Gatwick Airport Northern Runway Project

Environmental Statement
Appendix 16.9.1: Assessment of Construction Greenhouse Gas Emissions

Book 5

VERSION: 1.0

DATE: JULY 2023

Application Document Ref: 5.3

PINS Reference Number: TR020005

APFP Regulations 5(2)(a) **Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009**

Table of Contents

Tables

1 Introduction

1.1 General

1.1.1 This document forms Appendix 16.9.1 of the Environmental Statement (ES) prepared on behalf of Gatwick Airport Limited (GAL) for the proposal to make best use of Gatwick Airport's existing runways and infrastructure (referred to within this report as 'the Project').

1.1.2 This document provides the Greenhouse Gas (GHG) Technical Appendix for the construction activities associated with the Project.

1.2 Overview of Methodology

1.2.1 The purpose of the construction assessment is to quantify the scale of works undertaken in future years under the Project, and compare these to construction works in the absence of the Project. By their nature emissions associated with construction do not follow a continuous year-on-year profile, they fluctuate significantly due to the scale of development undertaken in any single year.

1.2.2 The construction assessment seeks to quantify emissions from those construction activities arising from the Project. It also provides information on already consented development, some of which will result in construction activities being carried out in parallel with the works resulting from the Project. These already-consented works represent the future baseline for construction – ie construction activity that will take place both without the Project, and with the Project.

1.2.3 The assessment does not seek to estimate impacts from typical day-to-day maintenance or minor works arising from normal operations, and those works which would not require to undergo a consenting process. These works are therefore excluded from the construction assessment as they are judged to be not material in the context of other construction carried out under existing consents, or under the Project.

1.2.4 The assessment of construction impacts is structured around three main works types:

- construction associated with the airfield works;
- construction of new buildings on the airport (including demolition of some existing buildings); and
- highway works associated with the Project.

1.2.5 The data sources available for each works type is different and so a range of methodologies have been used to develop quantified estimates for materials, fuels, waste etc prior to converting these to estimates of GHG emissions.

1.2.6 Each sub-project within the Project has its own programme for delivery. The estimated emissions for each sub-project are calculated and then pro-rata'd across the years of construction for that sub-project. In this way a time-series for the overall Project can be developed.

1.2.7 Estimating impacts from the construction of airfield works is largely drawn from costings data that provides material volumes for different sub-projects. These are augmented with estimated data on plant operation, water demand, and staffing levels.

1.2.8 Estimated impacts for the construction of buildings are drawn from the use of benchmark data based on m^2 floorspace for each building.

1.2.9 Estimated impacts for the construction of highways works are based on cost plans for these works.

1.2.10 Additionally, the construction assessment includes an appraisal of land use change. This is dealt with in a separate way to the main construction assessment as it does not seek to include a time-based assessment of land use change emissions. This is discussed in isolation in Section 7 of this ES Appendix.

2 Baseline Development

2.1 Baseline Methodology

2.1.1 The baseline for GHG emissions includes a single historic year – 2018 – and then a future baseline period extending from 2018 to 2050.

2.1.2 Construction works form part of the day-to-day operation of large airports and works were being undertaken during the calendar year of 2018. However, for the purposes of the assessment of construction emissions it is not considered of value to quantify historic construction activities as these have no bearing on the assessment of impact under the Project in future years. For this reason, the 2018 baseline construction emissions are taken to be zero.

2.1.3 GAL has several sub-projects within the airport that are committed to be developed whether the Project proceeds or does not proceed. These sub-projects form the future baseline for construction emissions.

2.2 Data Sources for 2018 Baseline

2.2.1 As noted above the 2018 baseline year is assumed to have zero construction emissions.

2.3 Data Sources for Future Baseline

2.3.1 The following data sources and forecasts have informed the future baseline development.

Table 2.3.1: Future Baseline Data Sources

Data	Source	Provider
Building footprints / areas, hotel capacity, car parking etc. for already consented projects	**ES Chapter 5: Project Description** (Doc Ref. 5.1)	GAL

2.4 Future Baseline Calculation Methodology

2.4.1 The quantification of construction related GHG for the future baseline is based on available information on already consented construction activities. This does not comprise full design information for these projects, and as such the assessment makes use of the data that is available, which is then supplemented with additional typical and representative data for construction based on typical practices.

2.4.2 Future emissions intensities (ie emissions of GHG per unit of activity) will differ from those that represent activities at the time of writing in 2023, and in many cases will reduce in line with wider national trends towards decarbonisation. However, as a conservative approach to the construction assessment no future decarbonisation trends have been incorporated into the assessment of construction emissions.

2.4.3 Methodology notes for each element of the future baseline quantification are presented in Table 2.4.1.

Table 2.4.1 Future Baseline Methodology

Activity	Methodology
Construction Emissions	
GHGs arising from the extraction, processing, and manufacturing of construction materials for buildings	Floor areas of proposed development for the future baseline scenario was provided by GAL and benchmarks were used for estimating GHG emissions arising from those projects. Detail on the projects that are already consented at Gatwick are presented in **ES Chapter 5: Project Description** (Doc Ref. 5.1). The majority of consented works represent new buildings at the airport, and the method used for estimating GHG emissions associated with these was to use the typical building benchmarks contained within the LETI Embodied Carbon Primer (LETI, 2020). • For all buildings excluding multi-storey car parks the assumed embodied carbon (covering modules A1-A5) was 1,000 $kgCO_2e/m^2$ of floor area. • For multi-storey car parks this was reduced to 500 $kgCO_2e/m^2$ of floor area to reflect that these building types typically lack any façade materials or building services equipment. They also typically lack any internal finishes beyond signage.
GHGs arising from disposal of construction and demolition waste	In the absence of specific data for this element an estimate of likely related emissions has been derived from the full Project assessment. This results in an assumption that this element contributes an additional 0.85% of GHG emissions over the A1-3 GHG emissions.
GHGs arising from surface access for transportation of materials and waste	In the absence of specific data for this element an estimate of likely related emissions has been derived from the full Project assessment. This results in an assumption that this element contributes an additional 6.3% of GHG emissions over the A1-3 GHG emissions.
GHGs arising from surface access for construction staff	In the absence of specific data for this element an estimate of likely related emissions has been derived from the full Project assessment. This results in an assumption that this element contributes an additional 3.2% of GHG emissions over the A1-3 GHG emissions.
GHGs arising from water usage for construction	In the absence of specific data for this element an estimate of likely related emissions has been derived from the full Project assessment. This results in an assumption that this element contributes an additional 0.03% of GHG emissions over the A1-3 GHG emissions.

3 Future Baseline GHG Emissions Factors

3.1.1 The following factors were used in preparation of the future baseline.

Table 3.1.1 Future Baseline GHG Modelling Parameters

Parameter	Value	Unit	Source	Notes
Business-as-usual school embodied carbon	1,000	$kgCO_2e/m^2$	LETI Embodied Carbon Primer	Assumed appropriate for all airport buildings except multi-storey car parks.
Business-as-usual estimated embodied carbon for multi-storey car parks	500	$kgCO_2e/m^2$	Derived from LETI Embodied Carbon Primer	Estimated impact for multi-storey car park – school archetype benchmark reduced by 50% to reflect lack of façade, HVAC, internal finishes, and simpler superstructure.
Typical embodied carbon breakdown:				
Substructure	31	%	LETI Embodied Carbon Primer	These values have been used to inform the estimation of 50% reduction for multi-storey car parks.
Superstructure	17	%		
Internal Finishes	22	%		
Façade	17	%		
MEP	13	%		

3.1.2 LETI includes three building types in their general benchmarks: residential, commercial office, and school. None of these is especially suited to airport buildings in terms of similarity however the school archetype has been chosen as it typically represents a lower rise development with mechanically controlled environmental conditions.

4 Future With Project Development

4.1.1 The future with-Project development includes additional construction types beyond solely buildings (as in the future baseline) namely airfield construction, and highways construction.

4.1.2 Methodology and assumptions relating to buildings are as per the future baseline methodology. Additional future with-Project GHG modelling parameters are set out in Table 4.1.1.

Table 4.1.1 Additional Future With-Project GHG Modelling Parameters

Parameter	Value	Unit	Source
Average assumed material waste uplift	5	%	N/A
Embodied Carbon factor – Asphalt	0.058	$kgCO_2e/kg$	ICE v3
Embodied Carbon factor – Pavement Concrete	0.149	$kgCO_2e/kg$	ICE v3
Embodied Carbon factor – Granular Sub-base	0.017	$kgCO_2e/kg$	ICE v3
Embodied Carbon factor – Lean Concrete	0.097	$kgCO_2e/kg$	ICE v3

Parameter	Value	Unit	Source
Embodied Carbon factor – Reinforcement bar	1.990	$kgCO_2e/kg$	ICE v3
Plant energy emissions	2.558	$kgCO_2e$/litre of diesel	Estimate derived from indicative plant equipment list.
Water supply emissions	149	$kgCO_2e$/million litres	BEIS GHG Conversion Factors 2022
Waste water treatment emissions	272	$kgCO_2e$/million litres	BEIS GHG Conversion Factors 2022
Average material haulage distance	100	km	Estimated based on factors from RICS Whole Life Carbon Assessment for the Built Environment (RICS 2017). Assumes 80% is locally sourced and 20% is nationally sourced.

4.1.3 Parameters relating to the construction of highways are contained within the National Highways Carbon emissions calculator tool (Highways England, 2022) and are not replicated here.

5 Evaluation of Construction GHG Emissions

5.1 2018 Baseline Emissions

5.1.1 As noted in Section 2.1 the 2018 baseline is assumed to be zero.

5.2 Future Baseline Emissions

5.2.1 The future baseline construction-related emissions are presented in Table 5.2.1and Table 5.2.2.

Table 5.2.1 Future Baseline Construction Emissions A1-A5

Year	A1-3 Embodied Carbon of Construction Materials (cradle-gate) $ktCO_2e$	A4 Transportation of Construction Materials ($ktCO_2e$)	A5 Construction Energy ($ktCO_2e$)
2019	-	-	-
2020	-	-	-
2021	-	-	-
2022	-	-	-
2023	14.369	0.605	0.151
2024	18.476	0.778	0.194
2025	4.107	0.173	0.043
2026	4.107	0.173	0.043
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-

Table 5.2.2: Future Baseline Construction Emissions for Worker Transport, Construction Waste, and Construction Water

Year	Construction Worker Transport ($ktCO_2e$)	Construction Waste Management ($ktCO_2e$)	Construction Water Use ($ktCO_2e$)
2019	-	-	-
2020	-	-	-
2021	-	-	-
2022	-	-	-
2023	0.453	0.121	0.005
2024	0.583	0.155	0.006
2025	0.130	0.035	0.001
2026	0.130	0.035	0.001
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-

5.3 Future Project Emissions

5.3.1 The future project emissions reflect the commitments made in the **ES Appendix 5.4.2: Carbon Action Plan** (CAP) (Doc Ref. 5.3), which include a commitment not to exceed 1.155 $MtCO_2e$ emissions from the construction of the Project. This level of emissions represents a 17% reduction on the 'unmitigated' scenario in the absence of the CAP.

5.3.2 The future construction-related emissions for the Project are presented in these categories in Table 5.3.1 to Table 5.3.2.

Table 5.3.1 Project Construction Emissions for Embodied Carbon of Materials

Year	A1-3 Embodied Carbon of Construction Materials (cradle-gate) $ktCO_2e$	A4 Transportation of Construction materials ($ktCO_2e$)	A5 Construction Energy ($ktCO_2e$)
2019	-	-	-
2020	-	-	-
2021	-	-	-
2022	-	-	-
2023	-	-	-
2024	61.089	4.082	25.337
2025	112.926	6.554	37.681
2026	102.472	6.071	55.663
2027	55.888	3.178	32.692
2028	53.658	3.392	33.722
2029	58.326	5.528	28.154
2030	82.060	6.390	18.089
2031	83.720	6.647	16.583
2032	55.068	2.606	13.291
2033	52.639	2.255	10.264
2034	61.217	2.620	6.431
2035	13.482	0.571	2.432
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-

Table 5.3.2: Project Construction Emissions for Commuting of Construction Workers

Year	Construction Worker Transport ($ktCO_2e$)	Construction Waste Management ($ktCO_2e$)	Construction Water Use ($ktCO_2e$)
2019	-	-	-
2020	-	-	-
2021	-	-	-
2022	-	-	-
2023	-	-	-
2024	2.331	1.270	0.024
2025	3.060	1.457	0.049
2026	3.731	1.009	0.044
2027	2.444	0.580	0.030
2028	2.618	0.859	0.039
2029	2.455	0.511	0.027
2030	2.809	0.409	0.030
2031	2.169	0.534	0.011
2032	1.375	0.012	0.005
2033	1.053	0.009	0.003
2034	0.638	0.009	0.003
2035	0.320	0.000	0.000
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-

5.4 Construction Emissions Time Series

5.4.1 The aggregated construction emissions are presented in Table 5.4.1.

Table 5.4.1: Aggregated Project Construction Emissions by Year

Year	Aggregated Construction Emissions ($ktCO_2e$)
2019	-
2020	-
2021	-
2022	-
2023	-
2024	94.133
2025	161.727
2026	168.989
2027	94.812
2028	94.288
2029	95.001
2030	109.788
2031	109.665
2032	72.356
2033	66.223
2034	70.916
2035	16.805

Year	Aggregated Construction Emissions ($ktCO_2e$)
2036	-
2037	-
2038	-
2039	-
2040	-
2041	-
2042	-
2043	-
2044	-
2045	-
2046	-
2047	-
2048	-
2049	-
2050	-
Total	1,154.704[1]

6 Mitigation

6.1 Aggregated Construction Emissions

6.1.1 The aggregated future baseline construction emissions are **0.045 $MtCO_2e$**.

6.1.2 The aggregated Project construction emissions are **1.155 $MtCO_2e$.**

6.2 Impact of the Carbon Action Plan

6.2.1 **ES Appendix 5.4.2: Carbon Action Plan** (Doc Ref. 5.3) includes commitments to achieving certain performance improvements in terms of GHG emissions from construction of the Project.

6.2.2 GAL has carried out an exercise to assess the scale of GHG reductions that might be achieved relative to an approach to construction. This exercise has considered a range of potential measures including:

- substitution of lower carbon materials at various scales of deployment across the airfield works, buildings construction, and highways construction;
- mitigation of construction waste across the Project;
- replacement of traditional concrete reinforcement with use of steel fibre reinforcement;
- alternative energy supplies for construction plant, such as use of electrical plant or HVO powered plant, at various scales of deployment across the Project works;
- improvements in transport associated with construction workers to encourage lower emissions travel modes; and
- targeting best practice benchmarks for construction of buildings.

6.2.3 At this stage in project development the specific measures that would be implemented across the construction phase are not confirmed. However, the assessment undertaken by GAL to identify the feasibility of these measures has provided an indication of what levels of GHG mitigation are likely to be achievable while reflecting uncertainties around:

- potential limitations around material substitution arising from the need to deviate from standard practice, or from accepted technical standards, for airfield infrastructure;
- availability of specific construction plant types using alternative energy supply/sources; and
- feasibility of low carbon building construction methods in the context of safety and security requirements for airport buildings.

6.2.4 Other opportunities for reducing and managing GHG may also arise from design efficiency and scope-reduction as the overarching Project proceeds through design stages.

6.2.5 **Based on this work GAL includes within the CAP a commitment to achieving a 17% reduction on the GHG emissions from construction of the Project, compared to a typical construction approach.** This mitigated level forms the main assessment scenario presented in the ES, and in the preceding sections of this ES Appendix.

- The construction emissions for the Project only with the commitments of the CAP in place are **1.155 $MtCO_2e$.**
- The construction emissions for the Project only without the commitments of the CAP in place are **1.391 $MtCO_2e$.**

7 Land Use Change

7.1.1 The appraisal of land use impacts is based on a common dataset as used for the calculation of biodiversity net gain for the Project. This appraisal provides an estimate of the hectarage of different habitat types before and after construction of the Project.

7.1.2 In the absence of the Project, land use impacts are assumed to be zero on the basis that existing habitats are mature, and any ongoing sequestration is at a low annual rate.

7.1.3 Table 7.1.1 provides a summary of the areas of habitat before and after construction has taken place:

Table 7.1.1: Biodiversity Habitat Areas Before and After Construction for the Area Impacted by the Project

Biodiversity Habitat Type	Area Before Construction (ha)	Area After Construction (ha)
Grassland	67.22	59.97
Heathland and shrub	5.90	9.97
Lakes	1.97	0.92
Sparsely vegetated land	0.08	0.01
Urban	151.21	159.38
Wetland	0.07	0.24
Woodland forest	13.16	7.46
Watercourse footprint	0.35	1.55
Individual trees	0.00	0.46

7.1.4 Representative carbon storage factors for different habitat types have been sourced from *Carbon Storage and Sequestration by Habitat 2021 (NERR094) (Natural England 2021)*. These factors are presented in Table 7.1.2.

Table 7.1.2: Biodiversity Habitat Area Carbon Storage Factors

Biodiversity Habitat Type	Representative Carbon Storage Factor (tC/ha)
Grassland	130.0
Heathland and shrub	144.5

[1] Throughout the chapter, and associated appendices, tables present the calculated values for that datum. These are frequently simplified to a specific number of decimal places or significant figures. In several cases disparities in rounding lead to tallies of summary values, and presented total values, being inconsistent.

Biodiversity Habitat Type	Representative Carbon Storage Factor (tC/ha)
Lakes	109.4
Sparsely vegetated land	0
Urban	60.0
Wetland	76.0
Woodland forest	255.0
Watercourse footprint	76.0
Individual trees	255

7.1.5 Due to the nature of the construction programme a portion of the landscape areas present before construction would be removed, and new habitat areas provided in different locations, although in some cases areas of habitat would be retained in situ. To estimate the GHG impacts of this process a worst-case assumption is adopted that assumes all habitat areas are lost during construction, and then sequestration of carbon in newly constructed habitat areas would develop over time as the habitat matures.

7.1.6 This represents a conservative approach to the appraisal of land use changes impacts as it assumes 100% loss of all habitat areas during construction processes whereas it is likely that some areas would remain undisturbed or minimally disturbed during construction.

7.1.7 The appraisal uses average carbon stock data for each of the habitat types, representing a mature habitat over 30 years of age, to estimate the maximum loss and subsequent gain of sequestered carbon. The scale of lost and sequestered carbon is presented in Table 7.1.3.

Table 7.1.3: Carbon Losses and Gains through Landscape Use Changes

Impact	Notional 100% Loss During Construction	Notional Full Post-Construction Sequestration (assumed 30 year maturity)
Carbon (tonnes C)	22,267	21,217
Carbon dioxide equivalent (tCO_2e)	81,645	77,794

7.1.8 The net change is estimated as an emission of 3,851 tCO_2e.

7.1.9 Considering the emissions arising from land use change it can be seen that in total these are of a scale comparable with the other construction emissions:

- Full construction emissions for the Project totals 1.155 $MtCO_2e$ over the construction period 2024-2038.
- Full land use impacts from loss of all habitats over the construction period totals 0.082 $MtCO_2e$.
- Net land use impacts are equivalent to approximately 0.33% of total construction impacts for the Project.

7.1.10 The scale of land use emissions for the area impacted by the Project is small compared to wider construction. While the comparison of habitat areas does indicate a net release of GHG emissions over the construction period and the 30 years following, the new areas of habitat would be expected to continue to sequester carbon beyond this period (albeit at a slower rate per year).

7.1.11 On this basis the impacts arising from land use are not considered to be material to the overall assessment of GHG emissions and are not considered to affect the assessment of significance within the main chapter.

8 References

Circular Ecology Ltd. (2019) *Embodied energy and carbon – The ICE database version 3.*

Construction Industry Training Board (2019) *Workforce Mobility and Skills in the UK Construction Sector 2018/19*.

Department for Business, Energy & Industrial Strategy (2022) *BEIS GHG conversion factors*.

Highways England (2022) *Carbon emissions calculation tool v2.5.*

LETI (2020) *LETI Embodied Carbon Primer.*

Natural England (2021) *Carbon Storage and Sequestration by Habitat 2021.*

RICS (2017) *Whole life carbon assessment for the built environment.*

9 Glossary

9.1 Glossary of Terms

Table 9.1.1: Glossary of Terms

Term	Description
BEIS	UK Government Department for Business Energy and Industrial Strategy
CAP	Carbon Action Plan
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
ES	Environmental Statement
GAL	Gatwick Airport Ltd
GHG	Greenhouse Gas
ha	Hectare
HGV	Heavy Goods Vehicle
HVO	Hydrotreated Vegetable Oil (diesel-like fuel)
ICE	Inventory of Carbon and Energy
RICS	Royal Institute of Chartered Surveyors