Eni Ghana

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No Net Loss Strategy for Natural Habitats – Appendix F:

Title
No Net Loss Strategy for Natural Wetlands
Note
Rev 04. Revision according to production phase and following December 2019 Post Construction survey report.

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Prepared by	Checked by	Reviewed by	Endorsed by
Jason Sali Senior Biodiversity Specialist – Eni Natural Resources	Sena Mawuyra HSE Engineer Anthony Ahenkorah Env. Coordinator	Arsenio Parrella HSE Manager	Giuseppe Valenti Managing Director

1 EXECUTIVE SUMMARY

This document provides a quantitative estimate of natural and critical habitat losses following the completion of concept development (construction) activities within the OCTP Onshore Receiving Facility (ORF) concession area (the project). This revised estimate considers both direct and indirect project-related impacts from habitat loss and degradation. In doing so, Eni Ghana believes *it meets the full requirements of IFC PS6*. It includes consideration of:

1. Direct natural habitat loses associated with the project "footprint" within the ORF concession
2. Restoration gains associated with restoration activities within the concession
3. Estimated changes in habitat quality or condition (degree of modification) within the ORF concession and the immediate surroundings,
4. Estimated indirect (secondary and cumulative) impacts associated with wider losses within a 5km area of influence.

Eni has selected a biodiversity accounting method based on consideration of the extent and estimated level of modification (condition) within the habitat affected. No impact on *critical habitat* was identified. The total estimated losses to natural habitat are shown in both hectares (ha) and an area/condition metric (Quality ha (Qha)) in Table 1.1

Table 1-1. Estimate direct residual impacts to Natural habitats associated with the construction of the ORF facility. Losses are listed as a negative (-), gains as a positive (+).

	Natural Habitat		**Critical habitat**
	Hectares (ha)	**Quality hectares (Qha)**	
Loss of habitat extent	-12.2	-8.4	0
Losses to habitat quality	0	0	0
Restoration area (extent)	+14.8	0	0
Total	2.6Ha	-8.4 Qha	0ha

The project avoided impacts to the majority of natural habitat (NH) within the 96.1 ha concession. This 39.1 hectares NH area (predominetly swamp forest) has been set-aside into an informal "forest reserve" within the concession. Unavoidable losses measuring 12.2ha (8.4Qha) were incurred from removal of NH to accommodate the ORF and other facilities within the concession area. Post construction biodiversity surveys did not show a measureable decline in the condition of natural habitat retained within the ORF. This outcome suggests that, with time, remaining modified habitat retained within the concession may also be restored to a natural state if undisturbed.

Considerable effort has been made to restore temporarily disturbed areas within the concession using native plants raised in an onsite nursery. The combination of active as well as passive restoration areas extends to 14.8 ha across the site, exceeding the area of natural habitat cleared for infrastructure. Restoration however, is expected to take up to 20 years before beginning to provide the habitat supporting services typical of natural habitats and contributing toward to the NNL objective, and therefore its contribution to natural habitat gains is yet to be quantified (as shown table 1). By 2040 however, we anticipate that the extent of restored areas within the ORF shall qualify as natural habitat, equivalent to 11.8Qha; greater than the losses incurred during construction.

A further 24.8ha of "modified habitat" consisting of mixed coconut and palm plantation, was retained within the concession at the completion of construction. Eni Ghana's NNL strategy aims to utilise this area as an "onsite offset" by excluding further exploitation, encouraging the regeneration of native plants, and "rewilding" through the placement of artificial nesting habitat. We estimate that this process will provide a gain of 19.8Qha of natural habitat in 2040.

Overall, we anticipate a net gain in natural habitat, from the pre-project state, of 27.3ha (30.3Qha), (Table 1-2), and the diversity of forest-dependent avian species living within this habitat to have increased. When avoided losses, (estimated at 1.5% per year) are considered, the estimated net gain increases to approximately 37ha. Eni believes that this gain is sufficient to adequately compensate for project related indirect impacts.

Table 1-2. Estimated extent of Natural habitat within the concession area over the lifespan of the project taking account of losses and predicted gains.

	Predicted extent of natural habitat within the ORF			**Estimated Gain from 2015**	**Estimate gain including avoided losses**
	Pre-construction	**Post-construction (2020)**	**End of project (est 2040)**		
Natural Habitat	39.1 ha (28.3 Qha)	26.9 ha (20.2 Qha)	66.4ha (58.6Qha)	27.3ha (30.3Qha)	37.0 (38Qha)

This post-construction revision of the NNL strategy also includes consideration of indirect impacts as per the general requirements of PS6. Indirect impacts include natural habitat losses that occur as a result of the project, but not by directly the project itself. For example, the displacement of livelihood related activities or the expansion of nearby villages to accommodate project-related in-migration to the area. Indirect impacts are more difficult to estimate than direct impacts and direct causation is hard to determine in multi-use areas.

Using global data on forest loss, this assessment identified that the rate of forest loss within 5km of the ORF concession is significantly higher than within the Amansuri Region

as a whole. However, this difference was already statistically significant prior to the project execution, and has not increased by a significant extent since the project commenced. Identified losses do not appear to be located in the "core" areas of wetland where the premium natural or critical habitat is located. Eni has monitored the drivers of in-direct impact through its Influx Management Plan (IMP) and Livelihoods Restoration Plan (LRP). Project-related influx was mitigated through the use of local labour and post-construction population monitoring does not show an increase in local populations. The location of alternative livelihood projects supported as part of the livelihood restoration plan also suggests that, in-line with the project guidance, as few as seven (each occupying 1 ha or less) have been established within natural habitat.

The total estimated area of natural habitat loss provided in this strategy acts as a target for the amount of biodiversity gains that must be provided by the selected offset solution. Currently, we predict that the potential gains available within the concession (37ha) is sufficient to cover both direct and indirect losses associated with the project. However, Eni Ghana shall continue monitoring both direct and indirect pressures through the implementation of the NNL strategy and the requirements of the IMP and LRP. Estimate losses will be updated as new information becomes available.

The Ghanaian Environmental Protection Agency has recently produced guidance for offset developers. The publication of this guidance has been delayed by the COVID 19 pandemic, but it is expected to be published in 2021. This is expected to provide additional guidance for the determination of offset requirements, and may require an alteration to this strategy.

In the interim period, Eni Ghana plans to focus on mitigation actions within the concession area, with the objective of improvement to the quality of existing natural and modified habitats, as well as continued restoration. This action will include silvicultural practices that enhance plant species that are favoured by avifauna for feeding and nesting, removing alien invasive species and practising sustainable natural resource management to improve the provision of important ecosystem services to local communities.

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2 INTRODUCTION

This strategy is focused on the main Project impacts on Critical and Natural Habitats associated with the presence of the Onshore Receiving Facility, located in Sanzule, and related infrastructures over this type of habitat (e.g. roads and pipelines).

The assessment of potential impacts on habitats related to the construction of the facilities, including the restorative mitigation measures, have been addressed in detail in the OCTP Phase 2 ESHIA (Doc. 000415 DV EX.HSE.0304.000) and in the Biodiversity Management Plan (plan ms hse 019 eni Ghana). The present document covers the analysis of the permanent and temporary loss of natural wetlands from infrastructures and define a dedicated NNL strategy.

The strategy is divided into several steps, mainly:

- Review of national guidelines and project financing commitments
- Description of the accounting methodology used
- Re-assessment of Impacts on Natural Habitats including quantitative calculation of Net Loss;
- Identification and Assessment of Potential No Net Loss Options;
- Development of the selected options.

3 OBJECTIVES

The key objective of the NNL strategy for Natural Habitat is to demonstrate how Eni Ghana aims to achieve "No Net Loss of Biodiversity" (NNL) for natural habitats and "Net Gain" (NG) for critical habitats within the ORF Area of Influence (AoI) by the end of the project lifecycle through the full application of the Mitigation Hierarchy.

The specific objectives of the NNL strategy are as follows:

- Identify the offset policies and frameworks applicable to compensate for residual impact to Natural Habitat;
- Identify applicable accounting models for demonstrating how NNL/NG shall be achieved;
- Determine the residual impact to natural habitat at the conclusion of the construction phase of the ORF
- Summarise the potential offset required, as identified through the residual impact assessment on natural/critical habitat
- Articulate the different offsetting options which will be further developed through an offset feasibility assessment

4 NATIONAL GUIDANCE and LEGISLATION

The Environmental Assessment Regulations require that all undertakings should take into account potential impacts of the development on the environment and institute appropriate mitigation measures to offset the impacts.

In March 2016, the Ghana Environmental Protection Agency issued a DRAFT guidance for offset developers and providers in Ghana[1]. This guidance outlines the necessity for the demonstration of the mitigation hierarchy, and proposes some standardized methodologies to account for the value of biodiversity in Ghana. The final version of this guidance is anticipated later in 2021.

The accounting model described in the DRAFT guidance recommends developers use a biodiversity metric that considers habitat area and condition (as per this strategy). It also requires developers to give additional considerations to loss of ecosystem services when determining offset requirements. These include the livelihood dependencies (primarily provisioning services) of local communities such as natural resources in the form of raffia and specific medicinal plants, and the maintenance of fish ponds (as a source of income and protein). Eni Ghana has compensated for ecosystem service dependencies though a Livelihood Restoration Plan (Doc Sust-PLAN-001.00, Rev 05), which included compensation for loss of access to natural resources within the concession. We anticipate stakeholder consultation and the avoidance of further impacts to ecosystem-service dependant livelihoods, as primary objectives when developing additional plans to compensate for habitat losses outside of the concession area.

The residual impact and offset strategy described in this document may need to be modified following the publication of the final guidance.

[1] Ghana EPA–Biodiversity Offsetting Guidelines, Guidance for Developers and Offset Providers in Ghana. March 2016

5 IFC PERFORMANCE STANDARD 6

IFC Performance Standard 6 (PS6) and associated Guidance Notes (IFC 2019) require that, in order of priority, impacts on BES should be avoided, or where not possible, minimised and afterward their viability restored before offsets are considered.

The impact identification process should consider **direct**[2] and **indirect**[3] project-related impacts on biodiversity and ecosystem services and identify any **significant residual impacts.** Relevant threats to priority habitats include direct loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution (PS6, Para 6).

The final objective is based on the type of habitat (modified, natural and critical) and the priority biodiversity features within these. It is anticipated that (for all habitat types) clients should minimize impacts on such biodiversity and implement mitigation measures as appropriate. In areas of natural habitat, a "no-net loss[4]" objective is required (PS6, para 15-16). However projects located within area of "Critical habitat", must demonstrate a "net-gain[5]" (PS 6, para 17-18). In both cases, a biodiversity offset may be utilized to achieve these targets, providing the mitigation hierarchy approach is followed (PS6 Para 10). For the OCTP project, the natural and critical habitat affected are variants of "swamp" forest, which although covering a wide extent of the Amansuri region, are relatively scarce at a national scale.

Where necessary to achieve NNL or NG, the IFC PS6 requires that project proponents should design the offset to adhere to the equivalence principle of "like-for-like or better". That is, it should conserve the same biodiversity values that are being impacted by the project (an in-kind offset). Furthermore, offsets should be achieved through collaboration with the responsible government agency (and other community stakeholders) to agree on the key outcomes that need to be achieved, and must be permitted by local law.

Eni Ghana acknowledges the requirements of performance standard, described briefly above. Furthermore, Eni Ghana believes that the requirement to apply a mitigation

[2] Direct impacts might include disturbance or reduction in species' populations or their habitats (e.g. wind turbine collisions, road kill, noise, light, land or shipping traffic), effects from emissions and effluents, alterations of surface hydrology, land forms, and coastal processes, competition by invasive species, edge effects and barriers to dispersal, reduced access to ecosystem services including loss or degradation. (GN 15).

[3] Indirect impacts might include project-induced access by third parties, in-migration and associated impacts on resource use, including land conversion, hunting and wildlife trade, and spread of invasive alien species (GN 15).

[4] IFC PS 2018 defines no net loss as "the point at which project-related impacts on biodiversity are balanced by measures taken to avoid and minimise the project's impacts, to undertake on-site restoration and finally to offset significant residual impacts, if any, on an appropriate geographic scale (e.g. local, landscape-level, national, regional)".

[5] In instances where a biodiversity offset is not part of the client's mitigation strategy (i.e., there are no significant residual impacts), net gains may be obtained by supporting additional opportunities to conserve the critical habitat values in question. In these cases, qualitative evidence and expert opinion may be sufficient to validate a net gain. (IFC 2018 GN87)

hierarchy approach to minimise impacts to natural and critical habitat has been followed during the definition phase. Key mitigation in support of the application of the MH include:

- A detailed site selection processes to avoid Critical habitat and minimise overlap with Natural habitat[6]
- Reducing the size of the ORF concession area to avoid interaction with areas of cultural values and natural habitat.
- Avoidance of Natural Habitats (particularly wetland forest) through the spatial arrangement of infrastructure within the ORF concession area.
- 90° counter-clockwise rotation of the ORF layout to avoid areas of natural habitat (swamp) during concept execution[7].
- Avoiding the loss of priority plant species and conservation of genetic material identified in pre-construction surveys and relocated as necessary.
- Minimisation of habitat loss and disturbance through minimising the Right of Way of pipelines and roads.
- Restoration of temporarily disturbed areas using locally collected seeds material, propagated within an on-site plant nursery.

[6] Ghana OCTP Block Phase 2 HSE Decision Support document for CPF and accommodation Location (2014).
[7] Risk Assessment Report for the 90° counter-clockwise rotation of the ORF (doc ID. 351400DFRV09562 (2016)

Box 1. IFC PS6 Definitions of Natural and Critical habitat

Natural Habitat

"Areas composed of viable assemblages of plant and/or animal species of largely native origin, and / or where human activity has not essentially modified an area's primary ecological functions and species composition"

Critical Habitat

"Areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and /or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and / or unique ecosystems; and / or (v) areas associated with key evolutionary processes".

5.1 Critical and Natural Habitats within the Project Area.

Areas of Critical and Natural habitat were defined and mapped by Eni Ghana during the project ESHIA prior to the OCTP development and the commencement of construction activities for the ORF[8]. Further analysis of wetlands within the concession area clarified the transitional nature of wetland forest, distinguishing between the Blackwater Swamp Forest (Critical habitat) and wetland forest (Natural habitat) on the basis of the presence of peat substrate[9].

The final extent for each habitat type is shown in Figure 5-1. On the basis of this map, the final area of each habitat type within the ORF concession area is shown in table

Table 5-1. Area of natural, critical and modified habitat within the ORF

Habitat Classification	Land cover types included	Area within the ORF concession prior to construction (ha)
Natural	Wetland Forest, Secondary thicket (regenerating forest),	24.2ha 14.9 ha (total 39.1 ha)
Critical	Blackwater Swamp forest (BWSF)	0
Modified	Crops, trails, oil palm & coconut plantation, cleared areas.	57.3

[8] ERM 2016. Ghana OCTP Block Critical Habitats Screening and Assessment.
[9] ERM 2017 plan ms hse 019 eni Ghana r00 – Desktop Analysis of Wetlands Habitats – Appendix G rev.01

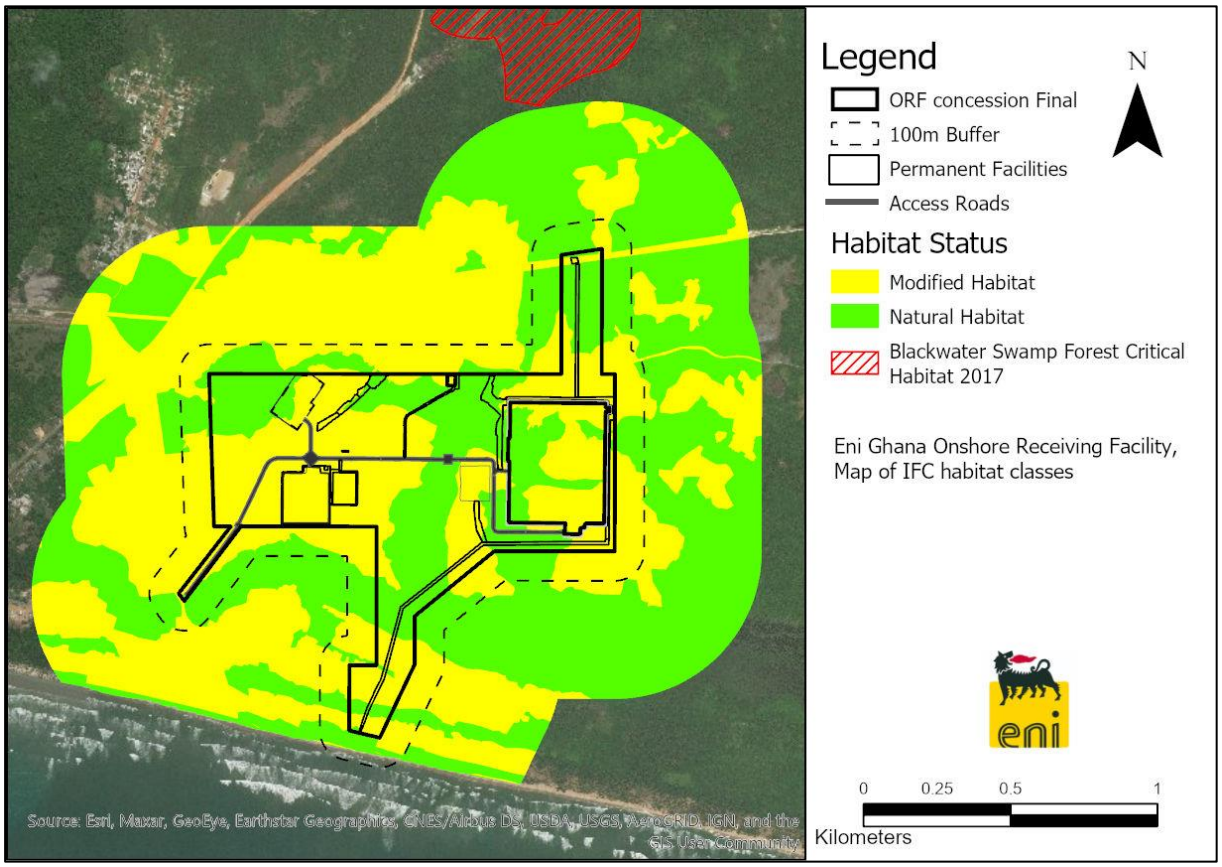


Figure 5-1. Map showing areas of critical, natural and modified habitat within a 5km radius of the ORF

This map indicates that a minor proportion of the habitat within the concession was considered to be a predominantly natural condition, while no critical habitat was identified within a 5km radius the Direct Area of Influence (DAoI) – of the ORF.

6 ACCOUNTING METHODS FOR HABITAT LOSS AND GAIN

Industry standards, best practice approaches and the Eni's internal guidelines all require demonstration of the systematic application of the mitigation hierarchy in order to justify the application of a biodiversity offset to deliver gains. Beyond this however, there is no standard approach to accounting for residual losses and gains for biodiversity or determining significance of accounted losses. Both measures are required however to inform whether the implementation of biodiversity offset is necessary to achieve NNL or NG outcomes.

IFC PS6 requires the implementation of biodiversity offsets for significant residual adverse biodiversity impacts. PS6 guideline notes do not provide a standard approach for accounting for losses nor determining the significance of a residual impact; this should be determined by the client.

Various biodiversity offset accounting models exist to provide a framework for the quantification of habitat loss and degradation. Eni Ghana proposes to account for all residual impacts on CH and NH shall using an aggregated area based metric. Habitat area based approaches that combine consideration of both area (loss) and condition (quality change) have become the mainstay of biodiversity accounting[10].

The company believes that this is justified by the relatively (minor) scale of the project, and the absence of species of high conservation priority from within the natural habitat present prior to construction activities[11]. Following this, consultation with stakeholders, local authorities and the IFC shall determine the requirements for an offset to achieve NG/NNL objectives, following the [draft] guidelines from the Ghanaian Environmental Protection Agency (EPA).

Complex offset accounting models including disaggregated approaches have not been considered at this time. Furthermore this strategy shall not attempt to estimate the offset requirement for achievement of NNL/NG [although some target areas shall be identified].

6.1 Measuring Habitat condition / quality.

The assessment of habitat quality is an underlying requirement for the quantification of potential impacts to natural habitats since a "habitat area x condition" metric [12] is

[10] Business and Biodiversity Offsets Programme (BBOP). 2012. Resource Paper: No Net Loss and Loss-Gain Calculations in Biodiversity Offsets

[11] The pre-construction baseline and the post-construction biodiversity assessment identified relatively few threatened floral species (5 listed as vulnerable), while only 2 threatened fauna species (Hooded vultures and Grey Parrot) were identified during the pre-construction avian surveys. Mitigation actions for vultures are subject to a separate action plan.

[12] No universally-accepted approaches exist for determining the type, nature and size of habitat loss as biodiversity is intrinsically difficult to measure and compare quantitatively. No single metric (or unit of measurement) can describe biodiversity as a whole. Most methods tend to focus on habitat as a useful proxy for biodiversity as a whole (e.g., a measure of habitat area x condition -'quality hectares')

commonly used for expressing the predicted net impact. However assessing habitat quality can be very difficult, expensive and time consuming since there are no assessment criteria or framework that is universally applicable for all habitat types. In many cases, an expert opinion and a qualitative description [13] can be sufficient.

A habitat's quality is synonymous with its "condition" in comparison to a defined "benchmark", that is – or approximates – what is considered the "pristine" condition within a cycle of disturbance and regeneration. Typically, this is considered the state in which ecological functions (ecosystem services) are maximised.

Habitat condition is normally defined by composition and structural elements (species diversity, abundance, age distribution, density, height and biomass volume); features on the ground and within the soil (the presence of rotting logs and dead trees, volume of organic matter) and "landscape" components such as connectivity, patch size, and core-edge ratio[14]). Abiotic factors such as temperature, sunlight exposure, ambient and peak noise, humidity, presence of artificial light (particularly at night), and air quality may also influence a habitat condition. These abiotic factors are important considerations, as these may be altered even in areas that are not physically disturbed by the project.

During the ESHIA process, the project conducted a detailed assessment and validation of habitat types within the concession. However, criteria and thresholds for conditional assessment were not determined. To put simply, the ESHIA mapped the habitat type to a relatively high resolution, but did not determine the condition of natural habitat present within the concession prior to commencement of the construction activities. Furthermore no published approach exists for habitat conditional assessment within the Amansuri region.

Nevertheless, in the absence of conditional indicators for habitat quality, a qualitative scale can be useful to prescribe biodiversity value to habitat type based on land cover descriptions according to their degree of modification (high-low), utilising the land cover data collected by ERM during the project baseline (Appendix A). This approach draws upon a "Corporate Biodiversity Impact Accounting" approach (Jarret 2012)[15] and can also be useful for assessing losses and gains in habitat quality, using expert judgment informed by data recorded during various biodiversity monitoring surveys. The methodology has the advantage of being rapid enough to inform early stage avoidance

[13] A qualitative description is an estimate of condition that is observed but not measured with a numerical result and is often relative to the "ideal" state. For example; low, medium, high quality. A qualitative scale is often then assigned a relative value for in order to facilitate quantification (i.e. low = 1, medium = 2, high = 3).
[14] Parkes, D., Newell, G. & Cheal, D. (2003) Assessing the quality of native vegetation: the 'habitat hectares' approach. Ecological Management & Restoration, 4, S29–S38.
[15] Jarrett, D. (2012) Corporate Biodiversity Accounting. Ecometrica publications. Available at: http://ecometrica.com/white-papers/corporate-biodiversity-accounting

actions to avoid natural areas, as well as providing flexibility to accommodate biodiversity values that may be assessed in more detail at a later date.

In this approach, condition is "measured" using six categories ranging from 'Very high/pristine' (100% quality) to 'Urban/denuded' (0% quality). The three upper value classes represent natural habitat, while the three lower values classes represent modified habitat (see Table 6-1).

Loss of habitat quality occurs when the state or condition of the habitat drops from a higher value class to a lower one. This can occur through vegetation clearing (100% loss of starting condition) or degradation, which may result in a movement to a lower value class. Habitat restoration, conversely, is measured through the uplift of an area from a lower class to a higher one (for example from a bare area to an area of natural vegetation). In both cases, the loss or gain is measured by the change in physical area and/or % quality assigned to each value class. The final assessment of net habitat loss aggregates those from the direct footprint losses and wider spatial habitat deterioration as well as any areas that will be restored and assumes a static counterfactual baseline.

Table 6-1 Biodiversity value classes representing habitat condition at pre-development stage.

Habitat status (IFC)	Biodiversity Value	Numeric value	Generic description	Eni Land cover categories
Natural	**5. Very High Value habitats**	100%	Highly intact habitat/Dense forest habitat.	• Blackwater Swamp Forest (critical habitat) • Mangrove Forests
	4. High value forest	80%	Intact forest habitat (>75% forest)	• Wetland evergreen Forest • Coastal strand
	3. Moderate	60%	Mixed forest and other vegetation Successional or otherwise productive natural vegetation (>50% forest)	• Secondary forest (thicket)
Modified	**2. Low value**	0%	Mixed Tree crops interspersed with native vegetation (<50% forest and other vegetation)	• Coconut palm plantation • Oil palm plantation • Mixed coconut and oil palm plantation • Sparse/degraded vegetation
	1. Very low value	0%	Highly modified habitats Annual crops / agricultural zones	• Mixed crops • Degraded coconut & palm plantation • Cassava • Mixed palms and crops

Habitat status (IFC)	Biodiversity Value	Numeric value	Generic description	Eni Land cover categories
	0. No Value (Urban / Developed areas)	0%	Villages, urban areas, built environment	• Bare land • Borrow Pits • Urban/built • Roads/trails

The preconstruction baseline studies[16.17] conducted by the project recorded the wetland forest as being "relatively intact" (in regards to vegetation composition), however the faunal monitoring indicated relatively low abundance of species, and species of high conservation value (threatened or endemic) in particular. On the basis of this evaluation, natural wetlands within the concession area are assigned to the "high" (80%) value class, while critical habitat (Blackwater Swamp Forest) as well as nearby Mangrove forest are considered as "very high" (100%) value class. Other predominantly natural categories identified within the ORF concession include secondary forest. This successional forest type was assessed in one value class lower than the mature wetland forest (i.e. the 60%).

Where, upon reassessment, indicators of habitat function (floral and faunal diversity), suggest that quality within the retained habitat has declined, the total area of the habitat type will be downgraded one value class (i.e. from high value to moderate).

Habitats found to have improved their functions (i.e. supporting threatened species, presence of indicator species, etc.) will be upgraded one (or more) value class. This includes uplift from modified to natural habitats are expected to occur as farming activities have ceased and native vegetation begins to dominate.

6.2 Forest restoration

The restoration of temporarily used areas within the ORF concession will provide a measurable gain towards the NNL objective for Natural habitat at a rate that is proportional to the life of the project (estimated 20 years).

In addition, the condition of previously modified habitat within the concession can be improved through the exclusion of farming and harvesting activities, silvicultural practices, such as in-fill planting and removal of invasive species, as well as the addition of artificial habitats (ponds, nesting boxes, hollow logs, etc.) to improve the suitability of the area for fauna habitation. It is anticipated that by 2040, all modified habitat will have transformed, through regeneration and succession, to the status of natural habitat (young secondary forest).

[16] ERM (2016a). Eni GHANA OCTP BLOCK Critical Habitats Screening and Assessment.
[17] ERM (2016b). Eni GHANA OCTP Project. Desktop Analysis of Wetland Habitats

7 REASSESSMENT OF IMPACTS ON CRITICAL AND NATURAL HABITATS, INCLUDING QUANTITATIVE CALCULATION OF NET LOSS

This re-assessment takes into account the latest status following the completion of all infrastructure construction and activities, and the status of restoration activities within the concession area. Data for this review was collected during a post construction biodiversity assessment, conducted in December 2019[18]

Direct losses are those associated with habitat *loss* and *degradation* resulting directly from the actions of the project. Habitat loss includes removal of vegetation (permanently or temporarily) to make way for project infrastructure or to enhance accessibility. Habitat degradation occurs when ecological conditions change as a result of land clearing or industrial activities (noise, light, heat, etc.), and assumes that these changes negatively affect the capacity of the habitat to support biodiversity and/or deliver normal ecological functions. Direct losses to natural habitats are estimated in ***section 7.1***

Indirect losses are those resulting from the actions of third parties, which can be reasonably considered to have been influenced or facilitated by the presence of the project, its activities or other consequential actions. For example, the displacement of livelihood activities from within the concession area, the expansion of settlements and agricultural areas by people migrating to the area to take advantage of new economic opportunities created by the project. Since other industrial developments have simultaneously been established with the project Area of Influence, impacts are also cumulative, and disaggregation between projects is not feasible. *Indirect losses are estimated in* ***section 7.2.***

The following sections include estimate of direct habitat loss and reasoned estimates of indirect natural habitat loss in accordance with the requirements of PS6.

Direct Losses and gains to Natural and critical habitat include considerations of:

a. Area of natural habitat cleared for construction within the concession area
b. Restoration **gains** from restoration (replanting) activities within the ORF concession
c. Change in habitat quality (degradation and improvement) within the concession area.
d. Change in habitat quality (degradation or improvement) within 500m (the Direct Area of Influence) of the Concession area.

[18] Envaserv Pty Ltd on behalf of Eni Ghana.

Indirect losses to Natural and critical habitat include considerations of:

1. Changes (losses) with the [wider] Project AoI, defined by the ESHIA as the area within a 5km radius, based on the observed change in the rate of loss (if any) following the project inception.

Habitat degradation within the wider AoI shall not be estimated due to data limitations.

7.1 Direct losses and gains to natural and critical habitat

7.1.1 Area of natural habitat cleared for construction within the concession area

The current area of natural habitat that has been cleared can be determined using GIS analysis.

The predicted area of natural habitat within the concession has been predicted in previous versions of this document (r00-r03). These estimates were based specifically on the project planned footprint and the overlap with natural habitats.

This version follows the completion of construction in August 2019. It draws on:

1. GIS analysis of the project layout over the pre-construction land cover (Annex 1).
2. the post-construction field assessment conducted in December 2019[19]

The project layout is shown in Figure 7-1. From this plan, we are able to conduct a GIS analysis against the validated land cover within the ORF to identify specifically the total area of natural habitat cleared (permanently or temporarily) for project infrastructure. The final direct area of natural habitat lost directly to the project footprint is shown in Table 7-1 and Figure 7-2.

The final area of direct **natural habitat** loss was 12.2ha. Over half (7ha) this area was "secondary forest"(thicket) of "moderate" conservation value. Approximately 5.2ha of wetland forest was removed for construction.

When habitat condition is taken into account, the total loss of natural habitat is estimated at 8.4 Quality hectares (Qha).

[19] Envaserv, Post construction biodiversity assessment 2019.

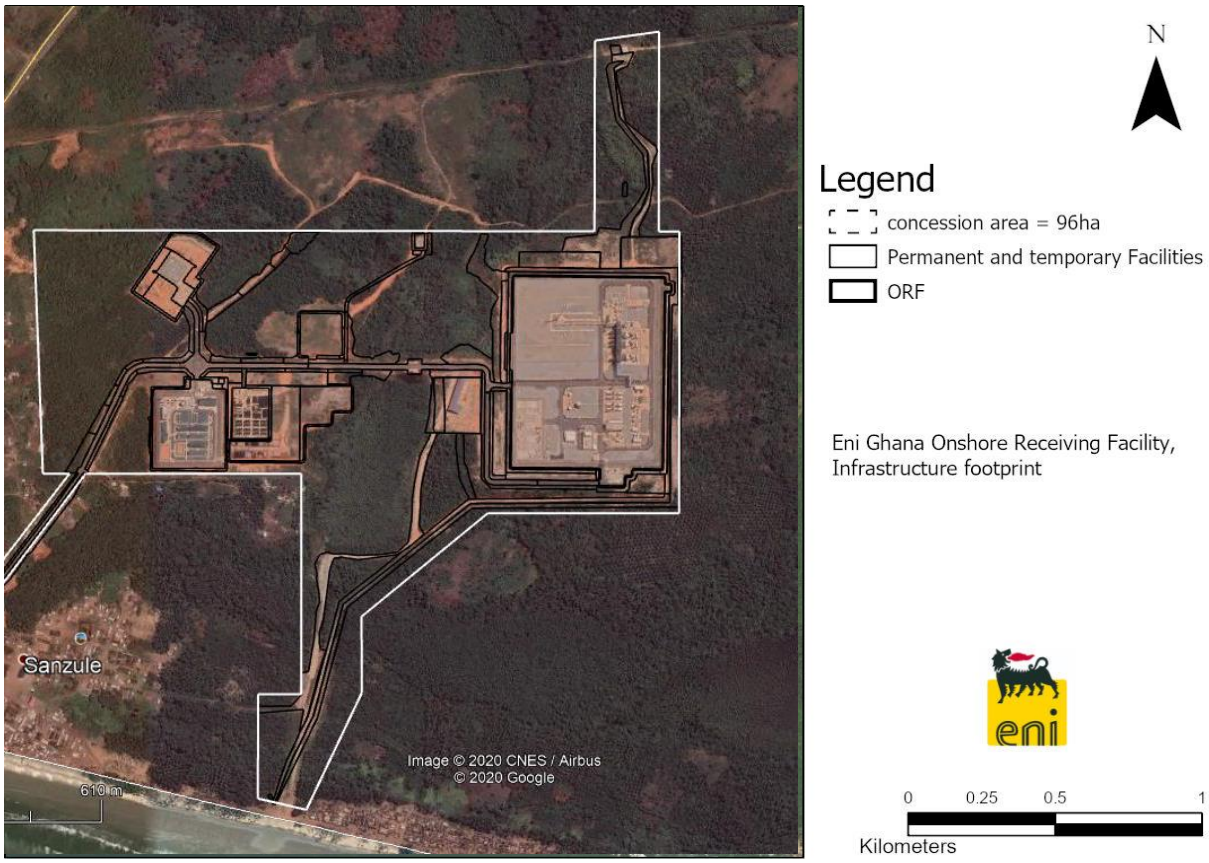


Figure 7-1. Post-construction layout of the ORF facility (source google earth accessed 07/07/20)

Table 7-1. Estimated losses to Natural Habitat within the ORF concession

Natural land cover type	**Estimated Biodiversity value**	**Total within the concession (ha) 2015**	**Estimated *permanent and temporary* losses of natural habitat (ha)**	
			Hectares	**Quality ha**
Wet Evergreen Forest	High	24.2	-5.2 (3.7 permanently)	-4.2 (3.0 permanently)
Secondary forest and thicket	Moderate	14.9	-7 (2.5 permanently)	-4.2 (1.5 permanently)
Total		39.1	-0 ha	**-8.4Qha**

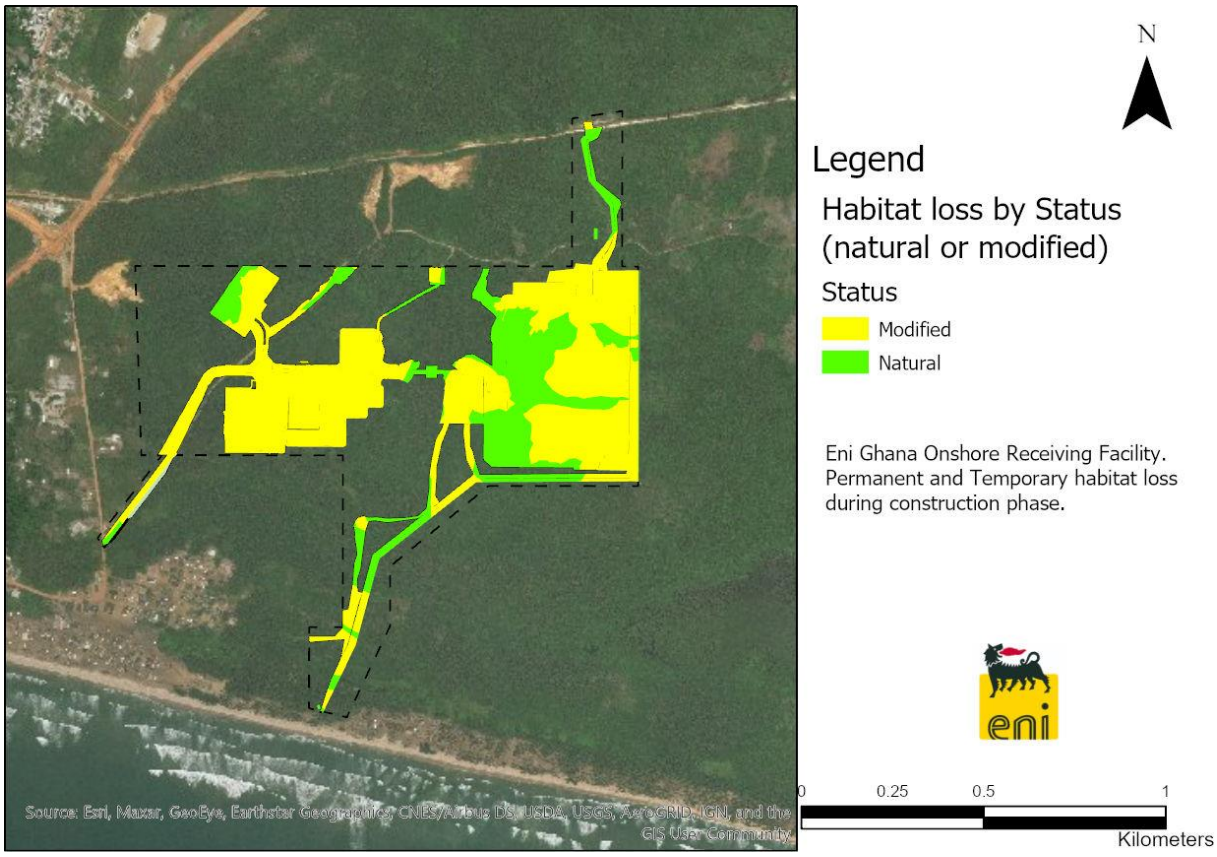


Figure 7-2. Starting condition of habitat permanently or temporarily cleared during construction activities

In terms of the estimated impact to wetlands (the highest priority natural habitat), this estimate (5.2ha), is slightly lower than the combined permanent and temporary losses (7.5ha) predicted during concept execution (NNL strategy r.03). This suggests that operational control over construction activities effectively minimised the overall direct footprint.

7.1.2 Restoration gains from replanting activities within the ORF concession

An estimated 44.5ha of natural and modified habitats were cleared for construction activities (Figure 7-2). OF this area, and estimated 24.9ha will be permanently occupied by project infrastructure, (ORF, accommodation / office, tarred roads, helipad, etc.). Habitat restoration can be undertaken within the remaining 19.6ha. To restore temporarily used areas, the project developed a Flora Conservation Plan (plan ms hse 019 eni Ghana r01 Appendix F) and a Reinstatement and Revegetation Standard (std ms hse 004) to guide in the selection of target species and locations for restoration activities. In line with these, the Project established an onsite plant nursery and has raised over

15,500 seedlings and cuttings from local native plant species within the concession). Species planted are matched to appropriate sites according to soil conditions (including hydrology), targeting two habitat types; wetland forest and thicket (secondary forest).

As at the 31 August 2020, 9,364 seedlings have been planted and further 6,170 seedlings as remain within the nursery (Table 7-2). Species currently in the nursery were identified as native to the sites either during the pre-construction surveys[20], or remaining on site during the post-construction survey.

Table 7-2.Inventory of species currently within the OCTP plant nursery.

STOCK OF SEEDLINGS AT THE NURSERY AS AT 31 AUGUST 2020					
S/N	**NAME**	**Habitat(s) found**	**Form**	**Recorded in pre or post construction**	**QUANTITY**
1	*Lophira alata*	Freshwater swamp. Thicket	Large tree	Yes	15
2	*Syzygium guineensis*	Thicket	Tree	Yes	2500
3	*Xylopia rubescens*	Freshwater swamp	Tree	Yes	400
4	*Tetracera dinklagei*	Freshwater swamp. Thicket	Shrub/tree	Yes	200
5	*Uvaria chamae*	Thicket	Climber/tree	Yes	1550
6	*Smeathmania pubescens*	Thicket	Small tree	Yes	600
7	*Carpolobia lutea*	Freshwater swamp. Thicket	Shrub/tree	Yes	20
8	*Terminalia spp*	Thicket	large tree	Yes	15
9	*Baphia spp*	Freshwater swamp. Thicket	tree	Yes	870
	Total				**6170**

According to data collected during the post construction biodiversity assessment, vegetation restoration occupies 14.8ha within the ORF concession area (Table 7-3). The aim of this restoration is to establish a habitat type that corresponds to either wetland forest or mature thicket, according to the soil conditions and natural hydrology. Vegetation within these areas are at an early growth stage, and do not yet provide the species habitat support and other ecosystem functions that would be expected from mature or semi-mature natural vegetation (for example, nesting habitat, edible fruits, soil erosion protection). It is estimated that this restoration process may take up to 20 years or more[21] for vegetation to become fully established. To support restoration,

[20] Noting that the pre-construction survey only included areas within the targeted location for the ORF, accommodation or road/pipeline areas. The post construction assessment surveyed along transects through existing vegetation.
[21] Envaserv 2019 Post construction biodiversity assessment

maintenance activities, including the removal of invasive species (weeding), are continuing within the concession area. These activities are controlled by a dedicated Work Instruction; opi ms hse 025, Control of Alien Invasive Species (AIS).

Figure 7-3. Selected images of the onsite nursery (source Envaserv, Post construction biodiversity assessment, 2019).

Figure 7-4. Sign post marking the restoration area (right) and planting activities (left) within the ORF concession (source, Envaserv Post construction biodiversity assessment 2019, Eni Ghana 2020).

Figure 7-5. Removal of invasive species around planted trees within the ORF concession (source, Eni Ghana 2020)

To account for restoration gains, in line with the accounting methodology, restoration gains have been forecast through a 20 year period, (estimated time to reach 80% quality level) with gains being credited on a proportional scale. Restoration gains therefore will not contribute towards NNL or NG targets until they reach an established level that approximates the minimum conditions for natural habitat. This process is estimated to take 10 years. Estimated contribution to NNL from restoration activities is shown in Table 7-3.

Table 7-3. Extent of Active and natural vegetation restoration areas within the ORF concession (December 2019) in Hectares and in quality hectares forecast until 2040.

Site description	Area (ha)	Year established	Contribution to NNL (Qha)		
			2020	2030	2040
Floral Restoration Site	11.8	2018	0	4.7	9.4
Natural Flora Restoration[22]	3.0	2018	0	1.2	2.4
Grand Total	**14.8**		**0**	**5.92**	**11.8**

On the basis of this simple extrapolation, we estimate the area habitat restored by 2040 will exceed the losses incurred in 2015. To achieve this, restoration will be monitored through the process described in the Flora Conservation Plan. The restoration must be successful to achieve the NNL goal, and therefore an adaptive management approach will be necessary to identify and remediate problem areas.

The location of current restoration areas is show in Figure 7-6 below

[22] An additional 4.8ha of cleared area was being utilized during the field survey (Dec 19). Restoration on these sites has not commenced. This area has not been included in the loss/gain forecast

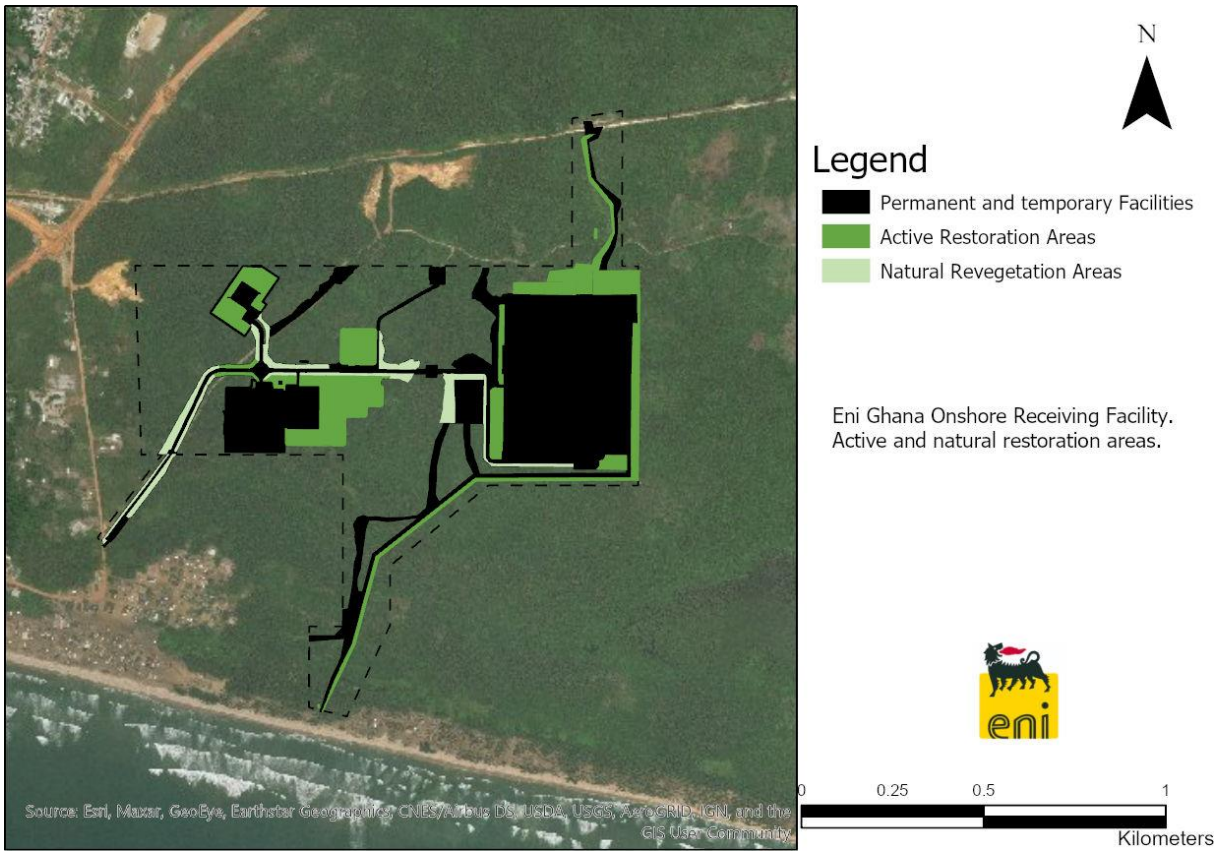


Figure 7-6. Vegetation restoration areas within the ORF concession (data source, Envaserv 2019

7.1.3 Change in Natural habitat quality (degradation and improvement) within the concession area.

7.1.3.1 Degradation of natural habitat (loss of habitat quality)

The next step in the residual impact assessment is to estimate losses associated with observed habitat degradation of natural habitats retained within the concession area. Eni Ghana successfully retained approximate 69% of the original natural habitat within the concession, in addition to areas of previously modified habitat containing species of tree-crops such as oil palm and coconut. Community members have been allowed continued access to these sites in order to continue to access fruits, fibres and other natural goods (e.g. to collect raphia palm).

The majority of natural habitat retained within the concession (Figure 7-7) is wetland forest running in a north/south direction through the concession. This wetland area broadly separates the accommodation facilities in the west of the concession from the production facilities of the ORF in the east of the concession. A central access road links the two facilities and separates the retained wetland into smaller units, although a large culvert is provided to maintain hydrological connectivity between wetland bisected by the road. In addition, pipelines are installed where temporary access roads pass through

seasonally inundated wetland (for example, near the Land Terminal End site), which allow water to flow across the concession (east/west).

As documented in the post-construction survey report, Eni Ghana has designated two reserve areas (Envaserv 2019); a swamp forest reserve incorporating natural wetland areas (dominated by raphia palm), and a lowland forest reserve that includes areas of previously modified habitat (dominated by tree-crops such as oil palm, coconut, and regenerating natural vegetation). Over time, these conservation activities may support the persistence of biodiversity values within the natural habitat.

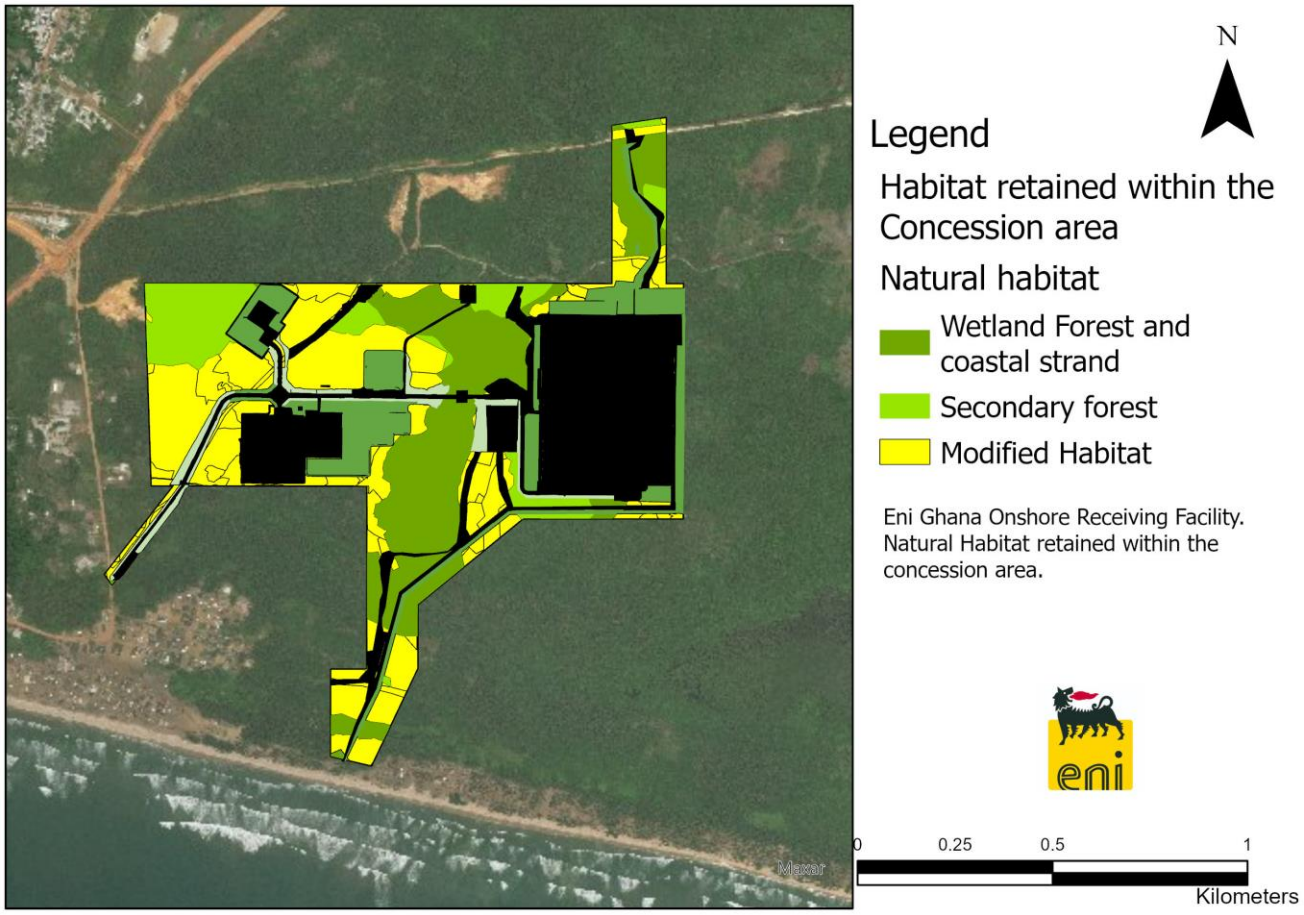


Figure 7-7. Natural and Modified habitat retained within the ORF concession area

The ESHIA identified the presence of avifauna as a suitable indicator for natural habitat quality within the Concession area, particularly those species that require a closed forest

canopy habitat for their continued persistence (forest birds)[23][24]. A number of these species were identified within the pre-construction avifauna survey and have been the focus of targeted surveys during monitoring (BIAP-6.1). These species included all forest-habitat dependent birds with a globally Threatened[25] or Near Threatened (NT) category.

Table 7-4. List of forest Birds of conservation importance (i.e. with a threatened or near-threatened status)

Species name	**IUCN threat category**	**Presence in avifauna surveys**			
		Pre-construction (ERM 2015)	**Monitoring (GWS 2017-2019)**	**Post construction assessment (Envaserv 2019)**	**Post construction monitoring** (ESL, June 2020[1])
Grey Parrot (*Psittacus erithacus)*	VU	Observed flying over concession[2]	Not Observed (NO)	NO	NO
Copper-tailed glossy starling (*Hylopsar cupreocauda)*	NT	Single sighting	NO	NO	2 sightings
Yellow-Bearded Greenbull (*Criniger olivaceous)*	VU	NO	NO	NO	NO
Green-tailed bristlebill *Bleda eximius)*	NT	NO	NO	NO	NO
Total number of species observed		86 species from XX families	78 species (	119 species from 28 families[3]	65 species from 28 families. (10 monitoring events)
Notes: 1. First progress report of the post-construction phase monitoring by ESL 2. This observation does not infer residence within the concession 3. Study area included the Concession area and transects within one-kilometre radius.					

[23] Since construction shall open up areas that have hitherto been inaccessible, certain bird species (i.e. those better adapted to modified habitats) may be attracted into the area. In addition, the increased visual accessibility for subsequent avifauna surveys, can result in an increase in species richness (in terms of actual number of different species). However, this apparent "gain" may come at a loss of species that have more specific habitat requirements and subsequently may be of a higher conservation importance.

[24] Notwithstanding the previous not, the first post-construction survey undertaken in June 2020 recorded the highest abundance and richness along the transect with the least disturbance (in terms of vegetation and noise disturbance, while the lowest abundance and richness was observed in transect 3, described "highly disturbed with human presence and noise".

[25] IUCN Red List "Threatened" categories include: Vulnerable (VU),Endangered (EN) and Critically Endangered (CR)

Monitoring of target species throughout the construction period and in post-construction failed to identify any of the target species. The pre-construction baseline fared little better; observing a pair of parrots in flight and only a single Copper-tailed glossy starling. The Grey Parrots were not considered resident because of their flight behaviour. A pair of Copper-tailed glossy starlings were observed as recently as June 2020[26]. The skill of the observer is among several factors that can significantly influence the results of avian surveys. It is worth noting that ESL observers (specifically James Biney) was also present on both occasions that the Copper-tailed glossy starlings has been detected.

The absence of these priority species in all phases, pre and post construction signifies a biodiversity concern. Opportunity therefore exists for Eni Ghana to enhance the suitability of remaining habitat for forest-dependant species, for example, through the installation of interventions such as specific nesting boxes to improve nesting choices within the forest reserve areas. Further discussions with ESL ornithologists and local biodiversity experts should explore other enhancement opportunities.

The post-construction biodiversity assessment conducted by Envaserv in December 2019 recorded more species than previous surveys prior to or during construction activities. This included 56 "unique" species that where not recorded prior to construction. The authors suggest that improved visibility and an increase in "habitat generalist species" including species associated with open habitats may have contributed towards the increase in the richness of species.

The post-construction survey also failed to observe 22 avian species previously found in preconstruction. Among these include five that are characteristic of "swamp forest and mangrove habitats"[27]. However, four of these have been observed during the ongoing monitoring, leaving only the dwarf bittern (*Ixobrychus sturmii*) as unobserved since pre-construction. Envaserv 2019 concluded that "Qualitatively, there was no significant difference between the species recorded in the two [pre-construction and post-construction] assessments".

In conclusion, subject to further discussion with local ornithologists, the data does not support the conclusion that natural habitat quality within the ORF has measurably deteriorated in during the construction phase. Therefore, at this stage, no losses are being associated with a decline in habitat quality.

7.1.3.2 Improvements in habitat quality (offset)

Improvements in habitat quality within the ORF concession is a feasible expectation associated with the restriction of subsistence activities from within the concession area and will be implemented as an "onsite offset". We anticipate that the condition of

[26] ESL 2020. Result of the June 2020 forest bird monitoring.
[27] Table 4.3 ERM 2016 Pre-construction Bird Survey Report.

previously modified habitat within the concession can be improved through the exclusion of farming and harvesting activities, silvicultural practices, such as in-fill planting and removal of invasive species, as well as the addition of artificial habitats (ponds, nesting boxes, hollow logs, etc) to improve the suitability of the area for fauna habitation. This improvement can also be forecast and is also included in the summary of estimated gains associated with uplift of habitat quality within the concession area (Table 7-5).

Table 7-5 Estimated gains associated with improvement to habitat quality within the ORF concession

	Remnant extent in Concession	**Area (QHa)** *t2020*[1]	**Area (QHa)** *t2040*[2]	**Max Uplift (QHa)** (*QHa t2040 – QHa t2020*)[3]	**Uplift / year**[4] **(Qha)**	**Forecasted increase in Quality hectares (20 Year)**		
						'2020	**'2030**	**'2040**
Increase in remnant WETLAND and Coastal Strand habitat quality (high – very high)[5]	19	15.2	19	3.8	0.19	0	1.9	3.8
Increase in remnant THICKET habitat quality (moderate – very high) [5]	8	4.8	8	3.2	0.16	0	1.6	3.2
Increase in remnant Modified habitat quality (low- high)[5]	24.7[6]	0[6]	19.8	19.8	0.99	0	9.9	19.8
Total	**51.76**	**26**	**46.8**	**26.8**		**0**	**13.4**	**26.8**

Explanatory Notes

1. Estimated extent in QHa as of 2020
2. Estimated extent in QHa in 2040
3. Estimated improvement over the 20 year period (t2040 – t2020)
4. Uplift per year assumes a simple linear improvement over 20 year period.
5. Estimate assumes that both Wetland and Thicket forest (all natural forest) will reach optimal quality status, (very high) over the20 year period while 'Modified' habitat will only reach a sub-optimal status (ie, will achieve a high value)
6. Modified habitat is not included in measure of Natural habitat extent and should not be considered "predominantly natural" until 2030. For ease of calculation purposes, biodiversity value in 2020 is nil

The forecast in Table 7-5 assumes that habitats now "behind the fence" will gradually see an uplift in natural condition as anthropogenic pressures (timber harvesting, fuelwood collection, subsistence hunting, agricultural activities) are excluded from habitat within the concession. Creating areas free of human influence has long been a concept underpinning biodiversity conservation. The pre-construction field survey (ERM 2016) identified that abandoned agricultural plots within the concession showed indications of vegetation transition towards thicket, and suggested that this progress

would be "rapid". In addition, the post-construction survey identified sites where the "*colonization by naturally dispersed species is promising*" (Envaserv 2019). These assessments provide evidence that, in terms of vegetation composition, the transition from modified to natural habitat will be successful. However understanding the rate at which species will recover once direct human disturbance are removed is less certain. Observations from other Eni projects suggest that biodiversity can persist within close proximity of operational sites particularly where human disturbance is low[28][29]. All avian species, and most species of other taxa identified in the post-construction survey should be able to move through the fence un-hindered. For those that can't (i.e. Common Duiker, tortoise) further consideration will be required to identify how their presence in the concession could be enhanced and sustained.

7.1.4 Change in habitat quality (degradation) within 500m (the Direct Area of Influence) of the Concession area.

As mentioned in the section above, the forest bird monitoring reports do not support the conclusion that natural habitat quality has measurably deteriorated during the construction phase. Therefore no losses are being associated with a decline in habitat quality within a direct Area of Influence (500m radial buffer) of the ORF concession

Table 7-6. Estimated losses associated with loss of habitat quality within the Direct Area of Influence (DAoI) of the ORF concession.

Site description	Biodiversity value	Extent within the AoI (ha)	Estimated change (quality loss or gain)	Estimated *permanent* losses of natural wetland (ha)
Mangrove Forest	Very High	10.4	none	0
Wet Evergreen (Swamp) Forest	High	10		0
Coastal Strand	High	5.9		0
Secondary Forest (thicket)	Moderate	36.9		0
Savannah Patch	Moderate	5.3		0
Grand Total				**0**

[28] IPIECA (2016), Biodiversity and ecosystem services fundamentals.
[29] For example, Eni operated fields in remote locations, away from significant human populations, (Congo, Alaska and Ecuador) all maintain high levels of biodiversity in close proximity.

7.1.5 Direct impact to critical habitat

The extent of Blackwater Swamp Forest (Critical habitat) identified during the assessment of wetland habitats in 2016, does not extend into areas directly affected by the ORF footprint or the area influenced by activities within the ORF. As a result, the ORF has not directly impacted critical habitat.

7.2 Potential indirect loss of habitat

Indirect impacts include changes resulting from induced access by third parties, in-migration and associated impacts on resource use, including land conversion, hunting and wildlife trade, and spread of invasive alien species. Due to the nature of indirect impacts, they can be more difficult to quantify and even more challenging to identify causation or correlation with the project. Attribution of indirect impacts is also challenged by the presence of other large scale industrial developments within the Western Region and more specifically near the project location. Other developments and activities in the Amansuri coastal region are shown in Figure 7-8.

Figure 7-8 Overview map identifying other major oil and gas developments and activities in the study area and extending to the west. Recent industrial facilities include A. The Ghana gas accommodation camp; B. The Ghana gas batching plant (left) and processing facility (right); C. Quantum gas facility, and; D. The Ghana Gas Export pipeline (red). Other industrial projects nearby also include the Nzema Gold Mine located in Nkroful (approximately 4km North of Esiama) (image source: Google Earth)

Attempts to measure indirect impacts using a combination of field-based surveys and satellite imagery across the wider spatial area can be technically challenging, costly and

time-consuming. A recent assessment for Eni Congo operations (Brauneder *et al* 2020[30]) recommends as alternative approach utilising data from Global Forest Watch[31].

This section will attempt to make a reasonable estimate of indirect impacts potentially attributable to the project using a combination of spatial and temporal analysis of the pattern of tree cover loss in the region. In doing so, the following hypotheses will be tested to determine whether observed changes impacts are significant;

1. That tree cover loss within the project AoI is NOT significantly higher than the background rate within the Amansuri region (spatial test), and;

2. That project has NOT led to a significant increase in the rate of tree cover loss within the AoI, in the years after the project commencement in comparison to a similar period before the project (temporal test).

These hypothesis are based on the assumption that that indirect impacts (such as increased tree cover loss from in-migration or displacement) are limited to a five kilometres radius of the concession area. Measurable changes beyond this distance are assumed to be related to drivers of change unrelated to the ORF (for example other industrial developments shown in Figure 7-8). We used 2015 as the project inception year, which is the year during which the concession area was demarcated, although construction activities commenced in 2016. For comparative purposes, losses over the four year period prior-to, and after 2015 was used. To standardise for different areas sizes, forest losses shall be expressed as a percentage of the total area.

7.2.1 Evaluation of the rate of forest loss within the Area of Influence and the Amansuri Region.

Developed specifically for the quantification of global forest change, Global Forest Watch (GWF) data is the best available data for assessing forest loss over time and is currently available on a yearly basis from 2011 to 2018. This data is used as a proxy for natural habitat loss. The key limitation of this data is that not all tree-cover loss will be natural habitat (may include loss of tree-crops); in fact, based on the ratio of natural to modified habitat identified during the ESHIA, an estimated 25% of this loss may have occurred within modified habitat. Furthermore, it is not possible to assess change in condition associated with indirect impacts

Tree cover loss is defined as loss of all vegetation greater than 5 meters in height, with a canopy densities of above 30%, the majority of which is either natural forests or tree crops[32]. Tree cover loss may be the result of human activities, including urban

[30] Brauneder, K., Gilly A., Murray N., Sandrin F., Escalas A., Victurine R., Assessment of habitat loss over time. Wildlife Conservation Society (2020). Unpublished report
[31] https://www.globalforestwatch.org/
[32] Tree crops include agricultural tree crops such as palm and coconut plantations. Although these are present in the AoI and may be at risk from urban expansion or industrial development, this assessment assumes that this is minor occurrence and that the majority of tree cover loss will be primary or secondary (natural) forest habitats.

development, agricultural expansion, or conversion to other land uses, as well as fire (often human-induced).

The GFW data can be used to monitor the annual rate of tree cover loss within the AoI and across the wider Amansuri area (the "background" rate). Results of the spatial analysis are shown in Table 7-7 and Figure 7-9. Results are discussed in the following sections below.

Table 7-7. Tree cover loss measured within and outside of the Area of Influence in pre and post construction years (Source: Hanson et al[33] and Global Forest Watch[34])

Area	Area (km^2)	Forest loss (km^2) Pre-construction (% of Area)				
		2011	2012	2013	2014	Total (2011-2014)
5km AoI	62.81	0.31 (0.49%)	0.86 (1.38%)	1.32 (2.09%)	1.24 (1.98%)	3.73 Km^2 (5.9%)
Amansuri Wetland	267.31	0.28 (0.11%)	1.45 (0.54%)	1.81 (0.68%)	2.15 (0. 80%)	5.68 Km^2 (2.1%)
		Forest loss (km^2) Post-project initiation (% of Area)				
		2015	2016	2017	2018	Total (2015-2018)
5km AoI	62.81	0.47 (0.74%)	1.65 (2.63%)	1.21 (1.93%)	1.73 (2.76%)	5.06 Km^2 (8.1%)
Amansuri Wetland	267.31	0.77 (0.29%)	2.436 (0.91%)	2.06 (0.77%)	1.88 (0.70%)	7.13Km^2 (2.7%)

This data is also shown in Figure 7-9. In this chart, the area between the lines (shaded grey) represents the forest loss above the background rate within a 5km project AoI. From 2011 to 2015, the area shaded grey is equivalent to 2.4km^2. From 2015-2018, the area had increased to 3.4 km^2.

[33] Hansen, M.C., Potapov, P.V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, A., Thau, D., Stehman, S.V., Goetz, S.J., and Loveland, T.R. (2013). High-resolution global maps of 21st-century forest cover change. Science 342, 850–853.
[34] https://data.globalforestwatch.org/search. Downloaded 03/04/2020.

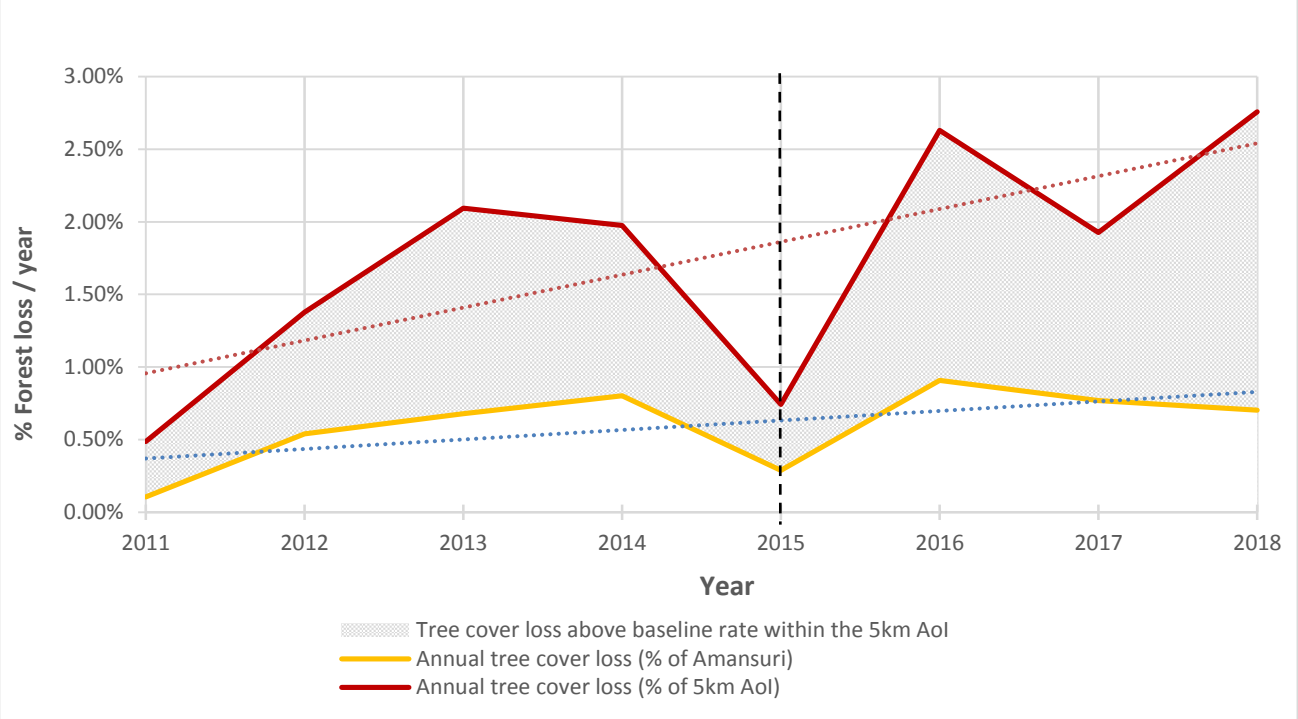


Figure 7-9. Chart showing the rate of forest loss within the Amansuri region (background rate – yellow line), and the rate within 5 Km DAoI of the concession – red line, over the 4 year period pre- and post-project initiation in 2015. (Source: Hansen et al)

Key observations from this data include:

- Tree cover loss within the AoI was 3.8% higher than the background rate taken from across Amansuri region in the four years prior to project inception.
- Since 2015, this difference has increased: over the four year period, tree cover loss within the AoI was 5.4% higher the Amansuri region. Both differences are statistically significant[35], meaning that the differences are not due to random chance.
- The rate of tree cover loss in the AoI and the Amansuri region is increasing. This increase appears to be faster within the AoI than outside.
- Human activities within the AoI are contributing to the increase in forest loss above the background rate. A no-project scenario assumes that the rate of forest loss would be consistent across pre-and post-construction periods. This is assessed as 1.5% per year, based on average of the four years prior to the project.

[35] t-Test: Paired Two Sample for Means (MS Excel analysis tool) was used to determine significant to the 95% confidence level. Losses within the AoI are significantly different from the background rate; 2011-2014 p-value = 0.02; 2015-2018 p-value = 0.03

- Eni's "contribution" is a component of the net "increase" in the rate of loss within the AoI above the rate in Amansuri region.

The next two sections attempt to determine if the assessed differences are statistically significant.

Spatial test for significance

If there is ***no significant difference*** between the rate of tree cover loss in the AoI and the background rate in the Amansuri region since the project inception in 2015, we can conclude that the project is not having a wider indirect impact on forest loss within the AoI.

Table 7-8 below shows the actual forest loss within and outside of the AoI since 2015. As the area of critical habitat outside of the AoI has not been mapped, this spatial test cannot be applied to critical habitat.

Table 7-8. Forest loss measured within and outside of the Area of Influence since 2015

Area	*Area (KM^2)*	*Tree Cover loss 2015-2018 (Km^2)*	*% forest loss 2015-2018*	*% above Background rate*	*Estimated Additional forest loss (Km^2)*
5km AoI	62.81	5.06	8.1%	5.4%	3.38 (338ha)
Amansuri Wetland	267.31	7.13	2.7%	-	-

Table 7-8 indicates that in real terms, tree cover loss is 5.4% higher within the 5km AoI. Tests of significance suggests that this difference *is significant* (p=0.03). Therefore we cannot rule out potential indirect impacts of the project.

However, tree cover loss was also 3.8% higher in the AoI in the four years before the project, a difference that is also statistically significant (p=0.02), during which time we assume there were no influence from the OTCP project. This suggests that not all additional impact within the AoI can be attributed to the OTCP project alone; i.e. other external activities are also contributing to existing loss of natural habitat.

The majority of these losses are occurring in area north of the N1 national highway outside of the Amansuri KBA (Figure 7-10).

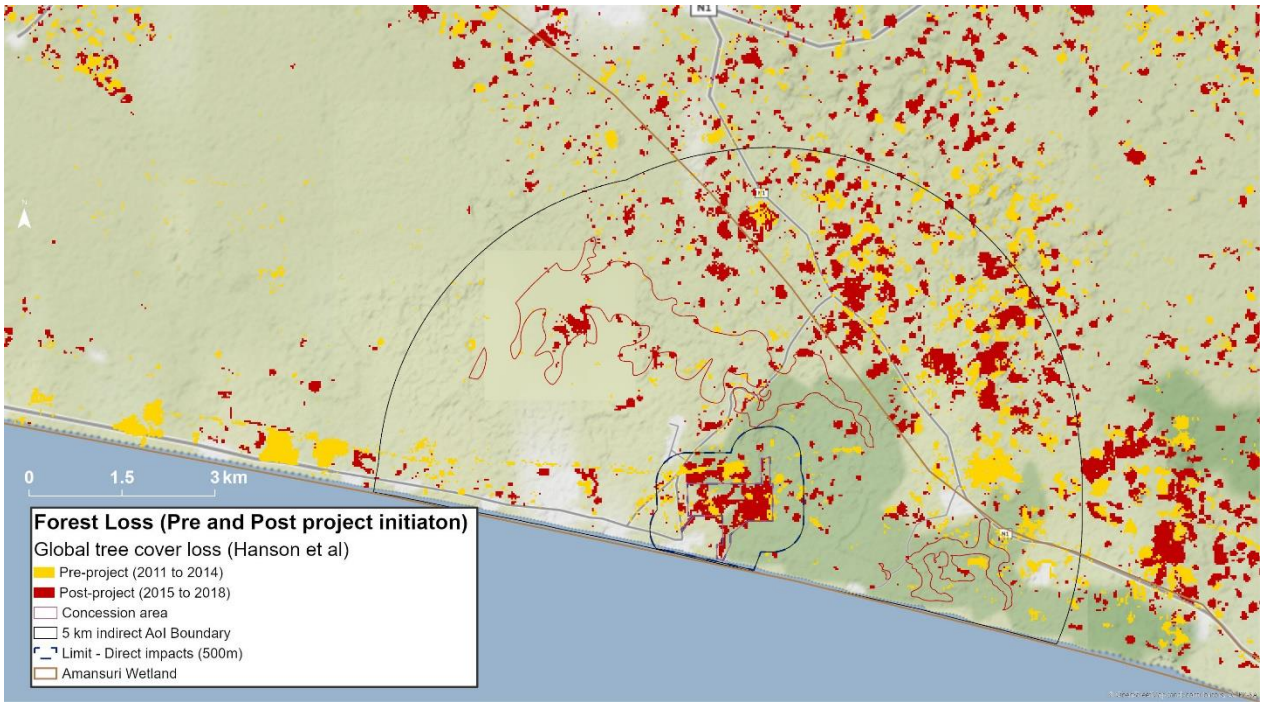


Figure 7-10. Map showing deforestation in the Area of Influence and across the Amansuri wetland since 2015. (Source: Hansen/UMD/Google/USGS/NASA, accessed through Global Forest Watch

The spatial pattern of tree cover loss appears to be correlated to accessibility and suitability for farmland. The potential drivers of indirect impacts (for example, project-related in-migration) may prefer to reside in the more accessible, larger towns located along the national highway. Access to available farmland may also be a contributing factor: with areas outside the wetland being more suitable for annual crops than seasonally flooded (wet) soils that are characteristic of the core swamp area.

A visual analysis of areas of tree cover loss also suggests that other industrial activities are contributing to habitat. For example, satellite imagery of the area indicates that a large gold mine has been established 4km north of Esiama, while the extent of small gravel extraction sites have expanded between 2015 and 2018.

Temporal test for significance

The temporal test will identify if the rate of forest loss has increased significantly in 4 years after project inception (the construction phase), than the four years before (pre-construction). We can also apply this same test to identify if there has been increase in forest loss from within critical habitat following the project initiation. The extent of forest loss before and after the project inception is shown in Table 7-9.

Table 7-9. Extent of forest loss within the two and five km AoI and within Critical Habitat (Blackwater Swamp Forest) in and equivalent period, pre and post initiation in 2015.

Year	Forest loss within 5 km zone (Km^2)	Forest loss in critical habitat (Km^2)
Pre-project inception		
2011	0.31	0.03
2012	0.86	0.01
2013	1.32	0.01
2014	1.24	0.02
Total (pre-construction)	**3.73**	**0.07**
Post-project inception		
2015	0.466	0.002
2016	1.652	0.081
2017	1.211	0.081
2018	1.732	0.108
Total (post-construction)	**5.06**	**0.27**
t-Test: Paired Two Sample for Means		
Average annual increase (km^2/year)	0.33	0.05
P-Value (T<=t) two-tail	**0.18**	**0.16**

This temporal comparison in Table 7-9, suggests that while tree cover loss has increased in absolute terms, in the four years since 2015, the increase is **not statistically significant** within the AoI or within the area of critical habitat (p-value >0.05). This implies that the increased losses observed after the project are within a range of variation observed on an annual basis. However trends in the data also suggest that tree cover losses are increasing at a faster rate within the AoI than outside of it. If this trend does continues, a repeat of this analysis in a years or two may show a different result. Since the construction period has now been completed and the construction workforce has been released, no further in-flux-related impacts are anticipated.

The data also suggest that up to 27ha of critical habitat has been lost from within the AoI since the project inception in 2015, however, once again, this change does not meet the 95% significance level. A visual analysis of the main area of critical habitat affected since 2015 does not suggest that the cause of this loss is related in any way to the ORF operations.

Results discussion

The data presented in Figure 7-9 and Table 7-7 indicates that the rate of tree cover loss, while varying from year to year, has increased over the time assessment period, both within the AoI and across the Amansuri region.

The rate of tree cover loss has been higher within the AoI throughout the time period studied, (including the 4 year period before project inception). The rate of forest loss prior to project inception was 3.8% above the background rate. Over the 4 years post project inception, this had increased to 5.4%. This 1.6% increase (equivalent to 99ha) is not statistically significant (still within the annual observed standard variation), although it does correlate to the project initiation. However, this alone does not imply causation, since and Eni is among a number of industrial activities in the regions (Figure 7-8), some of which have been initiated within a similar time period[36]. Furthermore, since global forest watch is unable to distinguish natural forest from plantation forest, at least part of this area may include the conversion of tree crops, particularly coconut and oil palm, which are abundant in the region. The potential contribution of the project activities to is evaluated in the next section.

7.2.2 Evaluation of project related contributions to indirect impacts

In this section, the likely contribution of worker influx management and livelihood resettlement on the rate of natural habitat loss is evaluated using evidence provided by the Eni Ghana Sustainability and Local Content Department.

The OCTP project has implemented an Influx Management Plan (IMP) and a Livelihood Restoration Plan (LRP) since commencement in 2015. These plans have had the overall effect of minimising indirect impacts to natural habitat through prioritising local communities as construction workers, and supporting a wide range of economic activities including many that do not require additional land (i.e. are non-agricultural related).

Monitoring of the IMP suggests that the population of communities within the AoI has not increased since the project commenced[37]. There is no marked population increase as a result of the project, and on the contrary, the population of three villages in the DAoI has decreased. Based on these findings, no contribution to indirect habitat losses are estimated from project induced migration.

The OCTP project has supported Project Affected Parties (PAPs) with alternative means of livelihoods (livelihood enterprises) as a means compensation for project impacts associated with the occupation of the concession area. Under the allocation system, Eni Ghana was able to provide guidance on site selection, but ultimately not influence where these enterprises were located, and therefore potentially some may have been

[36] For example, construction of the Quantum Gas facility, located near Bakanta, commenced construction 2016.
[37] Eni Ghana (2019). Household Survey in the Implementation of the Influx Management Plan (SUST-RUP-MR)

established on natural habitat. However, of the 318 new project enterprises mapped, 311 were located within existing areas of modified habitat[38] and only 7 appear within areas of continuous natural habitat (Figure 7-11), and each of these are estimated at no more than 1ha in size.

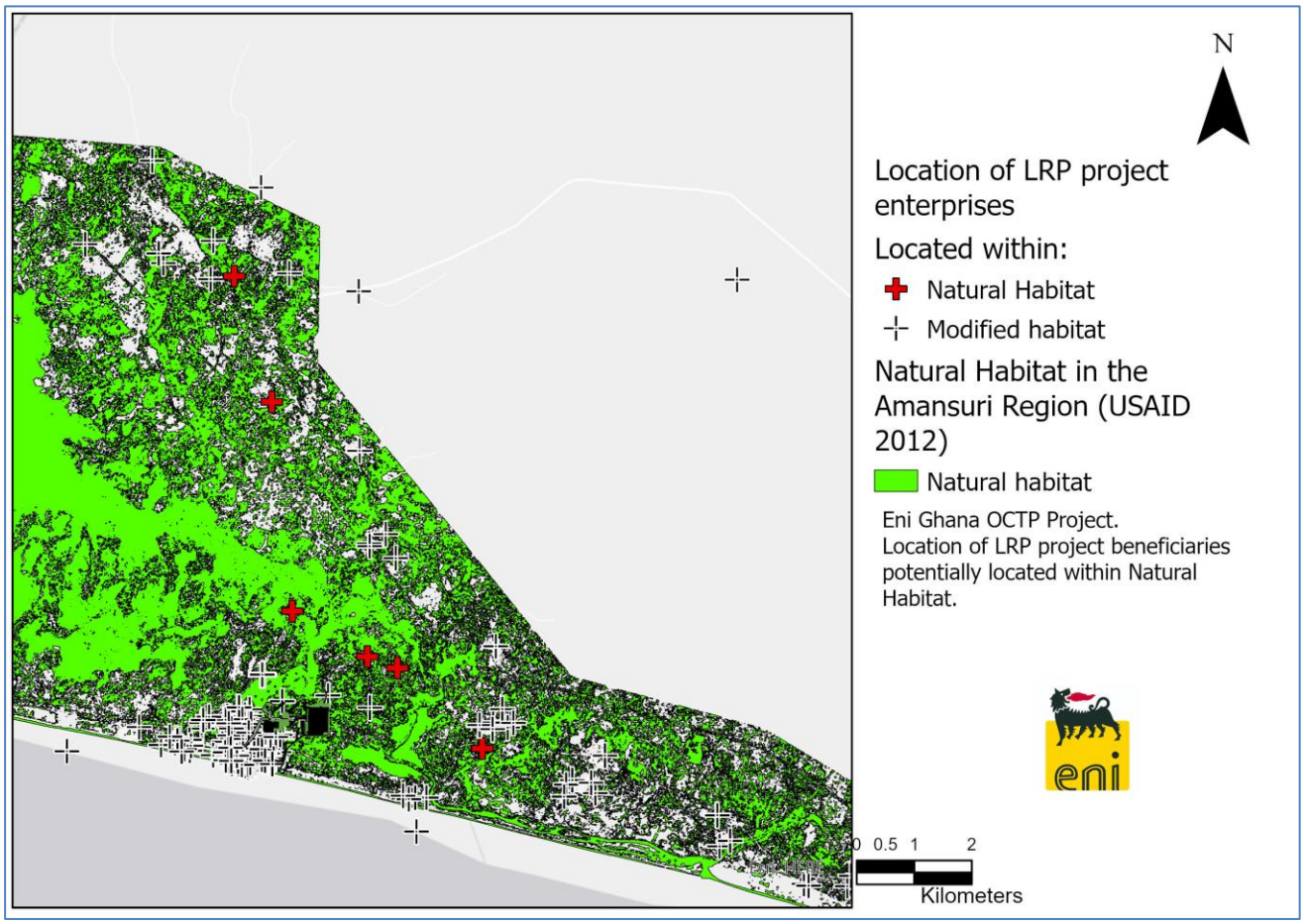


Figure 7-11. Location of LRP enterprises in relation to natural habitat extent within the Amansuri Region.

The result of this evaluation suggests the livelihood restoration activities did not result in any significant resettlement or displacement of livelihood activities within forested areas. We estimate that indirect losses are limited, and do not exceed the anticipated natural habitat gains expected from within the ORF facility. However, this position will be reassessed in line within the monitoring and evaluation plan for the IMP and LRP.

[38] Defined as modified habitat identified either by USAID & Hen Mpoano, (2012) Land Cover Land Us (LCLU) data for Ghana Amansuri Region, or ERM (2015), Land cover after field survey (within 500m of the Concession area), or as sites within or adjacent existing village structures, and no clear separation into forested areas..

7.2.3 Summary of Indirect impacts to natural and critical habitat

The spatial and temporal tests performed here show that tree cover loss is significantly higher within the AoI, than outside of the AoI. However, this situation existed prior to the project inception, meaning that other activities are also likely to be influencing the extent of habitat loss. Our analysis shows that the rate has increased since the project commenced, although this increase did not meet the significance test, meaning that the difference may be due to non-specific annual variation in the data. The evaluation of the IMP household surveys data and LRP beneficiary locations furthermore shows that the potential project indirect losses associated with displaced livelihood activities is very limited (less than 10ha) since most were located within the confines of local communities or existing modified habitat.

When these factors are considered, we estimate that natural habitat loss within the AoI in the time period between project early works and 2019 (end of construction period) are minimal and that the total estimated gain (approx. 27ha) that we foresee from habitat enhancement activities within the ORF concession will likely exceed project NH indirect losses.

For critical habitat, the increased loss of tree cover is not statistically significant between the pre and post project periods, suggesting that there is no increase associated with the OCTP project.

7.3 Total estimated loss and gains to natural and critical habitats

The following table provides a summary of the estimated residual impact on natural and critical habitat associated with the project at the time of writing.

Table 7-10 Estimated total residual impacts on Natural and Critical habitats

	Residual impacts as at 2020		
	Natural Habitat		**Critical habitat**
	Ha	**Quality ha**	
Direct impacts	-12.2	-8.4	0
Indirect impacts	-10ha	10	0 ha
Total	-22.2-ha	-18.4 Qha	0ha

Gains in the natural habitat are also anticipated from within the Concession. The amounts to 14.8ha (11.8Qha) from restoration activities (section 7.1.2), and 24.7[39]ha (26.8Qha) from habitat improvement during the 20 year lifespan of the project (section 7.1.3). We therefore anticipate the extent of natural habitat within the concession area to exceed the area before project commencement, (in terms of both physical area (ha) and quality area (Qha).

Debate still exists around the inclusion of "avoided losses" within accounting models used to predict NNL target, particularly in areas of high biodiversity loss. Based on the rate of forest loss in the four year period prior to construction, natural habitat within the concession area would have been expected to have declined at a rate of 1.5% per year (Table 7-7). Over a 20 year period, a no-project scenario, (without other interventions) would have reduced the extent of natural habitat within the concession from 39.1ha to 29.3ha. By implementing this strategy, the project has theoretically "avoided" this loss (9.7ha), *in addition* to the gains described.

This strategy predicts that Net Gain will be achieved *without* the inclusion of avoid losses. However, when avoided losses are included, the anticipated gain exceeds the losses by 163%.

Table 7-11. Estimated extent of Natural habitat within the concession area over the lifespan of the project ta king account of losses and predicted gains.

	Predicted extent of natural habitat within the ORF			**Estimated Gain from 2015**	**Estimate gain including avoided losses**
	Pre-construction	**Post-construction (2020)**	**End of project (est 2040)**		
Natural Habitat	39.1 ha (28.3 Qha)	26.9 ha (20.2 Qha)	66.4ha (58.6Qha)	27.3ha (30.3Qha)	37.0 (38Qha)

[39] 24.7ha is the extent of modified habitat retained after construction, which is expected to become predominantly natural over the 20 year period (Table 7-5).

8 IDENTIFICATION AND ASSESSMENT OF POTENTIAL NO NET LOSS OPTIONS

Offsets are the final step on the MH required to compensate for residual impacts that remain after all preventative and restorative steps have been exhausted. They are defined as *'Measurable conservation outcomes, resulting from actions applied to areas not impacted by the project, that compensate for significant, adverse project impacts that cannot be avoided, minimized and/or restored'*. Offsets require specific and preferably quantitative goals directly related to the residual project impact. Practical experience with offsets is still limited, but shows that they can be complex, expensive and uncertain in outcome.

This NNL strategy foresees the requirement for offsets to compensate for temporal losses associated with the construction of ORF and related onshore facilities in order to achieve the objective of NNL to natural habitat.

Typically, the offset should match the impact in both quality (e.g. the same kind and condition of habitat), quantity (e.g. the same extent of habitat) and time (e.g. match the temporal duration of the impact). This suggests that the offset would be located within the Amansuri region, focusing primarily on wetland habitats, and include a condition of permanence.

At a high-level, and in the absence of National guidance on biodiversity offsetting in Ghana, all options are still available for Eni Ghana to assess. These include the identification of:

- Restoration offsets; e.g. supporting the improvement (restoration) of areas damaged or degraded by activities not related to the project.
- Averted loss / protection offset; e.g. preventing future [non-project related] harm through reducing (or contributing to the reduction of) imminent threats to natural habitat, for example, by supporting measurable formal or informal protection activities.

In other terms, a restoration offset is where an area of degraded NH is identified and efforts to improve the quality are supported such that gains are achieved. The conservation (averted loss) offset is where a largely intact area is identified and the current (background) threat level is estimated – the offset would seek to reduce this through a recognised conservation approach. Averted loss offsets are most feasible where the existing threat levels are high and formal or traditional cultural institutions exist with the capacity to influence or modify the actions of those actors that are presenting threats. Averted loss offsets are also controversial as they provide "credits" for reducing rather than halting outright, the loss of biodiversity.

Eni Ghana will develop an offset implementation plan in line with the offset guidance from the Ghana Environmental Protection Agency (in draft, formal publication during the next year) and in conjunction with its Sustainability and Local Content department giving priority to restoration offset sites, although potential averted loss offsets could also be considered. The implementation plan roadmap is provided in chapter .10.

8.1 Restoration Offsets

8.1.1 Enhanced restoration with the Concession area

Eni Ghana shall implement an offset within the ORF concession area, for obvious reasons of relative simplicity of implementation, as the area has already been purchased by Eni Ghana. Opportunity exists to enhance the restoration and increase the habitat support and other ecosystem service functions of natural and modified habitats retained within the concession area. One way, described earlier, is through the installation of nest boxes to provide more nest options for forest birds. In addition, other practical and effective natural resource management actions can also be applied, for example, raising and planting seedlings that provide food and shelter for priority biodiversity, reducing access to illegal hunting and regular patrolling to remove snares and other traps targeting small mammals. A specific target may also be to provide safe roosting areas for vultures.

These and other natural resource management practises will seek to uplift the existing areas of modified habitat into a more natural state that supports priority biodiversity species. Eni will look at ways to secure the continuation of the restoration offset beyond 2040. This will include advocating for adoption of the "forest reserves" established into the Ghanaian protected area network.

8.1.2 Other options available off site.

Progress of the onsite restoration and habitat enhancement will be monitored on an annual basis. Should the onsite restoration and offset not proceed as expected, off-site areas will be reviewed to identify where habitat restoration or averted loss interventions could be targeted within the Amansuri Wetland area. Offset interventions also provide opportunities to focus conservation or enhancement efforts within critical habitat regions that comprise the core of the Amansuri wetland.

As an example, the attached map shows these 3 potential with locations where interventions (restoration or avoid loss) may be focused.

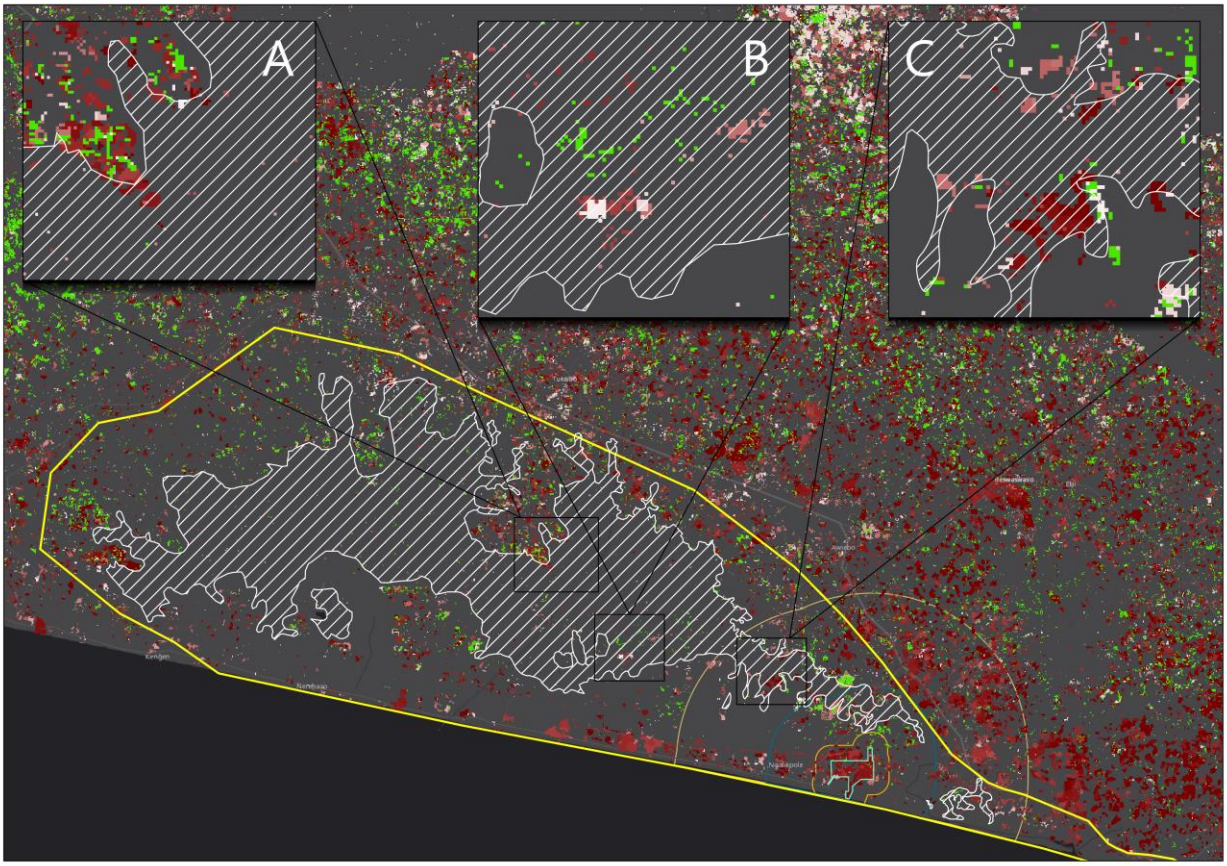


Figure 8-1. Example of Potential locations for Offset projects within the Amansuri wetlands.

The first area, A, shows a mix of forest gain and very recent forest loss, with potential for the forest loss to encroach further into critical habitat area (BWSF). This area may be suitable for targeted conservation actions aimed at preventing critical habitat losses.

The second area, B, shows a mix of old and recent forest loss but with very little forest gain, suggesting that this is land that has undergone permanent change from BWSF to another land use but hasn't expanded since. The small bubbles of non-BWSF contain classes of modified and low-grade natural habitat, typical of abandoned farmland. It may be suitable for active restoration back to critical habitat.

The third area, C, is closer to the concession area within the 5 km buffer zone but contains quite recent forest loss with almost no forest gain and could be a good place for a conservation intervention aimed at reducing further encroachment into critical habitat.

The full evaluation of these options must be performed in consultation with local stakeholders including relevant government agencies i.e. Ghana Wildlife Division (GWD) of the Forestry Commission i.e. and local NGOs.

Notwithstanding stakeholder specific ideas, a first set of potential actions could include community awareness and education, integration of conservation issues into sustainable community investment and livelihood restoration programmes, promotion of Community Resource Management Areas (CREMAs).

9 IMPLEMENTATION PLAN AND NEXT STEPS

Planning for the implementation of the NNL strategy shall commence in 2021 and will follow the roadmap in Figure 9-1. It will consist of stakeholder consultation running in parallel with the update of existing operating plans and the production of a Natural Habitat Offset Implementation Plan that will provide a detailed action plan for the onsite offset and habitat restoration within the ORF concession.

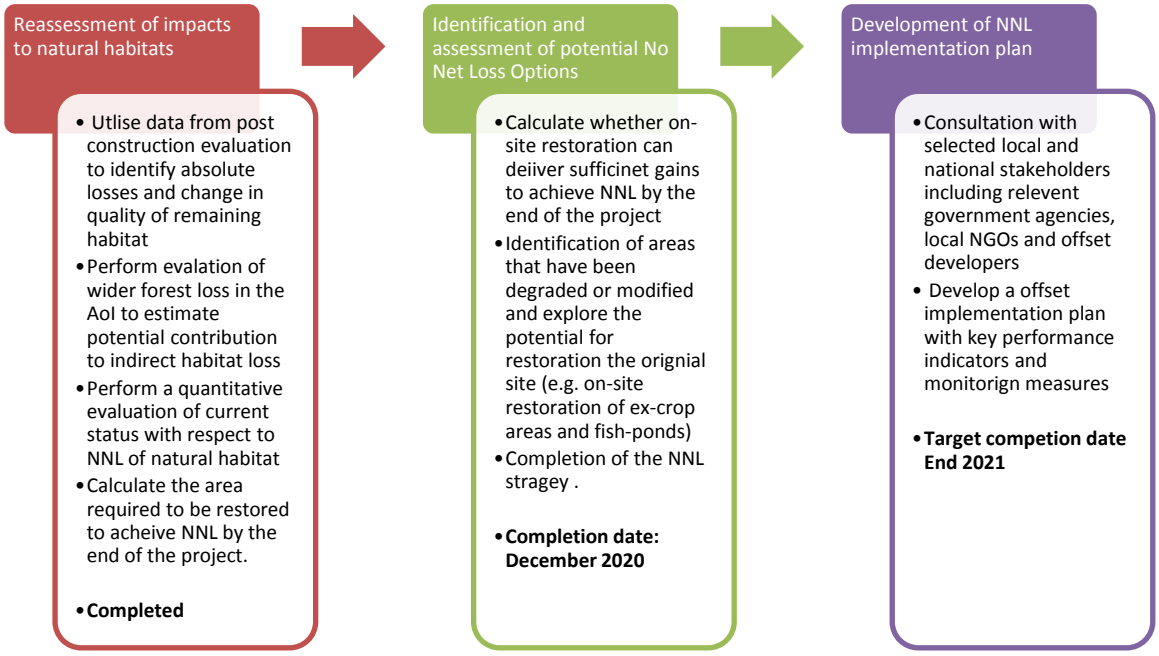
An important part of the implementation is monitoring and adaptive management. The Reinstatement and Revegetation Standard shall be updated to ensure that monitoring of the restoration status is conducted regularly (quarterly status and annual progress reporting) to ensure that issues are identified and remediated without delay. Flora Conservation Plans and Alien Invasive Species Standard will be reviewed to ensure consistency with this NNL strategy.

Many mitigation actions (particularly restoration) may take some time to demonstrate whether they have been successful. Vegetation restoration in a complex tropical ecosystem may appear successful insofar as vegetation will grow back relatively quickly; but it is expected that it will take years to determine if the succession and species composition is on-track to replace what may have been originally lost. Nevertheless, this process can be encouraged through the introduction of features that provide shelter to species. Features such as hollow logs, woodpiles, artificial nests and other enhancement techniques can be utilised to mimic the structural conditions of more mature forest and support the presence of a wider number of species.

A set of key performance indicators and a monitoring plan will be included in the Natural Habitat Offset Implementation Plan (NHOIP).

The flowchart below provides a summary of the NNL strategy steps and the key actions to be developed, along with the timeline for completion.

Figure 9-1 NNL Strategy Steps - Final Timeline



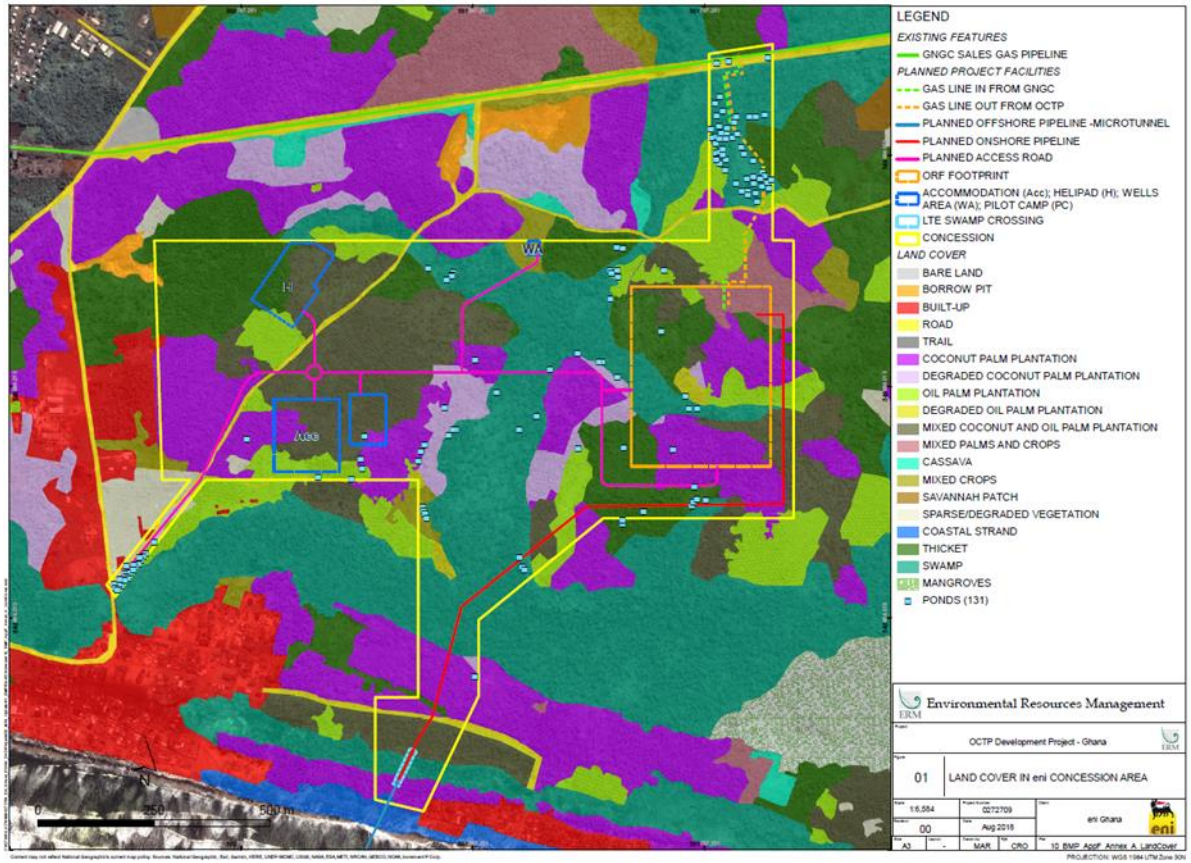
Updating of existing operational plans and the development of a dedicated Natural Habitat Offset Implementation Plan shall commence in the first quarter of 2021 and proceed following the timetable in Table 9-1.

Table 9-1. Action plan for the update and production of operational management plans in support of the implementation of the NNL strategy in 2021

Document	Actions	Timing
1. Reinstatement and Revegetation Standard (RRS) (std ms hse 004)	Include specific section for enhance the suitability of remaining habitat for forest-dependent Avian species, for example, through the installation of interventions such as nesting boxes to improve nesting choices within the forest reserve areas.	Feb – May
	Revise M&E plan: quarterly status and annual progress reporting required	
	Include section on activities to improve "naturality" of current modified area.	
	Include section on feasibility of species reintroductions (reinstatement)	
2. Work Instruction; opi ms hse 025, Control of Alien	Invasive species control should be extended to removal of non-native species in transects through areas of modified habitats.	Feb

Invasive Species (AIS).		
3. Flora Conservation Plan (plan ms hse 019 eni Ghana r01 Appendix F)	Review and ensure alignment with NNL strategy	Jan-march
4. "Natural Habitat offset implementation plan" (NHOIP)	**Function:** This will tie together the actions necessary to achieve NNL through restoration and onsite enhancement.	June/July* (covid dependent)
	Draft Content: Describe action in more details Include outcome of consultation with stakeholders on feasibility of enhancement (on-site offset). Include action plan Include Monitoring and evaluation plan Outline long-term strategy for ensuring offset permanency at decommissioning phase	
5. Environmental Monitoring Program (plan ms hse 018 eni ghana)	Ensure alignment with all above	July

10ANNEX A – LAND COVER WITHIN ENI CONCESSION AREA MAP 2016



11 ANNEX B – LAND COVER OF PROJECT FOOTPRINTS

TYPE	biodiversity value	Area (ha)
Natural		
Coastal Strand	High	0.02
Wet Evergreen Forest	High	5.24
Secondary Forest	Moderate	7
		12.26
Modified		
Coconut Palm Plantation	Low	12.02
Mixed Coconut and Oil Palm Plantation	Low	10.89
Oil Palm Plantation	Low	3.81
Sparse/Degraded Vegetation	Low	0.19
Mixed Crops	Very Low	0.12
Degraded Coconut and OIl Palm Plantation	Very Low	2.33
Mixed Palms and Crops	Very Low	2.19
Road and Track networks, bare land, other	None	0.69
		32.24