ramrattan	Chairman
	Theresa Persaud	Overseer
	Abdool Yasim	Councillor
La Grange/ Nismes	Alvin Parag	Chairman
	Thakur Arjun	Councillor
	Rebekah Krisharam	Councillor
	Ashton Crawford	Councillor
	Mariai D. Ritney	Councillor
	Leemar Roberts	Overseer

NDC	Names	Designation
	Tiffony Samuels	Environmental Health Assistant
	Kishan Shivgobin	Councillor
	Takiesha Kansinally	(Not Given)
	Hansa K. Mangroo	Councillor
Canals Polder	Yogieraj das	Chairman
	H. Harrylall	Vice Chairman
	C. Bhagwandas	Overseer
	Seecharran Persaud	Councillor
	Bibi S. Alli	Councillor
	Seelall Shivcharan	Councillor
	Dian David	Part-time Worker
	Salim Rasheed	Supervisor
	Bibi Faneeza Rattan	Part-time Worker
	Shridevi Gendalall	Part-time Worker
	Nandkumarie Harlall	Caterer
Toevlugt/ Patentia	Makkhe	Chairman
	N. Lewis	Overseer
	Beccles	Environmental Health Assistant
	G. Castello	Former Overseer
	Talata Khan	Monitor
	Yoganand Singh	Monitor
	Baston	Part-time Worker
	Rajwatie	Part-time Worker
	Bibi Hussain	Part-time Worker
	Kamini Mangra	Typist/ Office Assistant
	Rasanna Sookoo	Assistant Overseer