**Cambridge Waste Water Treatment Plant Relocation Project**
Anglian Water Services Limited

# Environmental Statement Chapter 10: Carbon

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## Figures



## Tables

## Summary

This chapter presents the findings of an Environmental Impact Assessment (EIA) completed in relation to the potential carbon emissions[1] generated by the Proposed Development. This assessment has considered the following aspects of the Proposed Development:

- Decommissioning: carbon emissions arising from activities in decommissioning the existing site.
  - The baseline is zero carbon emissions (no decommissioning activities).
- Construction: capital carbon emissions associated with construction materials, transport of materials to the Proposed Development, and construction activities.
  - A baseline of a pre-value-engineered view (based on 2010 construction practices and baseline models) has been assessed.
- Land use change: carbon sequestration impacts from proposed landscaping plans.
  - The baseline is for no change in land use of the Proposed Development site
- Operation: carbon emissions associated with operational energy use and other operational processes over the opening year of the Proposed Development. Two different scenarios are presented for operation:
  - Preferred Option: where biogas generated by the Proposed Development is exported to the UK gas grid (known as 'gas to grid'). The export of gas to grid has been estimated to result in avoided carbon emissions through displacement of other sources of gas supply to the UK grid.
  - CHP Option: where biogas generated by the Proposed Development is used in efficient combined heat and power engines (CHP). This reduces the requirement for grid electricity to operate the Proposed Development. This has been modelled as an alternative scenario as a worst case, should gas to grid be unviable at point of construction. This option aligns to the operational emissions of the baseline.
- Whole assessment life: carbon emissions associated with all the above aspects presented for the whole assessment lifetime.

The estimated carbon emissions have been presented as gross and net emissions. Net emissions show the impacts when avoided emissions are accounted for.

[1] The term 'carbon emissions' is used throughout this report. Carbon is the commonly used term referring to greenhouse gases (GHGs).

Under the Preferred Option scenario, the assessment lifetime impact has been calculated as net negative carbon emissions (-35,380 $tCO_2e$) based on the anticipated export of gas to grid during operation.

The alternative Proposed Development scenario of using biogas in CHP is estimated to have overall net carbon emissions over the assessment life of 68,430 $tCO_2e$. The net operational carbon emissions under this scenario would be offset through a l Carbon Management Plan, to ensure that Anglian Water's commitment to an operationally net zero project would be met.

Good practice construction measures to reduce GHG emissions have been recommended in the Code of Construction Practice Part A and B (CoCP) (Appendix 2.1 & 2.2, Application Document Reference 5.4.2.1 and 5.4.2.2). Reductions in construction emissions of just under 50% have been made between the assessment of the baseline design when compared to the Proposed Development. Further design optimisation opportunities are being investigated by the Applicant to meet their target of at least a 70% reduction that will continue during detailed design of the Proposed Development.

# 1 Introduction

## 1.1 Purpose of this chapter

1.1.1 This chapter of the Environmental Statement (ES) presents the findings of an Environmental Impact Assessment (EIA) completed in relation to the potential carbon emissions arising from the Proposed Development.

1.1.2 The ES has been prepared as part of the application to the Planning Inspectorate (PINS) for development consent. This chapter considers the potential greenhouse gas emissions (GHGs) (commonly referred to as carbon emissions)[2] arising as a result of the Proposed Development during its construction (including commissioning), operation and maintenance and decommissioning phases.

1.1.3 Potential impacts of future climate conditions on the Proposed Development are assessed in Chapter 9: Climate Resilience.

1.1.4 This chapter summarises information from supporting studies, technical reports and publicly available data which are included within Appendix 10.1: Carbon Calculations (App Doc Ref 5.4.10.1).

## 1.2 Competency statement

1.2.1 Summaries of the qualifications and experience of the chapter authors are set out in Table 1-1:

**Table 1-1: Competent experts**

| Author | Qualification / Professional Membership | Years of experience | Project experience summary |
|---|---|---|---|
| [redacted] | MSc, CEnv, MIEMA | 14 | Contributor and reviewer roles for multiple EIA and ESIA projects. Multi-sector experience, including major transport projects and the power sector. Experience in data management and analysis for a range of environmental assessments. Specialist in carbon management and assessment. |
| [redacted] | MSc, CWEM | 10 | Contributor as part of the technical authoring team for PAS 2080:2016. Experience in developing carbon data sets for water sector assets and carbon assessments for major infrastructure projects. |
| [redacted] | MSc, CEnv, MIES | 7 | Contributor and reviewer roles for multiple EIA projects. Multi-sector experience, including the |

[2] *GHGs refer to the seven gases covered by the Kyoto Protocol: carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride ($SF_6$) and nitrogen trifluoride ($NF_3$). These are measured in units of carbon dioxide equivalent ($CO_2e$) which expresses the impact of each gas in terms of the amount of $CO_2$ that would create the same impact.*

| Author | Qualification / Professional Membership | Years of experience | Project experience summary |
|---|---|---|---|
| | | | water sector (EIA, regional planning, WRMPs). Experience in data management and assessment for a range of environmental assessments, specialist in EIA, as well as Natural Capital and Ecosystem Services Assessments. |

## 1.3 Planning policy context

### National Planning Statement (NPS) requirements

1.3.1 Planning policy on waste water Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to water resources, is contained in the National Policy Statement (NPS) for Waste Water .

1.3.2 Table 1-2: sets out how the scope proposed in this chapter complies with the NPS for Waste Water.

**Table 1-2: Scope and NPS Compliance**

| NPS requirement | Compliance of ES scope with NPS requirements |
|---|---|
| Paragraph 2.2.3 sets out the policy context including 'to help deliver the UK's obligation to reduce greenhouse gas emissions by 80% by 2050 and work to carbon budgets stemming from the Climate Change Act 2008'. | Note that the Climate Change Act was amended in 2019, and now commits the UK to 'net zero' by 2050.<br>This ES scope includes assessment of GHG emissions from operation and construction, with mitigation measures to reduce emissions identified. Emissions estimates are compared against the UK's carbon budgets. |

### National planning policy

1.3.3 National planning policy of relevance to carbon and pertinent to the Proposed Development is listed below.

- National Planning Policy Framework (NPPF) with particular reference to:
  - paragraphs 8, 20 and p153-154 in relation to adaptation, mitigation and climate change resilience;
  - paragraphs 152, p154-158 in relation to reduction of GHG emissions through design and reduced energy consumption (Ministry of Housing, Communites & Local Government, 2021).

### Local planning policy

1.3.4 Local planning policy of relevance to the Proposed Development includes:

- South Cambridgeshire District Council Local Plan 2018 (South Cambridgeshire District Council, 2018) with particular reference to:
  - Policy CC/1: Mitigation and Adaptation to Climate Change, which states that proposals should 'embed the principles of climate change mitigation and adaptation into the development'; and
  - Policy CC/3: Renewable and Low Carbon Energy in New Developments requires developments for new dwellings or other buildings to reduce carbon emissions.
- South Cambridgeshire District Council (SCDC) has committed to deliver Net Zero Carbon by 2050 and declared a Climate Emergency in December 2018:
  - The commitment is that the next local plan (to be a combined local plan with Cambridge City Council) will 'look at ways South Cambridgeshire District Council can press for a carbon-free area through the design of homes and other buildings, land use including open space, transport links, energy supplies and waste and recycling services'. The current local plan is focused on buildings and energy reduction, the new local plan will have to take a broader view on all new developments and how to reduce carbon (embedded and operational emissions).
- Cambridgeshire and Peterborough Minerals and Waste Local Plan 2036, adopted in July 2021 (Peterborough City Council and Cambridgeshire County Council, 2021) with particular reference to:
  - Policy 1: Sustainable development and climate change, where mineral and waste management proposals will be assessed against their active role in guiding development towards sustainable solutions.
- Cambridge City Council Local Plan 2018 (Cambridge City Council, 2018) with particular reference to:
  - Policy 28: Carbon reduction, community energy networks, sustainable design and construction, and water use which states that 'all developments should take the available opportunities to integrate the principles of sustainable design and construction into the design of proposals... including carbon reduction'.
- Cambridge City Council declared a Climate Emergency in January 2019. Relevant climate change strategy includes Cambridge City Council Climate Change Strategy (2021-2026) (Cambridge City Council, 2021) and supporting Carbon Management Plan (2021-2026) (Cambridge City Council, 2021). The climate change strategy identifies key objectives to tackle, including:
  - reducing energy consumption and carbon emissions from homes and buildings in Cambridge; and

- reducing consumption of resources, reducing waste and increasing recycling in Cambridge.

## 1.4 Legislation

### National Legislation

1.4.1 The requirement to consider a project's impact on climate change (i.e. its GHG emissions) was introduced in the 2014 amendment to the Environmental Impact Assessment (EIA) Directive (2014/52) (The European Parliament and the Council of the European Union, 2014). The Directive has been fully transposed into UK law in the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. Schedule 4, paragraph 5 of the regulation states that 'A description of the likely significant effects of the development on the environment resulting from, inter alia—... (f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions)…' is required.

1.4.2 The Climate Change Act 2008 (UK Government, 2008) and its 2019 amendment (UK Government, 2019) supports the UK's transition towards a low carbon economy. It includes a legally binding commitment to reach net zero by 2050, which represents a 100% reduction in national carbon emissions compared to 1990 levels. The Act also sets a national 5-year carbon budgeting system, with legally-binding 'carbon budgets' to cap the amount of GHGs emitted in the UK over a five-year period. It also established the context for Government action and incorporated the requirement to undertake Climate Change Risk Assessments, and to develop a National Adaptation Programme (NAP) to address opportunities and risks from climate change (which is covered in Chapter 9: Climate Resilience).

## 1.5 Consultation

### Scoping

1.5.1 Table 1-3: provides a summary of key points raised during scoping.

**Table 1-3: Key points raised during scoping**

| Consultee | Points raised | How and where addressed |
|---|---|---|
| Greater Cambridge Shared Planning | Assess both GHG (including carbon) and the vulnerability of the project to climate change. | GHGs are addressed in this assessment (Section 4 presents the assessment of effects). Chapter 9 covers Climate Resilience. |
| Greater Cambridge Shared Planning | Scope of assessment should include: decommissioning of the current WWTP and WRC and the intention (with carbon implications) for the proposed WWTP at the end of the plant's design life (post 2050). | Decommissioning of the existing Cambridge WWTP is quantified within this assessment (Section 4.5). Decommissioning involves limited activities to drain down and render safe the existing structure and has a limited impact.<br>The Development Consent Order application does not include the demolition of the existing facility or its redevelopment for low carbon housing and employment uses, which will be approved through a separate planning permission. Carbon impacts associated with these activities are therefore not assessed in the environmental statement, but they are considered in a high-level strategic carbon assessment (Whole Life Carbon Assessment Application Doc Ref 7.5.2).<br>Future forecasts of emissions are subject to broad assumptions and a high degree of uncertainty. There are no proposals to decommission the proposed WWTP, which would be retained indefinitely. |
| Greater Cambridge Shared Planning | Consider materials and technologies for reducing embodied carbon and offsetting carbon in both the construction and operational stages. | Opportunities for reducing capital carbon have been included within the design process, summarised within this assessment (<br>Table 2-4).<br>Carbon offsetting purchases are not considered within this assessment. The impacts presented here represent a reasonable worst-case scenario, without offsetting. The carbon benefits of land-use change and biomethane export are considered as part of the footprint. |

| Consultee | Points raised | How and where addressed |
|---|---|---|
| Fen Ditton Parish Council | Include an assessment of the embodied and operational carbon footprint if the current works were retained as a baseline. | The baseline for this assessment is a pre-value-engineered design which represents an early view of how the existing Cambridge WWTP would likely have been re-built through conventional processes and approaches (see section 3.1 - Current baseline). |
| Fen Ditton Parish Council | Include an assessment of decommissioning of the Proposed Development. | Decommissioning and demolition of the Proposed Development has not been quantified – future forecast of emissions is subject to broad assumptions and a high degree of uncertainty. As discussed in the Project Description chapter ,There are no proposals to decommission the proposed WWTP, which would be retained indefinitely. |
| Fen Ditton Parish Council | Assessment of emissions significance based on net impact as per IEMA Guidance. | IEMA Guidance (Institute of Environmental Management and Assessment, 2022) has been used to inform this assessment. |
| Fen Ditton Parish Council | Provide a clear description of the energy generation proposals. | The assessed operation of the Proposed Development includes either export of biogas to grid, supported by solar generation, or use of biogas in CHP energy generation, supported by solar generation. These are described in Chapter 2. |

### Technical Working Groups

1.5.2 Table 1-4: provides a summary of key points raised during engagement with Technical Working Groups.

**Table 1-4: Key points raised during engagement with Technical Working Groups**

| Date | Consultee | Points raised | How and where addressed |
|---|---|---|---|
| June 2022 | Carbon SoCG Meeting (Anglian Water, Greater Cambridge Planning) | Clarify scope of assessment in the ES (especially re. decommissioning). | Section 2 on Assessment Approach covers the scope of assessment.<br>The Development Consent Order application does not include the demolition of the existing facility or its redevelopment for low carbon housing and employment uses, which will be approved through a separate planning permission. Carbon impacts associated with these activities are therefore not assessed in the environmental statement, but they are considered in a high-level |

| Date | Consultee | Points raised | How and where addressed |
|---|---|---|---|
| | | | strategic carbon assessment which accompanies the DCO application. |

### Statutory s42 consultation

1.5.3 There are no statutory consultees for the regulation of carbon emissions.

### Statutory s47 local community consultation

1.5.4 The Consultation Report (App Doc Ref 6.1) describes the consultation process that the Proposed Development has followed and details the responses to all comments made during this consultation. Matters raised in relevance to the carbon assessment include:

- the provision of details regarding the estimated carbon emissions involved in decommissioning of the existing Cambridge WWTP, construction (including transport) and operation of the Proposed Development, and land use change;
- the provision of information available to support the Applicant's 70% construction capital carbon reduction commitment; and
- requests that the details of carbon payback of the Proposed Development, including operational emissions and transport, be provided.

# 2 Assessment Approach

## 2.1 Guidance

2.1.1 The following guidance provides best practice for the assessment of carbon emissions and has been used to inform the EIA:

- Institute of Environmental Management and Assessment (IEMA) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance – Second Edition is widely accepted as comprehensive guidance on assessment of GHG emissions, and has been used to inform assessment of significance (Institute of Environmental Management and Assessment, 2022);
- Infrastructure Carbon Review (HM Treasury, 2013) sets out carbon reduction actions required by infrastructure organisations. In terms of the Proposed Development, this means that emissions reduction actions should be taken into account when developing scheme specific mitigation measures;
- National Planning Practice Guidance includes a dedicated section on climate change (Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government, 2019), which sets out key legislation and drivers for considering climate change in planning. The guidance sets out examples of climate change mitigation (reduction of emissions), and adaptation to climate change;
- PAS 2080: 2016 Carbon Management in Infrastructure (British Standards Institution, 2018) establishes a common understanding, approach, and language for whole life carbon management in the provision of economic infrastructure (defined as water, energy, transport, communications, and waste). This approach is key to informing the methodology for assessment, and the Applicant's carbon models are assessed against PAS 2080.
- The assessment of the impact on land use change has been undertaken in line with the following methodology guidance:
  - Enabling a Natural Capital Approach (ENCA): (DEFRA, 2021);
  - The Green Book Central Government Guidance on appraisal and evaluation: (HM Treasury, 2018); and
  - Natural Capital Atlas: Mapping Indicators for County and City Region (NECR318): Cambridgeshire: (Natural England, 2020).

## 2.2 Assessment methodology

2.2.1 The approach to assessment described in Chapter 5: Assessment Methodology has been followed.

2.2.2 Primary and tertiary mitigation for the Proposed Development has been identified as part of an iterative design process and is described in Chapter 2 (Project Description) and Chapter 3 (Alternatives). The preliminary assessment of the likely significant environmental effects has been undertaken with the assumption that primary and tertiary mitigation will be implemented.

2.2.3 Following the preliminary assessment, any further mitigation measures (secondary mitigation) are identified and described. These mitigation measures would further reduce an adverse effect or enhance a beneficial one.

2.2.4 This section provides specific details of the carbon emissions methodology applied to the assessment of the Proposed Development.

## Impact assessment criteria

2.2.5 The significance of an effect is determined based on the magnitude of an impact and the sensitivity of the receptor affected by the impact of that magnitude. This section describes the criteria applied in this chapter to characterise the magnitude of potential impacts and sensitivity of receptors.

2.2.6 The assessment methodology is based on the IEMA Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022). Following this guidance, the significance of the effect is based on whether a project contributes to reducing carbon emissions (against the agreed baseline) in line with a relevant trajectory to net zero. The magnitude of carbon emissions is not necessarily an indicator of the significance of effect, instead the focus is on aligning with net zero.

## Sensitivity of receptor

2.2.7 There is one receptor for carbon emissions assessment; the global climate. National planning policies and the UK Climate Change Act reiterate the serious nature of climate change and the need to rapidly decarbonise. This has been taken into account, in line with IEMA guidance, by defining the sensitivity of the global climate as high.

2.2.8 Significance of effect

2.2.9 Table 2-1 sets out the significance criteria adapted from the IEMA Guidance. Following this guidance, any effects with a significance level of minor or less are considered to be not significant. Where a range of significance is presented, the final assessment is based upon expert judgement.

**Table 2-1: Significance criteria**

| Scale of effect | Description | Significance |
|---|---|---|
| **Major adverse** | Emissions are not mitigated, or only comply with do-minimum standards. | Significant |
| **Moderate adverse** | Emissions are partially mitigated, but do not align to relevant policy decarbonisation goals. | Significant |

| Scale of effect | Description | Significance |
|---|---|---|
| **Minor adverse** | Emissions fully align to applicable policy requirements and good practice. | Not significant |
| **Negligible** | Emissions reductions are well beyond applicable policy and design standards towards net zero, with minimal residual emissions. | Not significant |
| **Beneficial** | Net impacts are below zero, having a positive climate impact. | Significant |

### Residual effect

2.2.10 The residual effects are those remaining after accounting for the embedded mitigation (primary) and legal requirements (tertiary mitigation), and after the application of further mitigation measures (secondary mitigation). Effects after mitigation are referred to as 'residual effects'.

## 2.3 Study Area

2.3.1 The assessment of the effects on climate does not have a physical study area *per se* as the receptor (the global climate) for GHG emissions is not spatially defined. Climate change resulting from GHG emissions will lead to social, environmental and economic impacts felt globally, regardless of where they are emitted. Chapter 10: Climate Resilience considers the vulnerability of the Proposed Development to climate change.

2.3.2 Instead of a physical study area, the carbon impact assessment considers the potential carbon emissions arising from activities over the assessment lifetime. Therefore, the assessment includes:

- decommissioning of the existing Cambridge WWTP;
- construction of the Proposed Development (capital carbon in materials, transport of materials to site, construction plant use);
- land use change (the net impact on GHGs of the change in land use for the proposed WWTP and associated infrastructure, and of the proposed landscaping); and
- operation of the proposed WWTP.

## 2.4 Temporal scope of assessment

### Construction

2.4.1 For the assessment, carbon emissions estimated are those for which the activity begins and ends during the construction and commissioning stages prior to the proposed WWTP becoming fully operational (as set out in Chapter 2 Project Description).

2.4.2 The assumed assessment years for construction are from Year to year 4 (currently assumed to be) 2024 until 2028, should construction activities be extended this would likely lead to increased emissions.

2.4.3 Decommissioning of the existing Cambridge WWTP would take place after commissioning of the Proposed Development.

2.4.4 The Development Consent Order application does not include the demolition of the existing facility or its redevelopment for low carbon housing and employment uses, which will be approved through a separate planning permission. Carbon impacts associated with these activities are therefore not assessed in this chapter of the environmental statement, but they are considered in a high-level strategic carbon assessment which accompanies the DCO application.

### Operation and maintenance

2.4.5 For the assessment, these are the carbon emissions that are emitted once the proposed WWTP is commissioned and fully operational and includes the effects of the physical presence of the infrastructure, its operation, use and maintenance, including the permanent change in land use.

2.4.6 Carbon emissions are presented for the whole assessment lifetime, including construction and operation up to the year 2057. This has been selected based on the 30 year lifespan of the Landscape, Ecological and Recreational Management Plan (LERMP) (Appendix 8.14, App Doc Ref 5.4.8.14) from year 1 of operation (currently expected to be 2028).

### Duration of effects

2.4.7 The assessment of the effects on climate assumes a permanent effect on the global atmosphere where effects cannot be reversed. Climate change resulting from GHG emissions will lead to social, environmental, and economic impacts felt globally.

## 2.5 Baseline study

### Desktop data

2.5.1 Baseline information was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 2-2 below.

**Table 2-2: Desktop information sources**

| Item or feature | Year | Source |
|---|---|---|
| Construction emissions include the following emissions sources:<br>Emissions associated with the manufacture of raw materials and construction products<br>Transport of those materials to construction site | Data accessed 2021/22 | Anglian Water carbon models (PAS 2080 compliant). The models rely on a number of emissions data sources, mainly using the Inventory of Carbon and Energy (Embodied Carbon - The ICE Database, 2019) for construction materials, and the (Civil Engineering Standard Measures of Measurement (CESMM4) Carbon and Price Book, 2013) for construction activities. Department for Business, Energy & Industrial Strategy (BEIS) annual conversion factors |

| Item or feature | Year | Source |
|---|---|---|
| Construction effort emissions e.g. fuel use in construction<br>Allowance for disposal of construction waste | | for company reporting (Department for Business Energy & Industrial Strategy, 2021) are used to account for transport emissions and waste. |
| Operation emissions for the commissioning year and full capacity operations, using predicted operational activities. | Data accessed 2021/22 | Anglian Water's data on operation emissions for wastewater treatment using emissions factors published by the UK Government and other industry sources. This accounts for grid carbon emissions from BEIS; including both current year grid carbon intensity data (Department for Business Energy & Industrial Strategy, 2021), and grid decarbonisation forecasts from Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, data tables 1-19, table 1 (Department for Business Energy & Industrial Strategy, 2021). |
| Land use change | Data accessed 2022 | Other ES technical topics: The extent and condition of the natural capital stocks was informed by the Extended Phase 1 Habitat Survey (Appendix 8.12, Baseline Survey Technical Note, App Doc Ref 5.4.8.12) and proposed landscape plan (within the Landscape Ecology and Recreation Management Pan (LERMP), Appendix 8.14, App Doc Ref 5.4.8.14). Carbon values from the Committee on Climate Change (JBA Consulting, 2018). |

### Surveys

2.5.2 No physical surveys were undertaken for the carbon assessment.

## 2.6 Maximum design envelope (Rochdale) parameters for assessment

2.6.1 The design parameters and assumptions presented are in line with the 'maximum design envelope' approach. For each element of this carbon assessment, the maximum design parameters detailed within Table 2-3 have been selected as those having the potential to result in the greatest effect on carbon emissions.

2.6.2 The assessment uses the Applicant's carbon models to calculate the likely scale of carbon emissions associated with the Proposed Development. The models have been reviewed against Chapter 2: Project Description to ensure that the key metrics of the model are aligned. The assessment considers a realistic maximum design envelope based on the maximum scale of the elements; as a result, effects of equal or lesser significance than those assessed are likely.

**Table 2-3: Maximum design envelope parameters for carbon assessment**

| Potential impact | Maximum design scenario | Justification |
|---|---|---|
| Emissions associated with decommissioning of the existing Cambridge WWTP, which includes draining and cleaning of the tanks and pipework and the removal of surplus chemicals. | An allowance for on-site vehicle movements and journeys to and from start location has been estimated based on discussion with contractors for the Proposed Development. | The main source of carbon emissions from decommissioning activities is vehicle movement. Any construction elements are included within the construction footprint. Decommissioning carbon emissions are a small proportion of the capital carbon impact in comparison to the construction of the proposed WWTP and this provides a pragmatic approach to estimate the likely scale of emissions from these activities. |
| Emissions associated with construction | Two construction assessments have been presented:<br>• Baseline (referred to as Delivery Milestone Zero, 'DM0'): Covers the pre-value-engineered design which represents an early view of how the existing Cambridge WWTP would likely have been re-built through conventional processes and approaches.<br>• Proposed Development: Covers the current DCO planning stage design (the preferred option), including for a range of mitigation measures that have been committed to within the design of the Proposed Development. Includes Biomethane production as this is worst case for carbon emissions associated with construction.<br>These assessments cover capital carbon in materials, expected transport distances of products and materials to site, and fuel use in construction. | The baseline for this assessment is a pre-value-engineered design (based on 2010 construction practices and baseline models) which represents an early view of how the existing Cambridge WWTP would likely have been re-built through conventional processes and approaches. The Proposed Development design provides a realistic viable design accounting for committed emissions mitigation activities.<br>To estimate carbon emissions from the transport of materials, reasonable transport distances were agreed with the Applicant. These distances were based on typical procurement practices and supplier locations (for example concrete us typically sourced from within 50km of a site). |

| Potential impact | Maximum design scenario | Justification |
|---|---|---|
| Emissions from operation | Two operation assessments are presented:<br>• The Proposed Development includes the upgrade of biogas to biomethane for export (the preferred option). For biogas export to the grid, the emissions intensity of the grid gas has been assumed to be constant up to 2050 (at which point the UK gas grid is assumed to be net zero).<br>• CHP option where biogas is used in CHP engines on-site (as per the baseline 'DM0' design). | Design provides a realistic viable design of preferred option of biomethane production, but also represents an option of CHP use (should changes to Government policy change on UK energy strategy favour alternative use of biogas to meet net zero climate targets). All avoided emissions are presented within the net totals. For the Proposed Development, utilisation of biogas in CHP represents the worst case position in terms of net carbon emissions.<br>As there is no readily available forecast for the likely decarbonisation of the gas grid per kWh, a constant emissions factor has been assumed year on year until 2050. |
| Emissions associated with construction and operation | Solar panels are excluded from the operation carbon footprint, although an estimation is provided for the capital carbon which occurs during construction. | As the exact configuration and capacity of solar panels is to be determined, exclusion of solar energy generation represents a worst-case assessment with higher operational emissions. |
| Land use change | The landscape masterplan will be implemented and managed in line with the commitments in the LERMP (Appendix 8.14, App Doc Ref 5.4.8.14), additional sequestration potential beyond the management plan period is not accounted for. | Represents the land use change over the 30 year lifetime of the management plan. |

## 2.7 Impacts scoped out of the assessment

2.7.1 The following emissions sources are not included in this assessment:

- Decommissioning and demolition of the proposed WWTP are not quantified. Future forecasts of emissions are subject to broad assumptions and a high degree of inaccuracy. There are no proposals to decommission the proposed WWTP before 2050 and it is anticipated that a future decommissioning exercise would likely take place in a world where low carbon plant and activities are commonplace;
- The wider effects as a result of redeveloping the existing Cambridge WWTP are not within the scope of this project:
  - demolition of the existing Cambridge WWTP;
  - redevelopment of/construction on the existing Cambridge WWTP; and
  - future use of the existing Cambridge WWTP (e.g. operational energy use and transport emissions generated during use following redevelopment).

2.7.2 From discussions between the Applicant and the developers who will demolish and redevelop the existing Cambridge WWTP, it is understood that these effects will be considered as part of their subsequent separate planning process as more detailed design information is developed.

## 2.8 Mitigation measures adopted as part of the Proposed Development

2.8.1 This section refers to the mitigation types, as defined in Chapter 5: Assessment Methodology, and how they apply to the assessment of carbon.

2.8.2 In developing the Proposed Development through an iterative process including consultation and engagement with consultees and through the EIA, the Applicant has sought to identify and incorporate suitable measures and mitigation for potentially significant adverse effects, as well as maximising beneficial effects where possible.

2.8.3 Some measures are 'embedded' in the design of the Proposed Development for which consent is sought by virtue of the scope of the authorised development as set out in Schedule 1 to the DCO and the accompanying Works Plans. These are considered primary mitigation. For example, the adjustment of Order Limits to avoid sensitive features, or amending the sizing and location of temporary access routes and compounds.

2.8.4 Other measures are either secondary, such as control plans, or measures integrated into legal requirements through environmental permits and consents (termed

tertiary). Chapter 5: Assessment Methodology sets out the required permits and consents related to the Proposed Development.

2.8.5 The remainder of this section sets out the embedded measures (primary), legal requirements (tertiary) and additional measures (secondary) relevant to the assessment of carbon.

## Primary (embedded) and tertiary measures

2.8.6 Mitigation options to reduce the impact have been identified and implemented throughout the development of the design, in line with the methodology set out in PAS 2080 and the Applicant's carbon reduction targets. This involved developing a carbon baseline for the Proposed Development (referred to as 'DM0'), then assessing the carbon impact of alternative options (for example alternative processes and the physical arrangement or extent of built development within the proposed WWTP). Carbon is a primary metric of the options evaluation process during design development.

2.8.7 During the design process, challenges have been set to reduce the impact of the construction and operation. These challenges include:

- process sizing to ensure requirements are optimised;
- flows to optimise network sizing to ensure infrastructure is not oversized;
- the selection of innovative low energy process technologies such as Membrane Aerated Biofilm Reactor (MaBR), vacuum de-gassing, and energy efficient steam raising plant;
- reviewing each component of the built development and process stream (e.g. primary and secondary treatment) to ensure process selection was optimum for carbon; and
- material selection and methodology of construction.

2.8.8 Table 2-4 sets out the embedded mitigation measures that will be adopted during the construction, operation and decommissioning of the Proposed Development.

**Table 2-4: Embedded mitigation (primary and tertiary) measures relating to carbon, adopted as part of the Proposed Development**

| Mitigation measures | | Type | Applied to | Justification |
|---|---|---|---|---|
| **Construction** | | | | |
| Tunnel design | Reduction in tunnel length and diameters | Tertiary | Proposed Development | Design changes made to optimise the design, reducing construction emissions. |
| Tertiary treatment | Choice of sand filter provider | Tertiary | Proposed WWTP | |
| Treated effluent pipelines and outfall | Choice of composite pipes over ductile iron and reduction in overall length | Tertiary | Treated final effluent and storm pipelines and outfall to the River Cam | |
| Optimisation of process-tank volume | Optimisation of major process-tank volumes from original baseline sizes (e.g. aeration lanes and storm tanks) | Tertiary | Proposed WWTP | |
| Optimisation of road area | Reduction in total area of roads required | Tertiary | Proposed Development | |
| **Operation** | | | | |
| Landscape masterplan | Provision of landscaped areas | Primary | Area of land required for the landscape masterplan | Represents area of land subject to land use change offering improved carbon sequestration from baseline |
| Gas to grid | Generating and feeding renewable bio-methane into the national grid | Tertiary | Proposed Development – biogas use | Design changes made to optimise the design, reducing operational and whole life emissions. |
| Pumping power demand | Optimisation pumping power demand of Terminal Pumping Station (TPS). | Tertiary | Proposed Development – TPS and site wide hydraulic profile. | |

| Mitigation measures | | Type | Applied to | Justification |
|---|---|---|---|---|
| Dewatering technology | Reduction in chemicals and power demand for sludge dewatering through choice of dewatering technology. | Tertiary | Proposed Development – Sludge thickening and dewatering. | |
| Vacuum degassing | Vacuum degassing post-digestion to recover more biogas to be upgraded to biomethane. | Tertiary | Proposed Development – Post-digestion biogas recovery. | |

## Secondary measures

2.8.9 Secondary measures will be applied to provide further controls to avoid or reduce impacts. Those applied during construction, decommissioning, operation and maintenance for water resources are indicated below.

***Construction***

2.8.10 During the construction phase, the Code of Construction Practice (CoCP) Part A and B (Appendix 2.1 & 2.2, App Doc Ref 5.4.2.1 and 5.4.2.2) and associated management plans specify the range of measures to avoid and minimise impacts that may occur in construction.

2.8.11 Section 7.5 of the CoCP Part A (Waste Management and Resource Use) (Appendix 2.1, App Doc Ref 5.4.2.1) requires the Principal Contractor(s) to put in place measures to minimise energy consumption and carbon emissions during construction.

2.8.12 The Proposed Development will seek to achieve BREEAM Excellent for the gateway building. BREEAM status is not a guarantee of specific measured carbon reductions, as there are different credits which can be used to achieve the target status. There are however several credits relating to carbon emissions, including reducing energy use, low carbon design and lifecycle impact assessment of the building (including embodied carbon in materials).

***Operation***

2.8.13 The LERMP is included within the Application (Appendix 8.14, App Doc Ref 5.4.8.14). The purpose of the LERMP is to set out how landscape, recreational features and ecological habitat and enhancements (vegetation and habitats) would be protected and managed for a period of 30 years following construction. Post grant of the DCO and prior to commencement of landscaping works, an updated plan will be prepared and agreed with the local authority. Management is key to ensuring that the vegetation grows and continues to sequester carbon.

2.8.14 The Development Consent Order (App Doc Ref 2.1) requires a Carbon Management Plan (CMP) to be agreed prior to the operation of the proposed WWTP. The CMP will ensure that, in the event of the worst-case option (CHP) being adopted, the proposed development will remain carbon neutral during its operation, in line with commitments made during the pre-application consultation. The CMP would secure the necessary measures, most likely offsets, required to ensure that the project is not a net emitter of greenhouse gases during the operational phase.

2.8.15 Operation and maintenance activities will be subject to operational management plans and procedures. The management plans and procedures will sit within the EMS required under the environmental permitting regime. These will be 'live' documents that identify the environmental risks and legal obligations associated with the operations of the Proposed Development once construction has been completed. These will specify the management measures the operator will implement in order

to prevent or minimise the environmental effects associated with the Proposed Development.

***Decommissioning***

2.8.16 Decommissioning of the existing Cambridge WWTP will be subject to a Decommissioning Management Plan which is to be agreed with the local planning authority. An Outline Decommissioning Plan (Appendix 2.3, App Doc Ref 5.4.2.3) describes measures applied to this activity. Post grant of the DCO and prior to commencement of decommissioning, a detailed plan will be prepared and agreed with the local planning authority.

## 2.9 Assumptions and limitations

2.9.1 Any carbon emissions assessment at design stage is an estimate based on best available data and using industry standard emissions factors. There is an inherent limitation in carbon assessments as the assessment is based on the scheme design at the time. The final constructed asset will not have the same carbon emissions as estimated due to differences in the final materials' procurement specification and construction practices on site. Final carbon emissions are expected to be less than the emissions estimated here, as the Applicant will continue to review the design and strive to meet their 70% capital carbon reduction target against the 2010 baseline.

2.9.2 In some cases, there is not an absolute equivalent emission factor available for the material specified in the design, for example where the unit of measurement is not directly equivalent, or the material specification varies. In these instances, assumptions based on professional judgement have been made to attempt to replicate the type and weight of the materials as closely as possible. Any assumptions made have been conservative, i.e. when there is a choice, the highest emissions factor or density is used.

2.9.3 The assessment of the carbon emissions from the construction and operation of the Proposed Development has been based on the Applicant's asset level carbon models. It is assumed that these are the most representative source of data. These have been developed to align to the Applicant's design standards, provide good quality representative data to make comparative decisions between options, and provide an understanding of likely scale of emissions.

2.9.4 The carbon mitigation strategy for the Proposed Development has considered several novel treatment processes. Where this is the case, standard emissions data and processes have been used alongside supplier data to estimate the emissions from these new processes. Where a full set of supplier data was not available, conservative assumptions have been made to fill gaps to avoid underestimating emissions.

2.9.5 Maintenance activities are expected to be labor-intensive rather than requiring significant additional energy or materials, and therefore it is assumed that the operational energy use covers routine maintenance activities. Carbon emissions

from capital replacements are calculated separately and included within the whole life carbon assessment.

2.9.6 The export of gas to grid has been estimated to result in avoided carbon emissions through displacement of other sources of gas supply to the UK grid. Avoided emissions are presented in the net emissions for the Proposed Development. For biogas export to the grid, the emissions intensity of the grid gas has been assumed to be constant up to 2050 (at which point the UK gas grid is assumed to be net zero) (Navigant, 2019). There is no readily available forecast for the likely decarbonisation of gas per unit.

2.9.7 The solar photovoltaic (PV) panels have been excluded from the operation carbon assessment because the design and scale of generation has not been finalised. An estimate has been made for the capital carbon emissions based on a build-up of technical datasheet and environmental product declaration for PV panels. Excluding the solar panels from the operation model is a worst-case approach, as the emissions savings (i.e. reducing the amount of grid electricity required) have not been accounted for in the modelling.

2.9.8 Decommissioning and demolition of the Proposed Development has not been quantified. Future forecasts of emissions are subject to broad assumptions and a high degree of uncertainty. There are no proposals to decommission the Proposed Development before 2050. It is anticipated that a future decommissioning exercise would likely take place in a world where low carbon plant and activities are commonplace.

2.9.9 The land use change assessment is based on the Proposed Development design and landscape plan. The assessment assumes a constant rate of carbon sequestration and that the assumed time period required to achieve carbon sequestration for newly planted deciduous woodland is 11 years. These assumptions are based on planned maintenance in accordance with the LERMP (Appendix 8.14, App Doc Ref 5.4.8.14).

# 3 Baseline Environment

## 3.1 Assessment approach

3.1.1 The section presents the assessment of the baseline for the Proposed Development. The baseline covers construction, land use change, operation, decommissioning of the existing WWTP. The baseline carbon emissions over the assessment lifetime are covered in Section 4.6.

## 3.2 Current baseline

3.2.1 The baseline used the 'DM0' model design for the likely scale of construction and operational emissions, taking a conventional approach to building the works at the new location. No decommissioning activities are included within the DM0 model (the baseline for decommissioning is zero). The baseline design is a pre-value-engineered design which represents an early view of how the existing Cambridge WWTP would likely have been re-built through conventional processes and approaches.

3.2.2 Baseline conditions associated with construction are presented below. These emissions are modelled based on a basic scheme design. All of the assets identified in Table 3-1: result in carbon emissions from construction materials and processes. These are presented as positive numbers (greater than zero) in the table below.

**Table 3-1: Baseline construction estimate**

| Asset | Carbon estimate ($tCO_2e$)* |
|---|---|
| Tunnel & Final Effluent Discharge | 39,960 |
| Aeration Tank | 5,060 |
| Final Settlement Tank | 7,850 |
| Sand Filtration | 3,890 |
| Roads | 1,070 |
| Primary Settlement Tank | 1,640 |
| Storm Tank | 1,480 |
| Import Area (Screening and Thickening) | 1,290 |
| Buildings | 5,970 |
| Inlet Works | 1,380 |
| Inter process Pumping | 2,660 |
| TPS | 4,210 |
| Electrical Distribution | 440 |
| Digestion | 1,940 |
| LTP | 960 |

| Asset | Carbon estimate ($tCO_2e$)* |
|---|---|
| Boundary Fencing | 400 |
| Common Control (MCC) | 490 |
| Biogas Area - Storage + CHP/BUP | 720 |
| HPH | 1,100 |
| Pressure Water System | 20 |
| Dewatering | 250 |
| Odour Control | 490 |
| Landscaping | 1,080 |
| Ferric Dosing | 700 |
| Site Services | <10 |
| Additional Items | 2,050 |
| **TOTAL** | **96,750** |

**$tCO_2e$ rounded to nearest 10 tonnes*

3.2.3 The baseline for land use change is the sequestration potential from the current land use of the site. This is presented in Table 3-2. The carbon sequestration rates are from a report on land use change for The Committee on Climate Change (JBA Consulting, 2018). The negative numbers are emissions savings from carbon sequestration.

**Table 3-2: Baseline carbon sequestration from land use**

| Landscape type | Carbon sequestration rate for landscape type (tCO2e/ha) | Baseline | |
|---|---|---|---|
| | | Area (Ha) | Total Seq/yr (tCO2e/yr) |
| Woodland deciduous | -5 | 1 | -6 |
| Woodland coniferous | -13 | <1 | -1 |
| Grassland | <0 | 29 | -12 |
| Arable land | <0 | 145 | -16 |
| Shrub | -1 | 5 | -3 |
| **Total** | | | **-38** |

*Seq = carbon sequestration. All figures rounded to the nearest whole number – totals may not sum due to rounding*

3.2.4 Baseline conditions associated with operation annually are presented below (Table 3-3:). The model used for the baseline includes on-site CHP using biogas generated by the sludge treatment centre. The on-site CHP plant would supply some of the energy required for operation (grid electricity emissions avoided are shown as negative emissions in Table 3-3), while the remainder of the energy requirement would be met by grid electricity. Carbon emissions during operation also arise from chemical use, and from transport of biosolids for recycling.

**Table 3-3: Baseline operational estimate**

| Process | Carbon estimate ($tCO_2e$)* |
|---|---|
| Grid Electricity | 2,690 |
| Chemicals | 20 |
| Fossil fuel consumption (propane) | n/a |
| Transport - biosolids recycling to land | 70 |
| **Total gross emissions** | **2,770** |
| CHP energy use | -1,350 |
| Biomethane export | n/a |
| **Total net emissions** | **1,420** |

**$tCO_2e$ rounded to nearest 10 tonnes*

3.2.5 The following emissions sources provide context for the carbon emissions presented in this assessment to help demonstrate the scale of the Proposed Development's impact:

- annual UK emissions, including national wastewater and construction sector emissions; and
- the Applicant's published operational emissions per Ml of treated wastewater.

3.2.6 In 2019, UK net greenhouse gas emissions were estimated at 455 $MtCO_2e$ (million tonnes of carbon dioxide equivalent) (Department for Business, Energy & Industrial Strategy, 2021). The water supply and sewage services sector accounted for 0.8% of UK GHG emissions in 2019.

3.2.7 The World Green Building Council has found that building materials and construction were responsible for around 11% of global energy-related GHG emissions in 2018 (World Green Building Council, 2019). This is similar to previous findings for the UK construction industry consumption of natural resources in the UK accounting for equivalent to 10% of the total UK carbon emissions (Institute of Civil Engineers, 2014). Therefore assuming a 10% proportion, it has been estimated that approximately 45 $MtCO_2e$ are attributed to the embodied carbon of construction materials in the UK as a whole.

3.2.8 The total annual net emissions in 2020 for the Applicant are reported as 290,266 $tCO_2e$ (Anglian Water, 2020). GHG emissions related to wastewater (water recycling and sludge treatment) comprise 53% of the Applicant's reported operational emissions. Emissions are also reported as 0.432 $tCO_2e$ per Ml of recycled water.

## 3.3 Future baseline

3.3.1 The Climate Change Committee (CCC) has determined a balanced net-zero pathway for construction and manufacturing that includes a reduction of 70% by 2035, and 90% by 2040 on 2018 levels (Climate Change Committee, 2020). This

pathway considers that a proportion of the reduction will come from improved resource efficiency in production and material substitution. Therefore, significant effort is required to ensure that all contributing emissions are reduced as far as possible through the design, construction, and operation of all projects. This project adopts a construction reduction target of 70% compared with the 2010 construction baseline.

3.3.2 In 2021, the CCC's ambitious 6th Carbon Budget was brought into law committing the UK to cut emissions by 78% by 2035 compared to 1990 levels. The UK carbon budgets should lead to decarbonisation across the UK, including in electricity generation and the transport sector. In 2019, the Applicant, along with other water companies in England, committed to achieve net zero operational carbon emissions by 2030. This includes emissions associated with operational power use, transportation, and process emissions of the Proposed Development.

3.3.3 The national policy, coupled with the Applicant's net zero commitment, indicates a future baseline of low carbon emission operation of wastewater assets.

# 4 Assessment of Effects

## 4.1 Assessment approach

4.1.1 The section presents the assessment of effects for the Proposed Development. The assessment is split into construction, land use change, operation, decommissioning of the existing WWTP and lifetime carbon. The assessment sets out a preliminary assessment that takes into account primary and tertiary mitigation in determining effects and then considers secondary mitigation and the assessment of residual effects.

## 4.2 Construction phase

4.2.1 The construction phase assessment includes the following emissions sources:

- emissions associated with the manufacture of raw materials and construction products;
- transport of those materials to construction site; and
- construction effort emissions e.g. fuel use in construction.

***Magnitude of impact***

4.2.2 The potential emissions from the construction of the Proposed Development are indicated in Table 4-1, listed by site or process area. This assessment has been completed on the basis that designed-in mitigation measures (see section 2.8,

4.2.3 Table 2-4) and CoCP requirements (Appendix 2.1 & 2.2, App Doc Ref 5.4.2.1 and 5.4.2.2) are implemented.

**Table 4-1: Estimated construction carbon comparing baseline to DCO design**

| Site Area | DM0 Baseline Design ($tCO_2e$) | DCO Design ($tCO_2e$) | % Change Against Total Design Footprint |
|---|---|---|---|
| Tunnel & Final Effluent Discharge | 39,960 | 13,660 | -27% |
| Final Settlement Tank | 5,060 | 5,820 | 1% |
| Aeration Tank | 7,850 | 5,280 | -3% |
| Primary Settlement Tank | 3,890 | 3,550 | 0% |
| Storm Tank | 10,720 | 2,100 | -9% |
| Import Area (Screening and Thickening) | 1,640 | 2,020 | 0% |
| Buildings | 1,480 | 800 | -1% |
| TPS | 1,290 | 1,710 | 0% |
| Roads | 5,970 | 3,140 | -3% |
| Inter Process Pumping | 1,380 | 1,320 | 0% |
| Inlet Works | 2,660 | 1,220 | -1% |

| Site Area | DM0 Baseline Design ($tCO_2e$) | DCO Design ($tCO_2e$) | % Change Against Total Design Footprint |
|---|---|---|---|
| Sand Filtration | 4,210 | 1,130 | -3% |
| Electrical Distribution | 440 | 1,010 | 1% |
| Digestion | 1,940 | 1,080 | -1% |
| LTP | 960 | 630 | 0% |
| Boundary Fencing | 400 | 600 | 0% |
| Biogas Area - Storage + CHP/BUP | 720 | 420 | 0% |
| Common Control (MCC) | 490 | 380 | 0% |
| Dewatering | 250 | 380 | 0% |
| HPH | 1,100 | 310 | -1% |
| FE Discharge Pipework | - | 280 | 0% |
| Odour Control | 490 | 220 | 0% |
| Landscaping | 1,080 | 1,080 | 0% |
| Ferric Dosing | 700 | 190 | -1% |
| Pressure Water System | 20 | 180 | 0% |
| Site Services | - | 140 | 0% |
| Additional Items | 2,050 | - | -2% |
| Solar Panels | | 2,150 | 2% |
| **TOTAL** | **96,750** | **50,790** | **-48%** |

*$tCO_2e$ rounded to nearest 10 tonnes, totals may not sum due to rounding

4.2.4 Table 4-1 shows the results of the construction assessment of the Proposed Development in comparison to the baseline design. Overall, there is a reduction of 48% compared with the DM0 baseline design.

4.2.5 This leaves an additional 22% of carbon reduction efficiencies to meet the Applicant's capital carbon reduction target. This will need to be achieved through the later design stages and on-site construction activities. The section on secondary mitigation highlights some of the areas of focus to achieve this further level of reduction.

4.2.6 Table 4-1 shows how the different site areas contribute to the overall 48% reduction in the construction footprint. The key areas driving this reduction in the capital carbon footprint are summarised below and are illustrated in Figure 4.1 below. The biggest reductions from DM0 Baseline to Proposed Development DCO design are:

- tunnel and final effluent discharge (reduction in length and diameter);
- storm tank (optimisation of volume);
- aeration tank (optimisation of volume);
- roads (optimisation of total area required); and

- sand filtration (change of process).

4.2.7 The elements of the Proposed Development that have been optimised and have achieved the greatest reductions still form a large part of the capital carbon emissions associated with the Proposed Development. These are mainly large civil structures and there are further opportunities for emissions reduction through materials specification (e.g. lower carbon intensity materials) and efficient construction (e.g. off-site manufacture or 3D printing of smaller items) which are being explored to further drive down emissions (refer to discussion on further mitigation in paragraph 4.2.13).

4.2.8 The remaining largest sources of carbon emissions in the Proposed Development are:

- tunnel and final effluent discharge (28% of DCO construction footprint);
- final settlement tank (FST) (12%);
- aeration tank (11%);
- primary settlement tank (PST) (7%); and
- roads (6%).

4.2.9 The Proposed Development represents around 0.1% of the estimated UK construction emissions of 45 $MtCO_2e$.

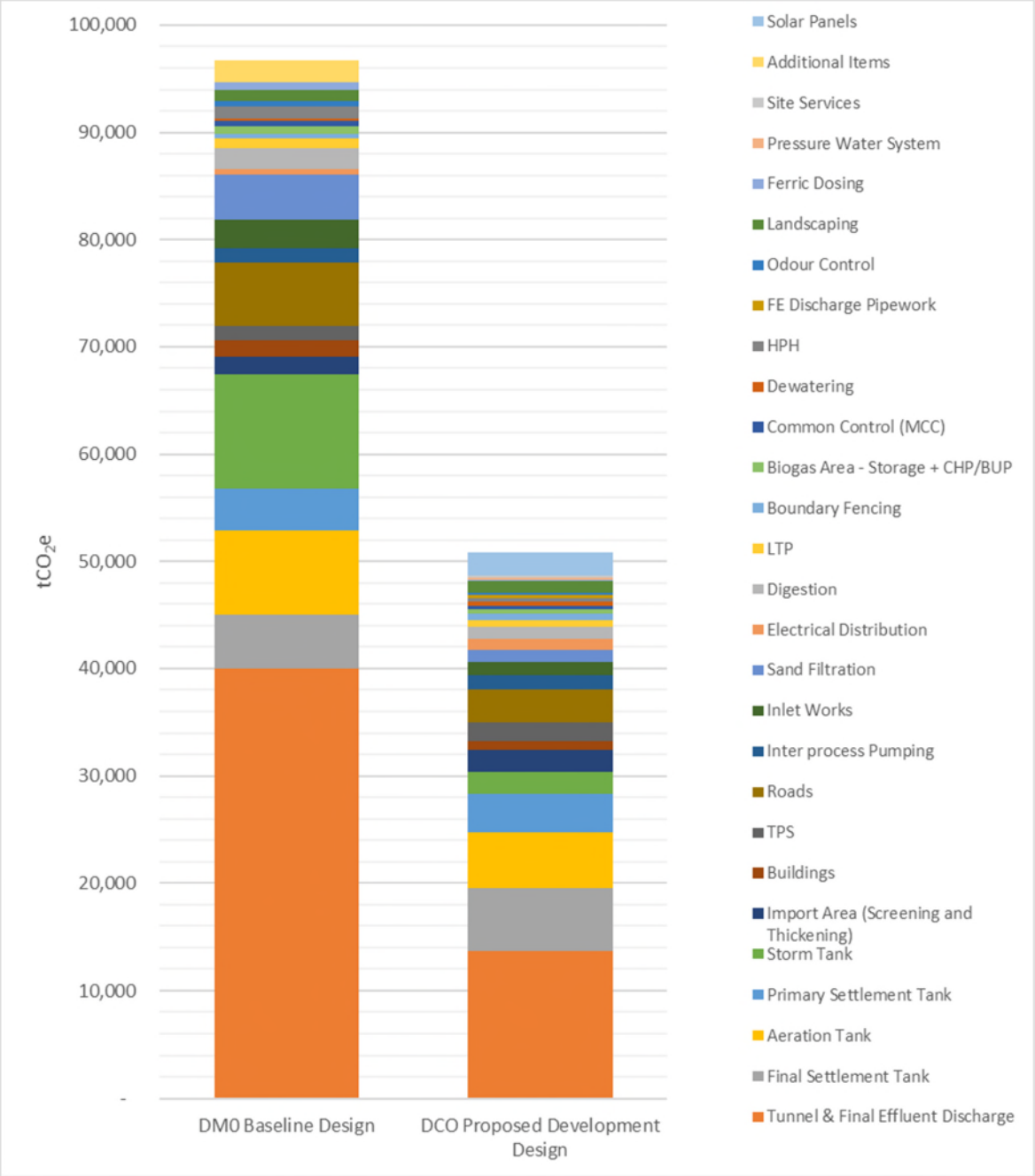


**Figure 4.1: Construction emissions ($tCO_2e$)**

***Sensitivity of receptor***

4.2.10 There is one receptor for carbon emissions assessment: this is the global climate. National planning policies and the UK Climate Change Act reiterate the serious nature of climate change and the need to rapidly decarbonise. This has been taken into account, in line with IEMA guidance, by defining the sensitivity of the global climate as high.

4.2.11 Significance of effect

4.2.12 Table 2-1 sets out the significance criteria adapted from the IEMA Guidance. The construction of the Proposed Development leads to carbon emissions which contribute to global climate change. The construction footprint shows a **moderate adverse** impact, which is rated as **significant**.

***Secondary mitigation or enhancement***

4.2.13 Whilst the design process for the Proposed Development has taken substantial steps towards mitigating its carbon impact against its baseline, the Applicant will continue the process of carbon reduction as detailed design progresses and construction is undertaken. Further opportunities to mitigate carbon have been identified by the design team, with an estimate of potential reductions provided based on previous experience and high-level estimates:

- **Continued innovation review (~1-10% estimated reduction potential):** there will be a continual review as technologies develop and market conditions change. This will include continued engagement and collaboration with the supply chain to implement innovations within the Proposed Development.
- **Material specification (~5-15% estimated reduction potential):** use of low-carbon construction materials (e.g. low carbon concrete, alternative materials) for tunnels and pipelines at procurement stage:
  - optimisation of concrete mix with up to 70% cement replacement in 5 major tank structures could achieve an additional 9% carbon saving (the Applicant has used this technology and is confident of its application in the detailed design). Further savings would be possible when expanded to other concrete structures and base pours within the Proposed Development;
  - alternative reinforcement options will also be reviewed, for example fibre options for large concrete pours and basalt rebar for structures; and
  - continuing to identify alternative materials or optimal concrete mixes for other smaller structures and chambers.
- **Efficient construction and temporary works (~0.5-3% estimated reduction potential):** The assessment method has largely assumed current methods of construction are used, such as the use of diesel-powered construction plant and typical site cabins and temporary works. The following opportunities are being reviewed, but are not accounted for within this quantified assessment:
  - use of electric crawler cranes;
  - solar powered temporary lighting towers;
  - solar porta-loos for on-site facilities;

- solar hybrid generators to provide lower carbon site power during construction; and
- solar powered Automatic Number Plate Recognition (ANPR) cameras and traffic lights.

4.2.14 Through progression of the Proposed Development, there will be reviews of development within the supply chain of construction plant, where feasible use of low and zero carbon alternatives will be maximised.

4.2.15 The Proposed Development will also seek to achieve BREEAM 'Excellent' standard for the Gateway building (this approach requires the assessment of capital carbon, and encourages the construction of assets with lower embodied carbon and lower whole life carbon).

4.2.16 Overall, with the secondary mitigation measures identified above, the Proposed Development is considered likely to achieve alignment with the Applicant's capital carbon reduction commitment of 70% reduction against the 2010 baseline model.

***Residual effect***

4.2.17 The construction stage would result in new carbon emissions which contribute to global climate change. On the basis that no secondary mitigation or enhancement measures are committed or calculated at this stage, the residual effect of construction remains **moderate adverse**, which is **significant**.

### Monitoring

4.2.18 Emissions will continue to be quantified to detailed design stage, working towards the Applicant's commitment to achieve a 70% reduction.

4.2.19 Section 7.5 of the CoCP Part A (Waste Management and Resource Use) requires the Principal Contractor(s) to put in place measures to minimise energy consumption and carbon emissions during construction.

## 4.3 Land use change carbon assessment

4.3.1 The impact of the Proposed Development on carbon sequestration within the study area was assessed using the proposed landscape plan within the Landscape Ecology and Recreation Management Plan (LERMP) (Appendix 8.14, App Doc Ref 5.4.8.14). Areas and types of landscaping were identified for the baseline and Proposed Development, with the change in sequestration potential being assessed. The baseline for the land use change assessment is the current land use of the site.

***Magnitude of impact***

4.3.2 Assessment results are presented in Table 4-2. The carbon sequestration rates are from a report on land use change for The Committee on Climate Change (JBA Consulting, 2018). The negative numbers are emissions savings from carbon sequestration.

**Table 4-2: Carbon sequestration from land use change**

| Landscape type | Carbon sequestration rate for landscape type ($tCO_2e$/ha) | Baseline | | Proposed Development in year 1 of operation | | Overall change in year 1 of operation ($tCO_2e$ /yr) |
|---|---|---|---|---|---|---|
| | | Area (Ha) | Total Seq/yr ($tCO_2e$/yr) | Area (Ha) | Total Seq/yr ($tCO_2e$/yr) | |
| Woodland deciduous | -5 | 1 | -6 | 22 | 0 | 6 |
| Woodland coniferous | -13 | <1 | -1 | <1 | -1 | 0 |
| Grassland | <0 | 29 | -12 | 39 | -16 | -4 |
| Arable land | <0 | 145 | -16 | 93 | -10 | 6 |
| Shrub | -1 | 5 | -3 | 5 | -3 | 0 |
| **Total** | | | **-38** | | **-30** | **8** |

*Seq = carbon sequestration. All figures rounded to the nearest whole number – totals may not sum due to rounding*
** Note that deciduous woodland is established from year 11 after planting.*

4.3.3 The results show an overall decrease in carbon sequestration per year. Only the first year of operation is accounted for here, because the ongoing management of the landscape is dependent on the LERMP (Appendix 8.14, App Doc Ref 5.4.8.14). This sums to -30 $tCO_2e$ in the first year of operation, a reduction in carbon sequestration of approximately 8 $tCO_2e$ compared to the baseline.

***Sensitivity of receptor***

4.3.4 There is one receptor for carbon emissions assessment: this is the global climate. National planning policies and the UK Climate Change Act reiterate the serious nature of climate change and the need to rapidly decarbonise. This has been taken into account, in line with IEMA guidance, by defining the sensitivity of the global climate as high.

***Significance of effect***

4.3.5 The results show that the Proposed Development would not sequester as much carbon as the baseline, with an overall decrease in carbon sequestration of 8 $tCO_2e$ per year.

4.3.6 Table 2-1 sets out the significance criteria, adapted from the IEMA Guidance. The land use of the Proposed Development (with embedded mitigation) is still sequestering some carbon in the first year of operation. Compared to the baseline this is a **minor adverse** impact, rated as **not significant**.

***Secondary mitigation or enhancement***

4.3.7 Once the LERMP (Appendix 8.14, App Doc Ref 5.4.8.14) planting management is taken into account, the largest increase in carbon sequestration is due to the planting of deciduous woodland. Overall, there would be a proposed reduction in landscaped area (including the area of arable land lost). However, the increase of

deciduous woodland as a result of the Proposed Development means that on balance, there is expected to be an increase in carbon sequestration.

4.3.8 Assessment results are presented in Table 4-3.

**Table 4-3: Carbon sequestration from land use change after secondary mitigation**

| Landscape type | Carbon sequestration rate for landscape type ($tCO_2e$/ha) | Baseline | | Proposed Development from year 11 after planting | | Overall change from year 11 after planting ($tCO_2e$ /yr) |
|---|---|---|---|---|---|---|
| | | Area (Ha) | Total Seq/yr ($tCO_2e$/yr) | Area (Ha) | Total Seq/yr ($tCO_2e$/yr) | |
| Woodland deciduous | -5 | 1 | -6 | 22 | -109 | -103 |
| Woodland coniferous | -13 | <1 | -1 | <1 | -1 | 0 |
| Grassland | <0 | 29 | -12 | 39 | -16 | -4 |
| Arable land | <0 | 145 | -16 | 93 | -10 | 6 |
| Shrub | -1 | 5 | -3 | 5 | -3 | 0 |
| **Total** | | | **-38** | | **-140** | **-101** |

*Seq = carbon sequestration. All figures rounded to the nearest whole number – totals may not sum due to rounding*

4.3.9 The results show an overall increase in carbon sequestration per year compared to the current undeveloped site, once the deciduous woodland is established from year 11 after planting. This sums to 101 $tCO_2e$ additional carbon sequestered per year.

***Residual effect***

4.3.10 The results show an overall increase in carbon sequestration of -101 $tCO_2e$ per year, once the woodland area is established.

4.3.11 Table 2-1 sets out the significance criteria adapted from the IEMA Guidance. On the basis of the LERMP (App Doc Ref 5.4.8.14) secondary mitigation, the operational footprint shows a beneficial impact with less than zero carbon emissions, having a **beneficial** climate impact, rated as **significant**.

### Monitoring

4.3.12 Monitoring in accordance with the landscape requirements to ensure that the landscape planting is successful. Landscape requirements are contained within the LERMP (Appendix 8.14, App Doc Ref 5.4.8.14).

## 4.4 Operation phase

4.4.1 The operation phase assessment includes annual emissions from year 1 of operation. Section 4.64.6 (whole life carbon) includes emissions associated with the operation and replacement of assets over the assessment lifetime. Carbon emissions are presented for two options:

- assessment of the preferred option for the Proposed Development of biomethane production; and
- the utilisation of biogas in CHP engines. This approach aligns to the operational emissions of the baseline.

4.4.2 Maintenance activities are expected to be labour-intensive, rather than requiring significant additional energy or materials. Therefore, it is assumed that the operational energy use covers routine maintenance activities. Carbon emissions from capital replacements are calculated separately and included within Section 4.6 (whole life carbon).

***Magnitude of impact***

4.4.3 This assessment has been completed on the basis that designed-in measures (see Section 2.8) are implemented.

4.4.4 In line with UK environmental reporting guidelines (Department for Business Energy & Industrial Strategy, 2019), energy produced and exported to the grid may be reported as an emissions reduction in a net figure. For the two options presented, net emissions arise as follows:

- DM0 model, CHP option: Use of biogas in on-site CHP to reduce the power demand of the development. UK average grid electricity emissions factor (forecast to 2028) has been used to calculate the emissions avoided (Department for Business Energy & Industrial Strategy, 2021);
- DCO model (preferred option): Biomethane supply to the gas grid replaces other sources of gas, and so avoids emissions from gas generated (wholly or partially) from other more carbon intensive sources. The UK average natural gas emissions factor has been used to calculate the emissions avoided (Department for Business Energy & Industrial Strategy, 2021).

4.4.5 The potential emissions from the operation of the Proposed Development are indicated in Table 4-4, split out by key processes. The positive numbers (greater than zero) are carbon emissions, while the negative numbers are emissions avoided.

**Table 4-4: Potential annual emissions from operation**

| Process | Biogas utilised in CHP (based on DM0) Tonnes $CO_2e/y$* | Biomethane production (DCO preferred option) Tonnes $CO_2e/y$* |
|---|---|---|
| Grid Electricity[3] | 2,040 | 1,740 |
| Chemicals | 20 | 50 |
| Fossil fuel consumption (propane) | - | 860 |

[3] Grid electricity emissions have been based on forecast 2028 (expected year of operation start) grid carbon intensity from BEIS green book supplementary guidance, data tables 1-19, Table 1 commercial/public sector.

| Process | Biogas utilised in CHP (based on DM0) Tonnes $CO_2e/y$* | Biomethane production (DCO preferred option) Tonnes $CO_2e/y$* |
|---|---|---|
| Transport - biosolids recycling to land | 70 | 70 |
| **Total gross emissions** | **2,130** | **2,730** |
| CHP energy use | -1,030 | |
| Biomethane export[4] | - | -6,210 |
| **Total net emissions** | **1,110** | **-3,490** |

*$tCO_2e$ rounded to nearest 10 tonnes, totals may not sum due to rounding*
***Grid electricity emissions account for power generated from CHP engine*

4.4.6 Annual carbon emissions from operation are illustrated in Figure 4.1 (gross emissions) and Figure 4.2 (net emissions).

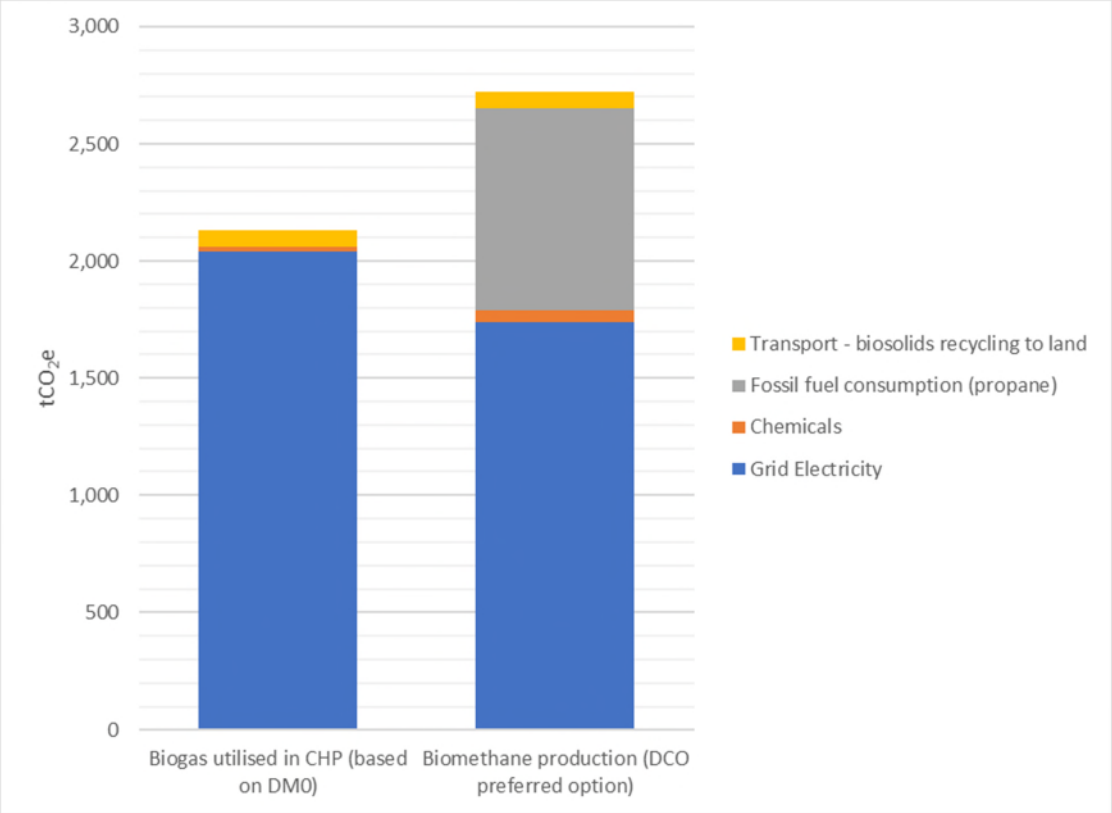


**Figure 4.2: Gross annual operation carbon emissions ($tCO_2e$)**

[4] A constant emissions factor has been used for calculating avoided emissions through biomethane export. There are no UK Government projections for gas grid decarbonisation by unit of gas. It has been assumed that from 2050 onwards, the gas grid will be net zero and therefore no avoided emissions have been included from this point.

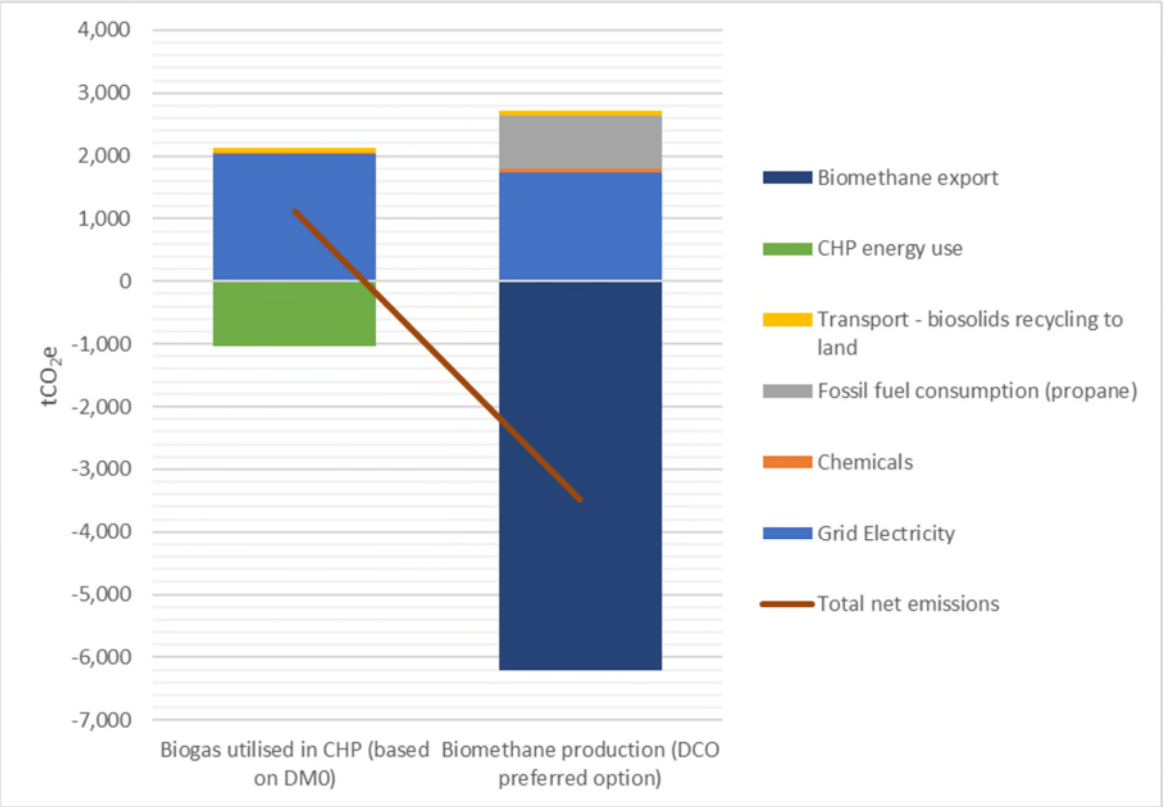


**Figure 4.3: Net annual operation carbon emissions ($tCO_2e$)**

4.4.7 Overall net emissions of -3,490 $tCO_2e$/year are identified during operation of the Proposed Development (preferred option). When compared to the baseline CHP option operation of net 1,110 $tCO_2e$/year, this is a reduction of 4,600 $tCO_2e$/year.

4.4.8 Gross emissions are higher for the Proposed Development (preferred option), an increase of 600 $tCO_2e$/year against the baseline CHP option. This is mainly due to the additional use of propane to achieve the required calorific content within biomethane to enable export into the gas network.

4.4.9 The anticipated emissions per mega litre processed have been compared in Table 4-5 for the Proposed Development, the baseline and the Applicant's reported annual average across their network. Mitigation has been included through the design process and is outlined in Section 2.8. Both gross and net figures are provided for context.

**Table 4-5: Operation emissions compared to annual average emissions reported by the Applicant**

| Operation emissions | Gross $tCO_2e$* per Ml | Net $tCO_2e$* per Ml |
|---|---|---|
| Proposed Development total – DCO preferred option of gas to grid | 0.043 | -0.055 |

| Operation emissions | Gross $tCO_2e$* per Ml | Net $tCO_2e$* per Ml |
|---|---|---|
| Baseline basic scheme design (DM0 design) of CHP | 0.034 | 0.018 |
| Applicant's average emissions per Ml recycled water | 0.432 | |

**tCO₂e rounded to nearest 10 tonnes.*

4.4.10 The gross emissions of the Proposed Development (preferred option) are around 0.08% of estimated UK water sector emissions of 3.6 $MtCO_2e$.

***Sensitivity of receptor***

4.4.11 There is one receptor for carbon emissions assessment: this is the global climate. National planning policies and the UK Climate Change Act reiterate the serious nature of climate change and the need to rapidly decarbonise. This has been taken into account in line with IEMA guidance by defining the sensitivity of the global climate as high.

***Significance of effect***

4.4.12 The significance of effect depends on the option selected and assessment of gross or net emissions. This is presented in Table 4-6 for clarity (reference

4.4.13 Table 2-1 sets out the significance criteria, adapted from the IEMA Guidance).

**Table 4-6: Significance of effect**

| Option | Significance |
|---|---|
| Proposed Development DCO preferred option of gas to grid Gross emissions | **Moderate adverse** impact, rated as **significant** |
| Proposed Development DCO preferred option of gas to grid Net emissions | **Beneficial** impact, rated as **significant** |
| Baseline basic scheme design (DM0 design) of CHP Gross emissions | **Moderate adverse** impact, rated as **significant** |
| Baseline basic scheme design (DM0 design) of CHP Net emissions | **Moderate adverse** impact, rated as **significant** |

4.4.14 The Proposed Development preferred approach shows net emissions avoided (a beneficial effect) in annual operation and aligns with Anglian Water's commitment to reduce emissions to net zero in operation by 2030.

***Secondary mitigation or enhancement***

4.4.15 As part of the design process, there is a continuing review of opportunities to:

- improve energy efficiency;
- generate renewable power (through solar panels with capacity of 7 MW); and
- maximise green gas production.

***Residual effect***

4.4.16 On the basis that no further mitigation or enhancement measures are committed or calculated at this stage, the residual effect of the preferred option remains as per Table 4-6.

4.4.17 Accounting for net emissions from the Proposed Development preferred approach leads to **beneficial** impacts, rated as **significant**. The net emissions of the CHP option, and the gross emissions of both options, lead to operational emissions and the residual effect would be classed as a **moderate adverse** impact, rated as **significant**.

## Monitoring

4.4.18 The Applicant will continue to monitor and report their annual operational footprint and the Proposed Development will form part of this monitoring and reporting.

4.4.19 Monitoring will be required in relation to annual carbon accounting in accordance with mandatory reporting of operational emissions for 2021-22 onwards to Ofwat (Ofwat, 2022).

## 4.5 Decommissioning existing WWTP

4.5.1 Chapter 2: Project Description sets out the main activities for decommissioning the existing WWTP as draining, desludging and cleaning. The main source of GHG emissions from these activities would be associated with vehicle movements.

***Magnitude of impact***

4.5.2 The potential emissions from the decommissioning of the existing Cambridge WWTP are indicated in Table 4-7, with vehicle movements identified as the main activity.

**Table 4-7: Potential emissions from decommissioning**

| Process | Tonnes $CO_2e$ |
|---|---|
| Medium Van Movements | 1 |
| Transit Truck Movements | 1 |
| Tanker Movements | 11 |
| **TOTAL** | **13** |

4.5.3 Vehicle movements have been agreed in discussion with contractors for the Proposed Development, considering project-specific requirements and experience from previous projects. Appendix 10.1 (App Doc Ref 5.4.10.1) includes the decommissioning carbon emissions calculations in more detail. The key areas driving this footprint are identified as:

- distance of vehicle travel off site (assumed 60 miles per vehicle per day to and from the site);
- distance of vehicle travel on site (assumed 1 mile for medium van and transit truck, and 5 miles for tankers per day);
- estimated duration of works; and
- estimated number of medium vans, transit trucks and tankers.

4.5.4 Overall, 13 $tCO_2e$ emissions are estimated as a result of decommissioning.

***Sensitivity of receptor***

4.5.5 There is one receptor for carbon emissions assessment: this is the global climate. National planning policies and the UK Climate Change Act reiterate the serious nature of climate change and the need to rapidly decarbonise. This has been taken into account in line with IEMA guidance by defining the sensitivity of the global climate as high.

***Significance of effect***

4.5.6 Although the decommissioning footprint results in emissions, these are considered to be of minor impact compared to the proposed construction

emissions (decommissioning is ~0.03% of construction emissions). Therefore, overall a **minor adverse** impact, rated as **not significant**.

***Secondary mitigation or enhancement***

4.5.7 Best practice construction site processes and further reduction initiatives will be pursued on site for construction and decommissioning. No specific mitigation measures have been identified for decommissioning at this stage.

***Residual effect***

4.5.8 On the basis that no further mitigation or enhancement measures are committed or calculated at this stage, the residual effect remains **minor adverse**, and is **not significant**.

### Monitoring

4.5.9 There are no requirements for ongoing monitoring in relation to decommissioning the existing WWTP.

## 4.6 Whole life carbon

4.6.1 This section provides an estimate of the likely carbon emissions over the assessment lifetime from construction through to operation, including the replacement of assets over the assessment lifetime. Carbon emissions are presented for the following scenarios:

- Preferred option of DCO construction model, with biomethane production in operation;
- Option of DCO construction model, using biogas in CHP during operation;
- Baseline assessment of DM0 construction model, using biogas in CHP during operation.

As per Section 4.4, carbon emissions are presented as gross and net emissions. The net emissions demonstrate emissions avoided through energy generation and sequestration (in line with UK environmental reporting guidelines (Department for Business Energy & Industrial Strategy, 2019)).

***Magnitude of impact***

4.6.2 The estimated whole life carbon impact of the Proposed Development up to 2057 is outlined in Table 4-8, summarised by emission category and the different scenarios modelled.

4.6.3 The year 2057 has been selected based on the 30 year lifespan of the LERMP (Appendix 8.14, App Doc Ref 5.4.8.14) from year 1 of operation (currently expected to be 2028). The management of the landscaping is secondary mitigation and so sequestration potential after the first year of operation is only calculated within the residual effects.

4.6.4 The whole life assessment has considered an estimate of the likely replacement lifecycles of assets within the Proposed Development.

4.6.5 The operational phase of emissions has been highlights the impact of biomethane exports on whole life emissions, as well as emission sources such as chemicals, transport, fuel and electricity emissions.

4.6.6 Electricity emissions have accounted for potential future grid decarbonisation based on BEIS Green Book supplementary guidance, data table 1-19, Table 1, commercial/public sector. Other emissions sources have not had a decarbonisation allowance applied to them. This is due to no readily available forecast for the likely decarbonisation of the gas grid or chemicals sectors, and therefore a steady emissions intensity has been assumed. In calculating the avoided emissions from export of biomethane, a constant emissions factor has been assumed for grid gas. At 2050 and beyond, it is assumed that the UK's commitments to net zero are in-place and therefore biomethane export is not counted as avoiding emissions from 2050.

4.6.7 The Proposed Development preferred option of biomethane production is estimated to have a gross emissions impact of 104,410 $tCO_2e$ across construction and a 30 year operation period. The biomethane export benefits and sequestration impacts account for a net benefit of -136,710 $tCO_2e$ avoided due to the export of biomethane. This results in total whole life net emissions of the Proposed Development of -32,330 $tCO_2e$.

4.6.8 The alternative Proposed Development worst case scenario of using biogas in CHP engines is estimated to have a gross carbon impact over the same period of 80,070 $tCO_2e$. This takes into account the mitigation measures adopted in construction. The benefits of CHP power generation and sequestration account for a net emissions benefit of -8,560 $tCO_2e$, which gives a total whole life net emissions impact of the Proposed Development of 71,480 $tCO_2e$.

4.6.9 Table 4-8 presents the whole assessment life carbon emissions for the baseline and both of the Proposed Development options assessed. Only the preferred biomethane option achieves a net negative emissions impact.

**Table 4-8: Potential whole life carbon emissions to 2080**

| Category | DM0 Baseline assessment | Biogas utilised in CHP (Proposed Development - worst case) Tonnes $CO_2e$* | Biomethane production (DCO preferred option) Tonnes $CO_2e$* |
|---|---|---|---|
| Construction emissions) | 96,760 | 50,790** | 50,790 |
| Capital Replacements | 16,270 | 9,600 | 9,600 |
| Operational Carbon – Electricity | 17,010 | 17,010 | 14,500 |
| Operational Carbon - Non-electricity | 2,660 | 2,660 | 29,520 |

| Category | DM0 Baseline assessment | Biogas utilised in CHP (Proposed Development - worst case) Tonnes $CO_2e$* | Biomethane production (DCO preferred option) Tonnes $CO_2e$* |
|---|---|---|---|
| **Gross total** | **132,700** | **80,070** | **104,410** |
| CHP Energy Use | -8,560 | -8,560 | |
| Biomethane Export | | | -136,710 |
| Sequestration | -1,240 | -30 | -30 |
| **Net total** | **122,900** | **71,480** | **-32,330** |

**$tCO_2e$ rounded to nearest 10 tonnes, totals may not sum due to rounding*
***Capital carbon emissions for the CHP option has used the same construction carbon assessment as the biomethane production to represent a worst-case position for this option. In reality, less carbon intensive infrastructure would be required for a CHP installation.*

***Sensitivity of receptor***

4.6.10 There is one receptor for carbon emissions assessment: this is the global climate. National planning policies and the UK Climate Change Act reiterate the serious nature of climate change and the need to rapidly decarbonise. This has been taken into account in line with IEMA guidance by defining the sensitivity of the global climate as high.

***Significance of effect***

4.6.11 The significance of effect depends on the option selected and assessment of gross or net emissions. This is presented in Table 4-9 for clarity (reference

4.6.12 Table 2-1 sets out the significance criteria, adapted from the IEMA Guidance).

**Table 4-9: Significance of effect**

| Option | Significance |
|---|---|
| Proposed Development DCO preferred option of gas to grid<br>Gross emissions | **Moderate adverse** impact, rated as **significant** |
| Proposed Development DCO preferred option of gas to grid<br>Net emissions | **Beneficial** impact, rated as **significant** |
| Baseline basic scheme design (DM0 design) of CHP<br>Gross emissions | **Moderate adverse** impact, rated as **significant** |
| Baseline basic scheme design (DM0 design) of CHP<br>Net emissions | **Moderate adverse** impact, rated as **significant** |

4.6.13 The whole life carbon impact of the Proposed Development (preferred option) shows an overall reduction in emissions primarily driven by the emissions value of biomethane exports. After 12 years of operation, the impact of the construction emissions is estimated to have been negated by the benefit of the biomethane

exports. An estimated net of -32,330 $tCO_2e$ avoided will likely be achieved from the Proposed Development operating for 30 years. The preferred approach whole life footprint shows a beneficial impact, rated as significant.

4.6.14 Note that the Proposed Development with CHP would lead to lifetime emissions of 71,480 $tCO_2e$. Although this is a reduction on the baseline, it is classed as a moderate adverse impact, rated as significant.

***Secondary mitigation or enhancement***

4.6.15 Ongoing management of the landscape is dependent on the LERMP, which is classed as secondary mitigation. Sequestration has been applied annually for up to the lifetime of the monitoring plan to 30 years (anticipated year 2057). The impact of the LERMP (Appendix 8.14, App Doc Ref 5.4.8.14) on carbon sequestration over the 30 year plan is -2,010 $tCO_2e$ additional carbon sequestered compared to the baseline (a total of -3,080 $tCO_2e$ sequestered).

4.6.16 As covered in the construction and operation phase sections above, several additional mitigation measures are being explored to further mitigate the emissions impact of the construction phase and optimise the operational carbon balance.

4.6.17 The optimal mix of technologies (gas-to-grid, solar, battery storage, CHP) will be determined at the detailed design phase in accordance with the DCO Requirements. As discussed above, the worst-case assessment for carbon assumes that a CHP option with no solar would be built, potentially resulting in net positive operational carbon emissions from the operation of the plant. To ensure that operational carbon neutrality is maintained under all build scenarios the DCO includes a requirement for a Carbon Management Plan (CMP) to be agreed prior to the operation of the plant.

***Residual effect***

4.6.18 On the basis that the carbon sequestration benefits are minor in comparison to the overall whole life carbon footprint, the residual effect remains as set out in Table 4-9 which is significant beneficial for net emissions of the preferred option and significant moderate adverse for the CHP option.

4.6.19 Operating for 30 years and including sequestration, an estimated net lifetime of -35,380 $tCO_2e$ avoided could be achieved for the Proposed Development.

4.6.20 Note that the Proposed Development with CHP, including sequestration, would lead to net lifetime emissions of 68,430 $tCO_2e$.

4.6.21 The assessment results with secondary mitigation (excluding the operation of the Carbon Management Plan) are presented in Figure 4.4 to Figure 4.8.

4.6.22 Figure 4.4 shows the gross cumulative emissions over the assessment lifetime. The step increase in emissions at 22 years into the lifetime of the proposed WWTP is where there is additional capital carbon required for equipment replacement.

4.6.23 Figure 4.5 shows the net cumulative emissions by design option and avoided emissions from use of CHP and export of biomethane. The whole life carbon impact of the Proposed Development (preferred option) shows an overall reduction in emissions, primarily driven by the emissions value of biomethane exports. After 15 years of development lifetime, the impact of the construction emissions is estimated to have been negated by the net benefit of the natural gas exports. The figure shows the impact of capital replacements during operation as an increase in emissions after a period of operation.

4.6.24 Figure 4.6 shows emissions for the Preferred Option year on year. This shows positive emissions for construction, replacements, operational power and non-power emissions. Gas to grid and sequestration are presented as negative emissions.

4.6.25 Figure 4.7 shows emissions for the CHP Option year on year. This shows positive emissions for construction, replacements, operational power and non-power emissions. CHP power generation and sequestration are presented as negative emissions.

4.6.26 Figure 4.8 shows the baseline emissions year on year. This shows positive emissions for construction, capital replacements (note that construction and replacement are larger than in the DCO design options), operational power and non-power emissions. CHP power generation and sequestration are presented as negative emissions.

4.6.27 These figures do not illustrate the operation of the Carbon Management Plan described at 4.6.17 above.

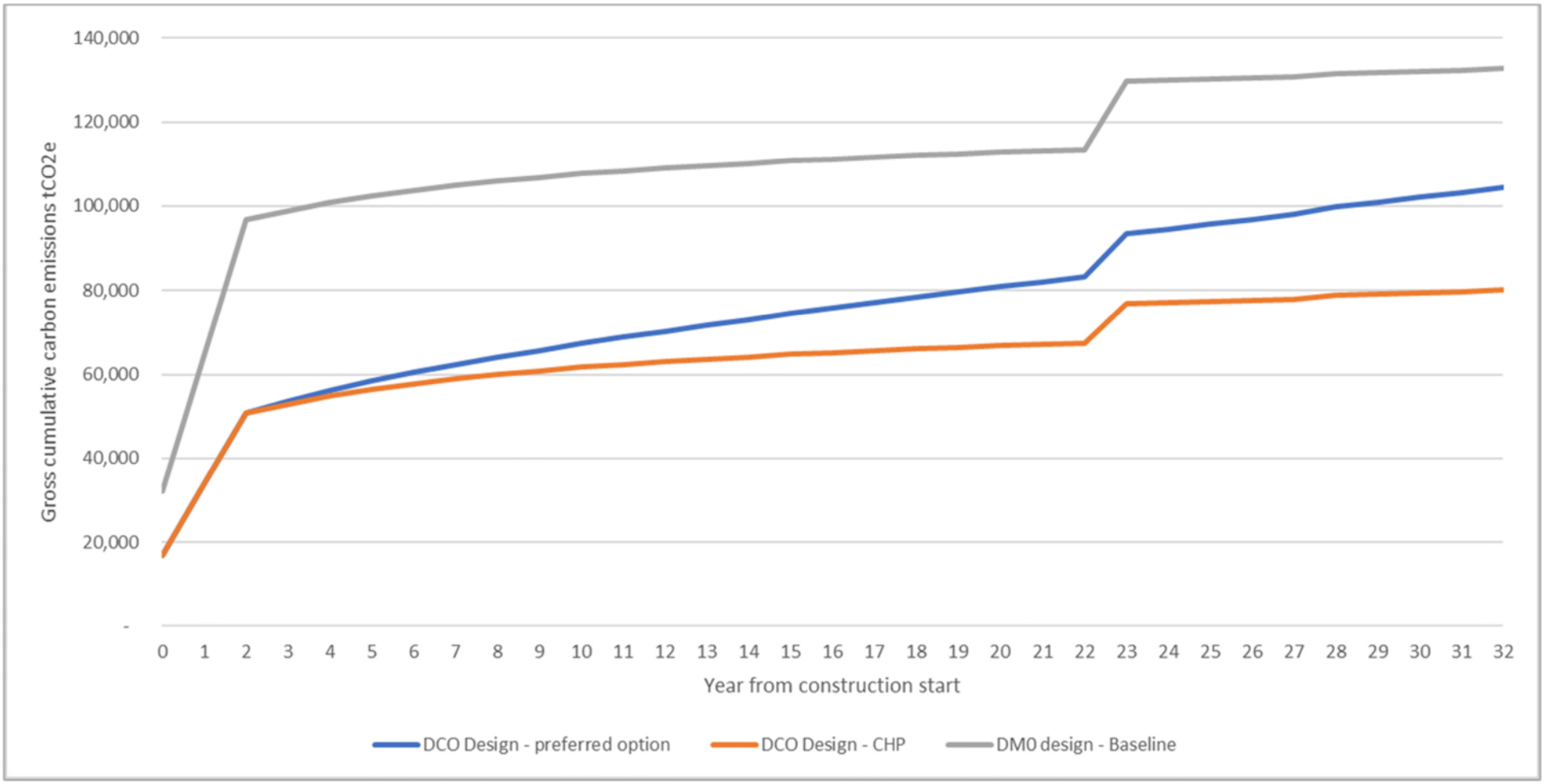


**Figure 4.4: Gross cumulative lifetime emissions**

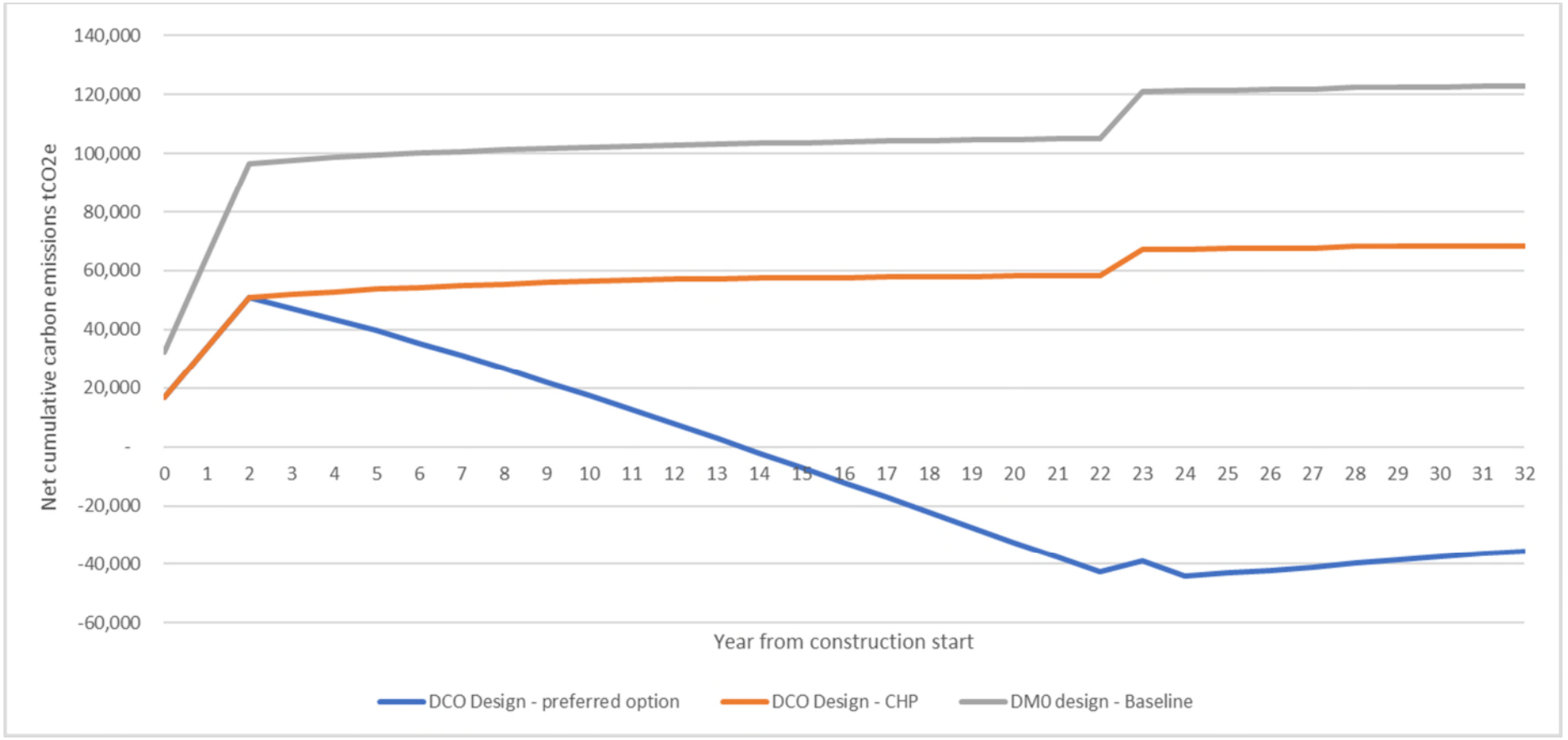


**Figure 4.5: Net cumulative lifetime emissions**

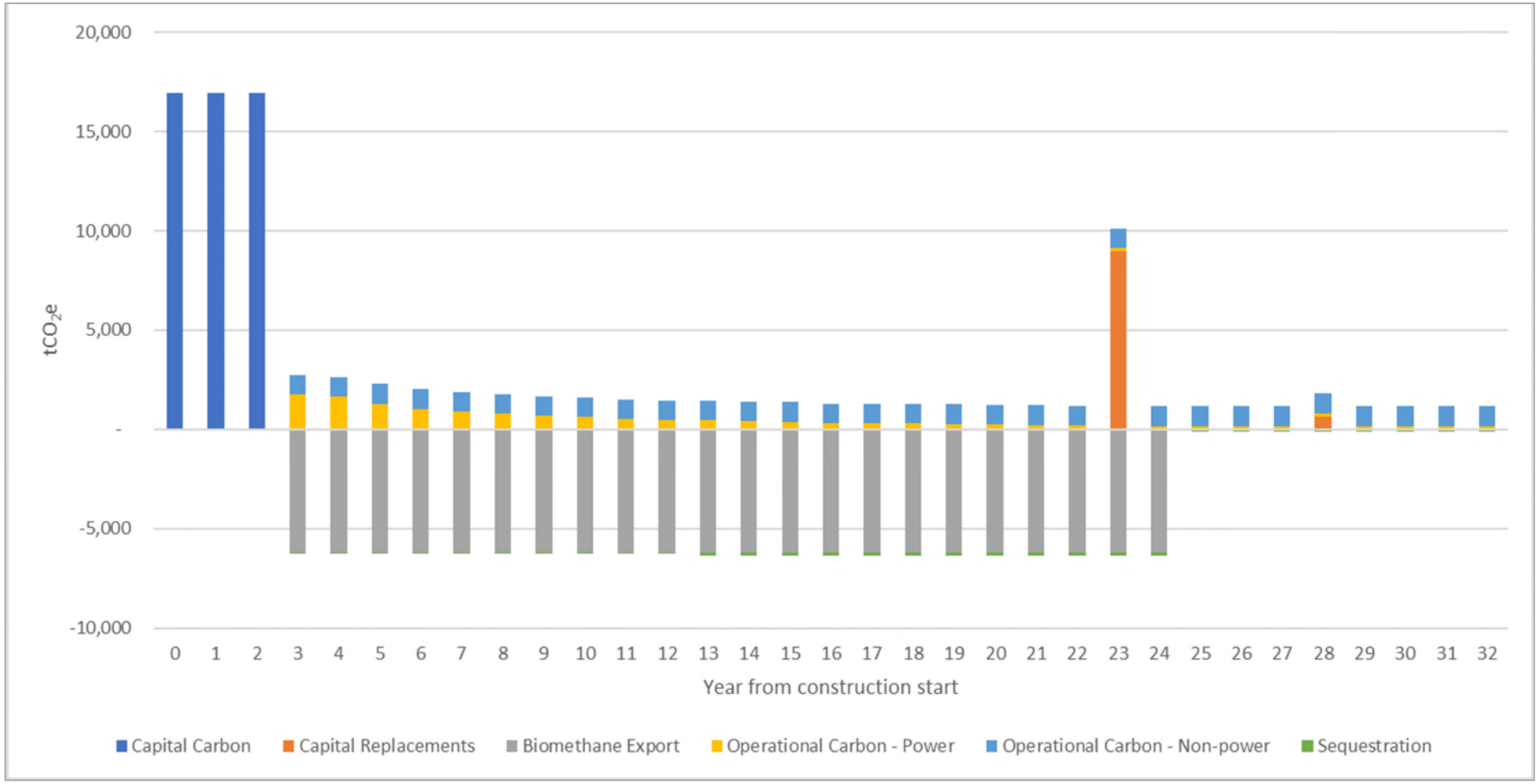


**Figure 4.6: Preferred Option lifetime emissions by source**

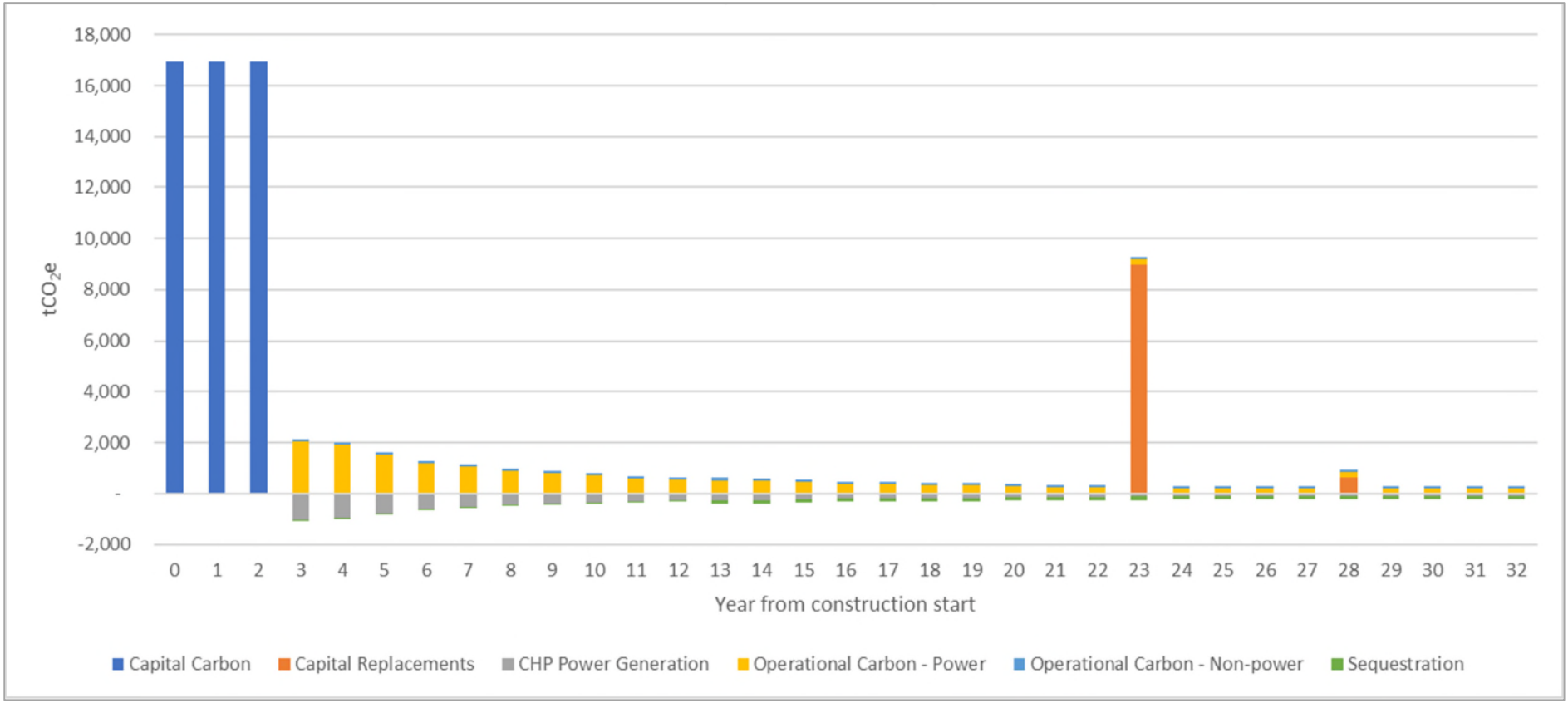


**Figure 4.7: CHP Option lifetime emissions by source**

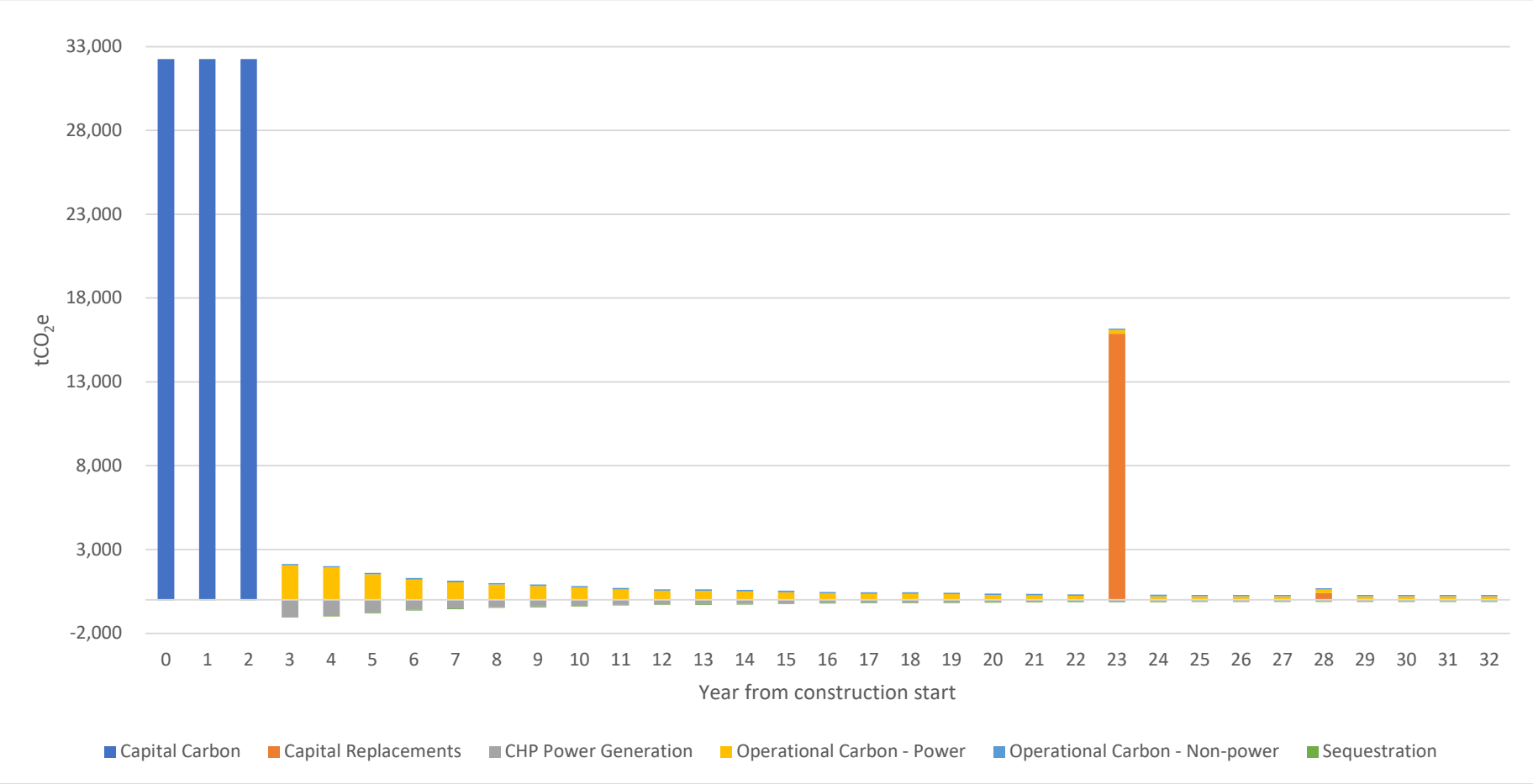


**Figure 4.8: Baseline lifetime emissions by source**

### Monitoring

4.6.28 Monitoring aspects are covered in the construction, land use change, and operation phase sections above.

### Cumulative effects

4.6.29 Emissions of GHGs are cumulative in nature, impacting the global atmospheric concentration of emissions. Additional development in the local area does not result in a greater local climate change effect from the Proposed Development (or vice versa).

4.6.30 IEMA Guidance states that "effects of GHG emissions from specific cumulative projects therefore in general should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has GHG emissions for assessment over any other".

4.6.31 For the Proposed Development, the relocation of the WWTP is intended to allow the development of the existing Cambridge WWTP. The processes employed for demolition of the existing Cambridge WWTP, and construction and operation for the Proposed Development would lead to further carbon emissions, but are currently unknown. These would be assessed by the developers of the existing Cambridge WWTP as part of separate planning application.

### Inter-related effects

4.6.32 Emissions of GHGs have been assessed for the construction and operation of the Proposed Development as a whole, including land use change and whole life impacts. Impacts assessed in Section 4.1 consider the impact of individual elements on the construction and operation of the whole site.

4.6.33 No further inter-related effects are considered.

# 5 Conclusion and Summary

## 5.1 Summary of carbon emission effects

5.1.1 The likely significant effects of carbon emissions from the Proposed Development on carbon have been assessed in this ES chapter.

5.1.2 Land use change is estimated to provide additional carbon sequestration once the deciduous woodland is established from year 11 after planting as stated in the vegetation management under the LERMP (Appendix 8.14, App Doc Ref 5.4.8.14).

5.1.3 Although construction emissions are outweighed over the lifetime of the Proposed Development with the preferred option of gas to grid, good practice construction stage measures to reduce GHG emissions have been recommended in the CoCP (Appendix 2.1 & 2.2, App Doc Ref 5.4.2.1 and 5.4.2.2). This is consistent with IEMA guidance that any GHG emissions (and hence opportunities for reductions) may be significant.

5.1.4 Although construction, operation, and decommissioning activities would generate carbon emissions (104,410 $tCO_2e$ lifetime gross emissions), the net whole life emissions of the Proposed Development preferred option would lead to an estimated -32,330 $tCO_2e$ (avoided emissions due to export of gas to the grid which displaces other sources of natural gas). The alternative Proposed Development worst case scenario of using biogas in CHP engines is estimated to have a net carbon impact over the same period of 71,480 $tCO_2e$. This impact could be effectively mitigated using an operational Carbon Management Plan with carbon offsetting.

5.1.5 Key uncertainties in the assessment relate to future energy policy and market responses, which affect the likely future baseline carbon intensity of national grid electricity and gas supplies. This impacts the projected operational electricity usage, the avoided emissions through use of CHP and the avoided emissions through export of biomethane to the grid.

5.1.6 Government projections of future grid electricity carbon intensities have been used. Whilst still uncertain and subject to review, these are the most up-to-date projections available. Another key uncertainty is the ongoing carbon emissions value of exporting biogas. The assessment assumes that the carbon benefit to displacing fossil-fuel derived natural gas from the national gas network over the assessment period remains the same each year up to 2050 (at which point the UK is expected to reach net-zero). Over time, to support decarbonisation to net zero, the gas network is likely to be blended with a greater proportion of biogas or other low-carbon gas sources, and reduce the carbon benefit of the exports from the Proposed Development.

5.1.7 Whilst there is uncertainty around the assumption to use a constant emissions factor for grid gas displaced, the current pace of decarbonisation of the gas grid is slow, and latest years figures show an increase in carbon intensity of the grid. The production of green gas is being incentivised by current policy e.g. Green Gas

Support Scheme (Department of Business, Energy & Industrial Strategy, 2021), highlighting the role of green gas production to support delivery of net zero targets (both for the energy sector and for transport fuels). Therefore, this assumption is seen as a reasonable view based on current knowledge and taking into account that green gas will have a significant role to play in achieving the UK's net zero targets.

5.1.8 The assessment also presents the potential for utilising biogas in CHP engines which was considered as a worst case option. While both options have been assessed, the preference as discussed in Chapter 2: Project Description is to proceed with the export of biogas to grid.

**Table 5-1: Summary of GHG emission effects**

| Description of impact | Effect | Design/mitigation measures adopted as part of the project | Magnitude of impact | Sensitivity of receptor | Significance of effect | Additional mitigation measures | Residual effect | Proposed monitoring | Responsible party |
|---|---|---|---|---|---|---|---|---|---|
| Capital carbon as a result of materials and activities to construct the Proposed Development | Moderate adverse | Reduction in tunnel length and diameters;<br>Tertiary treatment;<br>Treated effluent pipelines and outfall;<br>Optimisation of major process-tank volumes from original baseline sizes;<br>Optimisation of road area. | 50,790 $tCO_2e$ | High | Significant | Continued innovation review; Material specification; Efficient construction and temporary works. | Significant, moderate adverse | Emissions only monitored to detailed design stage.<br>In accordance with Section 7.5 of the CoCP Part A (Waste Management and Resource Use). | Appointed contractor(s) |
| Land use change | Minor adverse | Landscaping plan initial planting results in a lower carbon sequestration potential. | <10 $tCO_2e$ per year | High | Not Significant | LERMP: management of vegetation going forwards enables increased sequestration of -100 $tCO_2e$ / year. | Significant, beneficial | In accordance with landscaping monitoring LERMP Table 5-1 | Main contractor and operator |
| Operation of the proposed WWTP | Depending on option:<br>Preferred gas to grid option: Beneficial net effect<br>CHP option: Moderate adverse net effect | This depends on the preferred option being taken forward:<br>Using renewable biomethane (gas to grid);<br>Optimisation pumping power demand of Terminal Pumping Station (TPS);<br>Reduction in chemicals and power demand for sludge dewatering; Vacuum degassing post-digestion. | Gross emissions:<br>3,300 $tCO_2e$ per year (preferred gas to grid option)<br>2,770 $tCO_2e$ per year (CHP option)<br>Net emissions:<br>-2,940 $tCO_2e$ per year (preferred gas to grid option)<br>1,420 $tCO_2e$ per year (CHP option) | High | Significant | Improve energy efficiency; Generate renewable power;<br>Maximise green gas production.<br>Operational Carbon Management Plan (CMP) to ensure that in the event of the CHP option being adopted the project would remain operationally net zero carbon. | Significant.<br>Depending on option:<br>Preferred gas to grid option: Beneficial net effect<br>CHP option: Moderate adverse net effect (reduced to neutral, negligible effect, non-significant, through use of CMP) | The Applicant will continue to monitor and report their annual operational footprint. | The Applicant |
| Decommissioning the existing Cambridge WWTP | Minor adverse | NA | >10 $tCO_2e$ | High | Not Significant | Efficient construction and temporary works. | Not significant, minor adverse | None | |
| Whole life carbon | Depending on option:<br>Preferred gas to grid option: Beneficial net effect<br>CHP option: Moderate | This depends on the preferred option being taken forward: Measures adopted in operation and land use change act to reduce emissions over the whole life of the assessment. | Gross emissions: 104,410 $tCO_2e$ per year (preferred gas to grid option)<br>80,070 $tCO_2e$ per year (CHP option)<br>Net emissions: | High | Significant | LERMP: management of vegetation going forwards enables increased sequestration. Net emissions:<br>-35,380 $tCO_2e$ per year (preferred gas to grid option)<br>68,430 $tCO_2e$ per year (CHP option) | Significant.<br>Depending on option:<br>Preferred gas to grid option: Beneficial net effect<br>CHP option: Moderate adverse net effect | See proposed monitoring above for construction, land use change, and operation. | The Applicant |

| Description of impact | Effect | Design/mitigation measures adopted as part of the project | Magnitude of impact | Sensitivity of receptor | Significance of effect | Additional mitigation measures | Residual effect | Proposed monitoring | Responsible party |
|---|---|---|---|---|---|---|---|---|---|
| | adverse net effect | | -32,330 $tCO_2e$ per year (preferred gas to grid option)<br>71,480 $tCO_2e$ per year (CHP option) | | | Operational Carbon Management Plan (CMP) to ensure that in the event of the CHP option being adopted the project would remain operationally net zero carbon.<br><br>Additional mitigation measures listed above for construction and operation would further contribute to carbon reduction over the whole life of the Proposed Development. | (reduced to neutral, negligible effect, non-significant, through use of CMP) | | |

## 5.2 Securing mitigation

5.2.0 The delivery of mitigation will be controlled through the 'Development Consent Order (DCO) which:

- identifies parameters within which certain works activities will be located and constructed (e.g. maximum and minimum building dimensions (including below ground), or locational zones);
- sets requirements for construction, operation and maintenance of the Proposed Development to be undertaken in accordance with 'control plans / documents' (including those that are related to compliance with environmental permits); and
- sets requirements for the control of specific issues or works (e.g. time limits around the completion of the outfall construction).

5.2.1 Table 5-2 summarises all mitigation in relation to Carbon, how these measures are secured, the party responsible for the implementation of the measure, when the measure would be delivered and any mechanisms to deliver the measure.

**Table 5-2: Securing mitigation summary**

| Description of impact | Residual effect | Mitigation measure | Mitigation type | Secured by | Responsible party | Timing on the provision of the measure | Trigger for the discharge of any related requirement |
|---|---|---|---|---|---|---|---|
| Capital carbon as a result of materials and activity to construct the Proposed Development | Significant, moderate adverse | Reduction in tunnel length and diameters | Primary | Requirement to update Carbon model to account for detailed design of the Proposed Development to monitor further carbon savings through detailed design when compared to the baseline DM0 design secured through a requirement of the draft DCO (App Doc Ref 2.1) | Appointed contractor(s) | Prior to construction | Update to model be completed alongside detailed design and final model issued with detailed design |
| | | Tertiary treatment | | | | | |
| | | Treated effluent pipelines and outfall | | | | | |
| | | Optimisation of major process-tank volumes from original baseline sizes | | | | | |
| | | Optimisation of road area in design | | | | | |
| | | • Continued innovation review<br>• Material specification<br>• Efficient construction and temporary works | Secondary | | | | |
| Land use change | Significant, beneficial | Landscape masterplan with the LERMP | Refinement and preparation of detailed plans | LERMP secured through a requirement of the draft DCO (App Doc Ref 2.1) | The Applicant | Prior to construction | Approved detailed plana[ |
| Operation of the proposed WWTP | Significant, beneficial to negligible (non-significant) | Inclusion of energy recovery within proposed WWTP (CHP or G2G) | Primary | Requirement to update Carbon model to account for detailed design of the Proposed Development to monitor further carbon savings through detailed design when compared to the baseline DM0 design secured through a requirement of the draft DCO (App Doc Ref 2.1) | The Applicant | Detailed design approved prior to start of construction | Decision made prior to start of construction supported by updated Carbon model to account for type of energy recovery facility taken forward |
| | | Solar panels to be included in the inner slope of the earth bank (for the preferred option of G2G). | Primary | | The Applicant | Detailed design approved prior to start of construction | Decision made regarding inclusion of solar and extent prior to start of construction supported by updated Carbon model to account for solar design |
| | | Gateway building to be designed to achieve BREEAM “Excellent” standard | Primary | Requirement to develop detailed design to meet BREEAM target secured through a requirement of the draft DCO (App Doc Ref 2.1) | The Applicant | Prior to construction | BREEAM assessment completed alongside detailed design and final report issued with detailed design |
| | | Optimisation pumping power demand of Terminal Pumping Station (TPS) within design | Primary | Intrinsic to design | Appointed contractor(s) | Prior to construction | Detailed design supported by update to carbon model with final model issued with detailed design |
| | | Reduction in chemicals and power demand for sludge dewatering through design | Primary | Intrinsic to design | The Applicant | | |
| | | Vacuum degassing post-digestion included in design | Primary | Intrinsic to design | The Applicant | | |

| Description of impact | Residual effect | Mitigation measure | Mitigation type | Secured by | Responsible party | Timing on the provision of the measure | Trigger for the discharge of any related requirement |
|---|---|---|---|---|---|---|---|
| | | Operational Carbon Management Plan | Secondary | Requirement to secure an operational Carbon Management Plan (CMP) through a requirement of the draft DCO (App Doc Ref 2.1)<br>Approval and implementation of a detailed management and monitoring plan secured to comply with LERMP secured through a requirement of the draft DCO (App Doc Ref 2.1) | The Applicant | Commencement of operation | Plan to be submitted with approval of gas management phase |
| Whole life carbon | Significant, beneficial to negligible (non-significant) | Land use change acting to reduce emissions over the whole life of the assessment | Primary | LERMP secured through a requirement of the draft DCO (App Doc Ref 2.1) | The Applicant | Landscape planting completion prior to operation | Detailed plan prior to start of construction |
| | | | Secondary | | | Annual monitoring of habitat types and extents | Once first year of operation completed |
| | | Measures adopted in operation act to reduce emissions over the whole life of the assessment:<br>• Follow the Net Zero to 2030 Strategy | Secondary | Schedule 2 requirement to apply 2030 strategy and include CWWTPR in annual reporting secured through a requirement of the draft DCO (App Doc Ref 2.1) | The Applicant | Year 1 of operation and then annually | Once first year of operation completed |
| | | • Implement the Operational worker travel plan to encourage mode shift in transport | | Requirement to implement OWTP (Appendix 19.8, App Doc Ref 5.4.19.8) secured through a requirement of the draft DCO (App Doc Ref 2.1) | | Commencement of operation | Approved plan prior to the commencement of operation |
| | | Operational Carbon Management Plan | Secondary | Requirement to secure an operational Carbon Management Plan (CMP) through a requirement of the draft DCO (App Doc Ref 2.1) | The Applicant | Commencement of operation | Plan to be submitted with approval of gas management phase |

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