

**DPS FRAMEWORK SCHEDULE 4: LETTER OF APPOINTMENT AND CONTRACT TERMS**

**Part 1: Letter of Appointment**

Dear [REDACTED]

**Letter of Appointment**

This letter of Appointment dated Thursday, 25th November 2021, is issued in accordance with the provisions of the DPS Agreement (RM6018) between CCS and the Supplier.

Capitalised terms and expressions used in this letter have the same meanings as in the Contract Terms unless the context otherwise requires.

Order Number:	PS21196
From:	The Department for Business Energy and Industrial Strategy (BEIS) ("Customer")
To:	RED Scientific Ltd, 1 Oriel Court, Omega Park, Alton, United Kingdom, GU34 2YT ("Supplier")

Effective Date:	Monday, 29 <sup>th</sup> November 2021
Expiry Date:	End date of Initial Period: 31 <sup>st</sup> March 2022

Services required:	Set out in Section 2, Part B (Specification) of the DPS Agreement and refined by: The Customer's Project Specification attached at Annex A and the Supplier's Proposal attached at Annex B.
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Key Individuals:	[REDACTED]
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Contract Charges (including any applicable discount(s), but excluding VAT):	£49,375.00 excluding VAT.
Insurance Requirements	Additional public liability insurance to cover all risks in the performance of the Contract, with a minimum limit of £5 million for each individual claim.  Additional employers' liability insurance with a minimum limit of £5 million indemnity  Additional professional indemnity insurance adequate to cover all risks in the performance of the Contract with a minimum limit of indemnity of £5 million for each individual claim.
Liability Requirements	<b>Suppliers' limitation of Liability</b> (Clause 18.2 of the Contract Terms);
Customer billing address for invoicing:	All invoices should be sent to should be sent to finance@services.ukpbs.co.uk or Billingham (UKPBS, Queensway House, West Precinct, Billingham, TS23 2NF)

GDPR	Please see Contract Terms Schedule 7 (Processing, Personal Data and Data Subjects)
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**FORMATION OF CONTRACT**

**BY SIGNING AND RETURNING THIS LETTER OF APPOINTMENT (which may be done by electronic means) the Supplier agrees to enter a Contract with the Customer to provide the Services in accordance with the terms of this letter and the Contract Terms.**

**The Parties hereby acknowledge and agree that they have read this letter and the Contract Terms.**

**The Parties hereby acknowledge and agree that this Contract shall be formed when the Customer acknowledges (which may be done by electronic means) the receipt of the signed copy of this letter from the Supplier within two (2) Working Days from such receipt**

**For and on behalf of the Supplier:**

**For and on behalf of the Customer:**

Name and Title:

[Redacted]

Name and Title:

[Redacted]

Signature:

[Redacted]

Signature:

[Redacted]

Date:

2nd December 2021

Date: 07/12/2021

## ANNEX A

### Customer Project Specification

#### Background

Buildings produce around 39% of the UK's CO2 emissions. To meet Net Zero virtually all of this must be abated through energy efficiency improvements and by transitioning to green energy sources.

The National Buildings Model (NBM) is a general purpose policy simulation tool representing energy consumption in both domestic and non-domestic properties. Its predecessor, the National Household Model, has been in use since 2014 and has provided analysis supporting the development of various interventions in domestic energy use, including the Energy Company Obligation and Green Homes Grant schemes.

The NBM extends this scope to incorporate non-domestic buildings. As these form a more diverse population than do homes, it has been more difficult to capture the range of buildings and energy uses within a single dataset of the form the model requires. High quality representation of the non-domestic building stock is necessary to produce reliable analysis, which will help ensure interventions that contribute to meeting climate commitments effectively and efficiently.

#### Aims & Objectives

This Invitation to Tender aims to procure, on behalf of the BEIS Secretary of State, an implemented methodology for producing synthetic population sample data from multiple overlapping data sources, relating to non-domestic buildings' energy use in the UK.

The BEIS National Buildings Model (NBM) makes use of disclosive property survey data to represent the diverse building population of the UK. While data of this type is richly detailed and necessary for building physics simulation, the sensitivity and relatively small sample sizes present a dual challenge. Data protection compliance requires that the "stock" datasets derived from surveys are not published, preventing external replication of BEIS analysis even once the NBM itself is published. Simultaneously, BEIS wishes to reconcile the weighted survey data with other trusted information that has been collected on the same population. These alternative data sources are diverse, from national aggregate statistics to meter-point data collected for most individual UK properties.

We propose that a synthetic dataset can resolve both issues. Synthetic data generators are algorithms for condensing the important properties of a dataset into a set of cross-correlations (a modelled distribution of traits). From this, a new "sample" can be drawn which preserves the key relationships we wish to infer from the original data, while scrambling everything else. Applied to a single dataset, this can ensure that private information is not disclosed, while maintaining the format of a detailed survey.

The synthetic data concept can be extended, producing a single generating algorithm from multiple otherwise incompatible datasets. The resulting "samples" would be a population of imaginary building records which are nonetheless collectively consistent with everything we (think we) know about the true population.

This project will procure expert assistance in the creation of this generating algorithm. The scope will be limited to non-domestic buildings energy use, but the approach taken is expected to be eventually extended to cover domestic buildings (which have their own unique data inputs) and potentially other domains as well. Therefore, flexibility and modularisation are important factors in the implementation.

The model will be developed and implemented in an appropriate programming language (Python 3 is preferred for compatibility with the NBM, but tenderers may make a case for alternatives, such as R, if they think it necessary). Development will be version controlled using Git. The contractor will

therefore need expertise in both software development and statistical inference/machine learning. Bayesian procedures have featured heavily in the exploratory work conducted so far (see below). Domain expertise with buildings energy use would be convenient but is not necessary.

### **Suggested Methodology**

BEIS will provide the input datasets which are to form the basis of the modelling, assist with their interpretation, and provide training in the NBM and buildings policy modelling as required. Access to BEIS IT networks may be possible to assist with data sharing but cannot be guaranteed given the project timeline.

It is not expected that the contractor will become proficient in the use of the NBM or will need to write code interfacing directly with it. However a good understanding of the stock format will be necessary in order to produce compatible outputs.

### **Tools**

BEIS will take full ownership of the project outputs upon completion of the project and will continue development on an ongoing basis, with a view towards eventual publication. Therefore, it is essential that the proposed solution rely only on freely available open-source components and products, and that these are operable within BEIS' IT environment. This operability must be tested and confirmed as the methodology is settled upon.

Python 3 is the preferred programming language, for consistency with the National Buildings Model, but tenderers may make a case for alternatives, such as R, if they think it necessary.

The project will be version controlled using Git, with BEIS having continual access to the developing model throughout the project, via a Git hosting solution (i.e. GitHub or alternatives).

### **Methodology**

The contractor will implement a statistical inference/machine learning process to condense the various data to a set of statistical relationships, making use of BEIS expert guidance to set any priors, prioritise inferences and assign appropriate confidence intervals which determine how strictly each relationship must be adhered to.

To give a simplified example: a surveyed sample of buildings may lead us to the conclusion that trait A is mutually exclusive with trait B, and that for each of these categories trait X is normally distributed with a different mean and standard deviation. Meanwhile another dataset leads us to conclude that traits X and Y are positively correlated with a noise term that increases with X. We have lower confidence in this conclusion so allow it to be violated in order to preserve the relationships between A, B and X in cases where they would otherwise contradict.

The resulting model is a probabilistic algorithm for generating the synthetic building records. It will be largely statistically derived from the data, under the guidance of the users' prioritisation and sense-checking.

The synthesised buildings must be compared back to the original data to ensure that the generated records are plausible both in isolation and as a population (i.e. that traits, combinations of traits and probabilities of occurrence are consistent with and recover the inferences drawn in the first place). Some iteration is likely to be required to correct for unanticipated combinations etc.

BEIS' initial exploration of this problem has used a Bayesian Hierarchical/Multi-Level Regression approach with the PyMC3 package. This work will be made available to the contractor, but bidders are free to propose alternative approaches so long as these are appropriately justified.

The method should conform to the Reproducible Analytical Pipeline standard. In particular, the parameters used to generate a particular stock shall be accessible so the stock sample is

reproducible (for a given random seed) without requiring access to the original data. The method should be extensible, with a clear framework for introducing additional features and data sources.

The generative model must be interpretable such that it is clear what relationships it is comprised of. There must be suitable quantification of uncertainties, and of robustness of the inferences to changes in input data. The delivered model will include metrics on the effectiveness of any solver used (for example, the coverage and convergence of an MCMC sampler).

### **Quality Assurance and Documentation**

All models and modelling must be quality assured and documented.

Contractors should include a Quality Assurance (QA) plan that they will apply to all of the research tasks and modelling. This QA plan should be no longer than 2 sides of A4 paper. It should include the delivery of a BEIS QA Log.

This [Link<sup>1</sup>](#) is an externally accessible version of the BEIS Modelling QA guidance, and the QA log: The QA log should be filled out during the project and submitted at project completion as a deliverable to demonstrate the QA tasks undertaken.

When models are submitted to BEIS, during the project or at completion, they should be accompanied by confirmation by a senior member of the contracting organisation, that the assurance has taken place in accordance with approaches outlined in the QA plan agreed with BEIS. Evidence of testing through development provided in support of the QA Log ratings greatly improves the level of confidence.

In addition to the QA documents, the model must be accompanied by thorough technical documentation in the form of in-line comments, docstrings and external technical guidance explaining the methodology; all of these must be sufficient to enable BEIS analysts to continue the work after the contract is concluded. The contractor must also provide sample scripts breaking down key processes, and an assessment of the success of out-of-sample/equivalent testing of the methodology.

The contractor will provide appropriate training for BEIS users of the model. This is to include advice about effective methods for future extension of the method with new data and/or descriptor variables, including outside the non-domestic buildings context. It should also include sufficient context in the mathematical or statistical theory underlying the chosen method to let BEIS analysts continue active development of the model.

### **Deliverables**

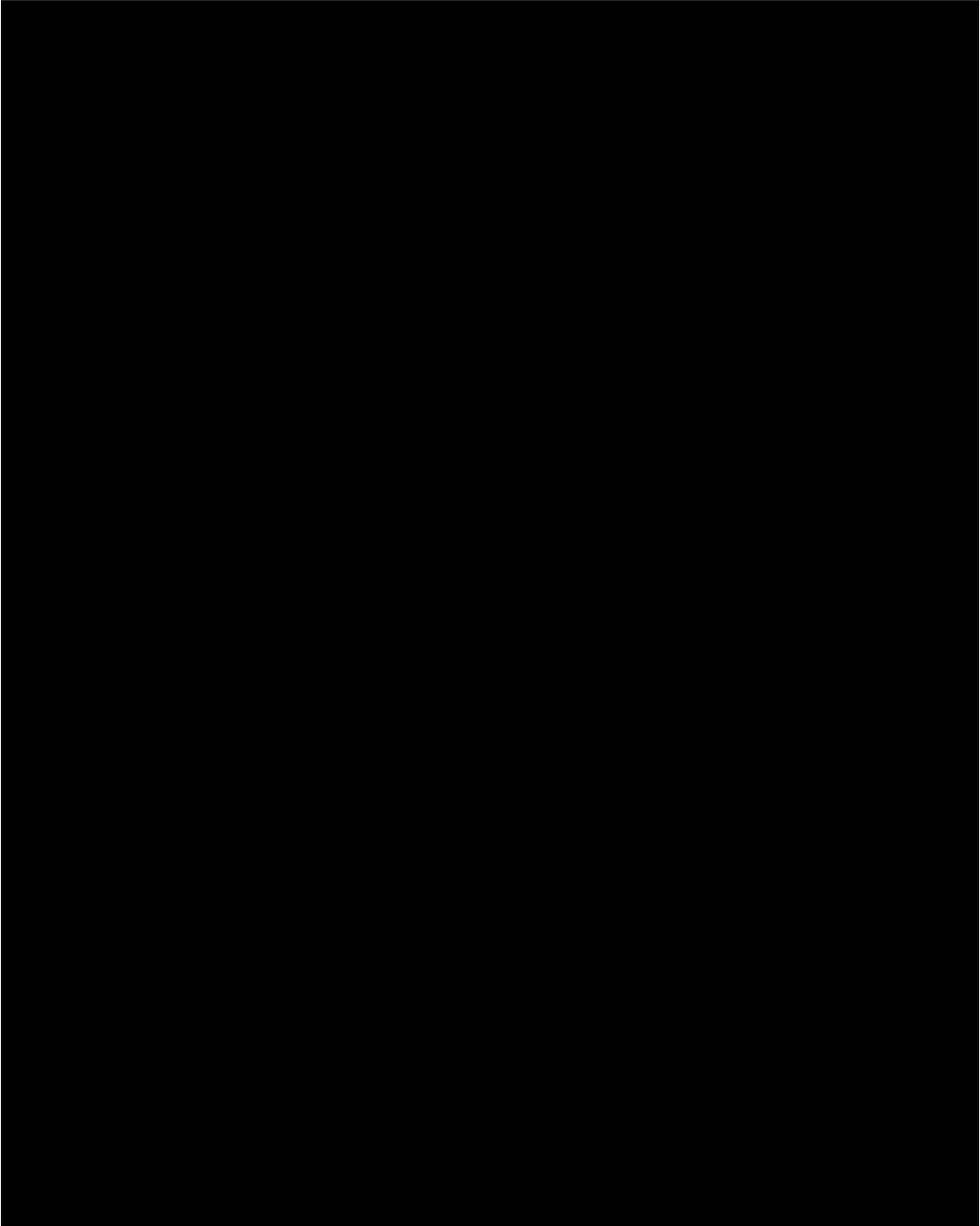
The contractor will provide the following at the appropriate times throughout the project:

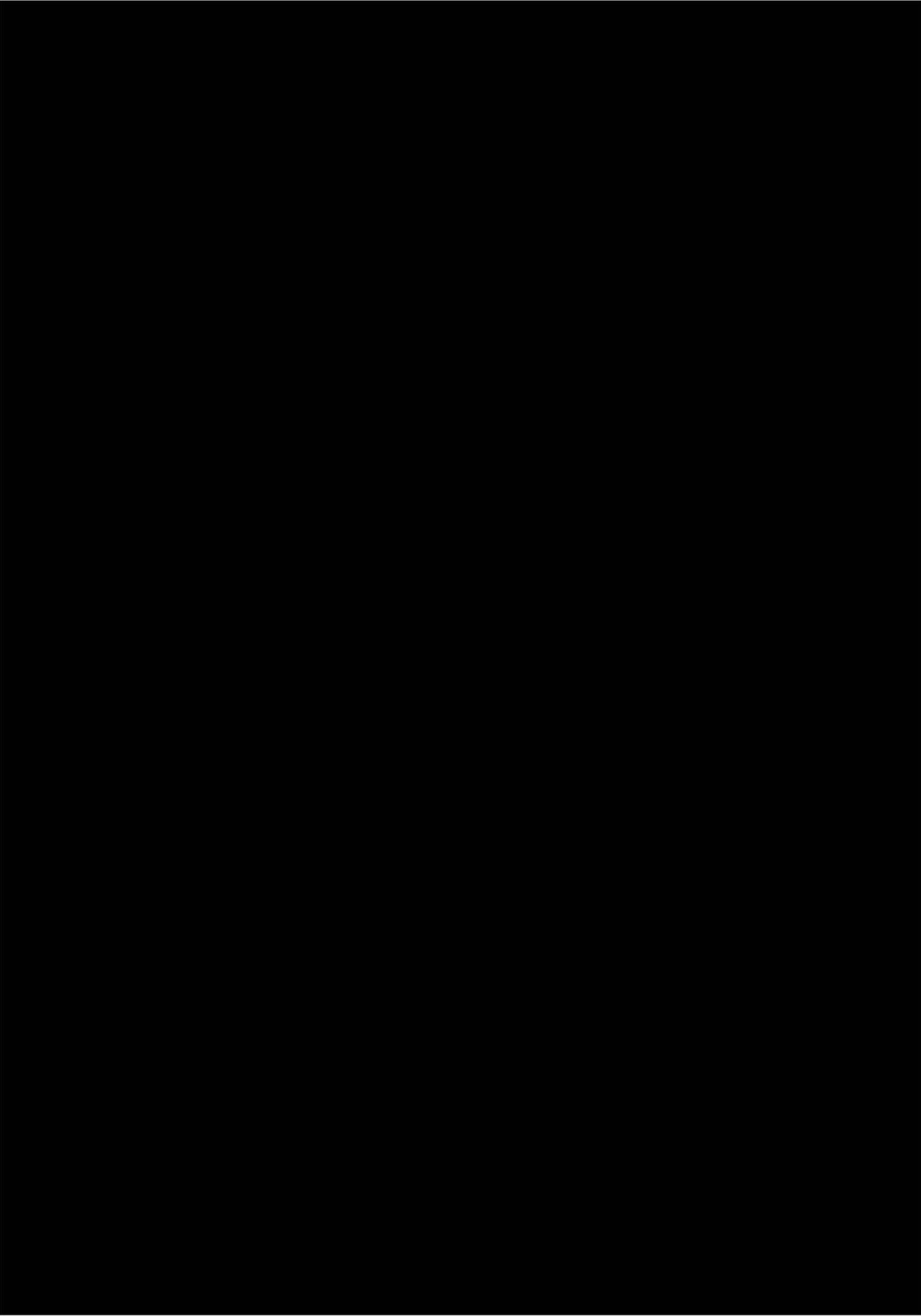
- A well-maintained Git repository of code containing the model and in-model documentation, and example scripts. To be handed over to BEIS upon project completion, with BEIS having continuous ongoing access to the in-progress code throughout the project via a Git hosting solution. The code should be accompanied by appropriate unit and end-to-end tests for assurance purposes, in accordance with the model QA plan to be agreed with BEIS.
- At least one non-domestic synthetic building stock sample compatible with the NBM (output of the code repository described above). The NBM synthetic stock is a weighted collection of building records (interpretable by the NBM simulation engine) that together represent the entire non-domestic building population.
- The completed model QA log in compliance with BEIS guidance and standards (see previous section), and associated logs of tests carried out on the model.

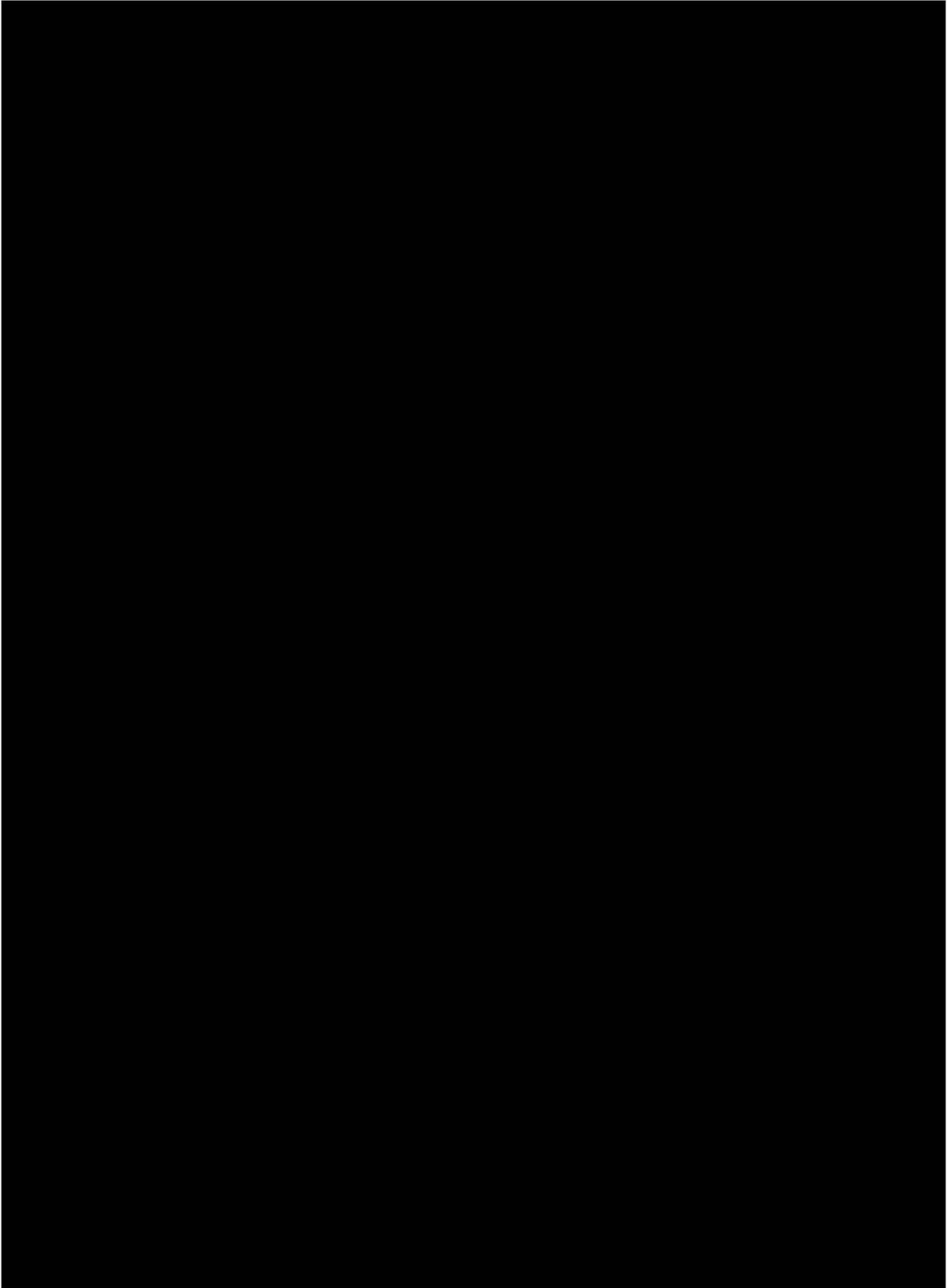
<sup>1</sup> <https://www.gov.uk/government/collections/quality-assurance-tools-and-guidance-in-decc>

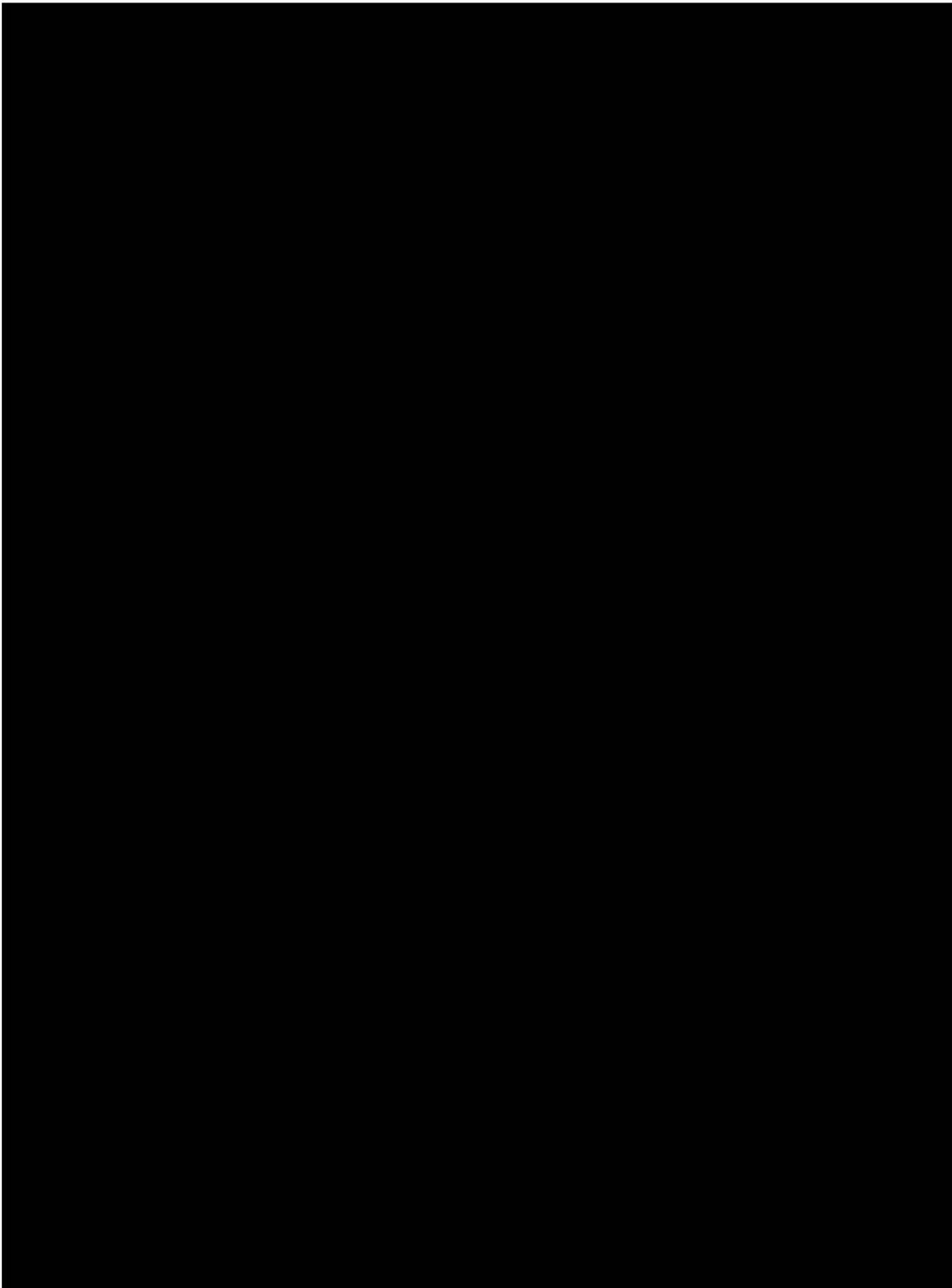
- A separate log of assumptions and modelling design choices (both general and specific to the context of the exact data used). This may form part of the Git repository if logs are appropriately linked to where choices have been implemented in code.
- Full technical documentation sufficient to allow BEIS to continue development of the methodology in-house. Precise format to be agreed with BEIS.
- Additional documentation explaining the approach for a general technically literate (analyst) audience, covering key success metrics, conclusions and implications for the applicability of the model to different types of problems
- Final presentation covering this high-level material (including slides), to be delivered at the end of the project
- Regular, frequent interim updates on progress and emerging findings, sufficient for the supervising analysts to understand, in detail, the technical decisions being made.

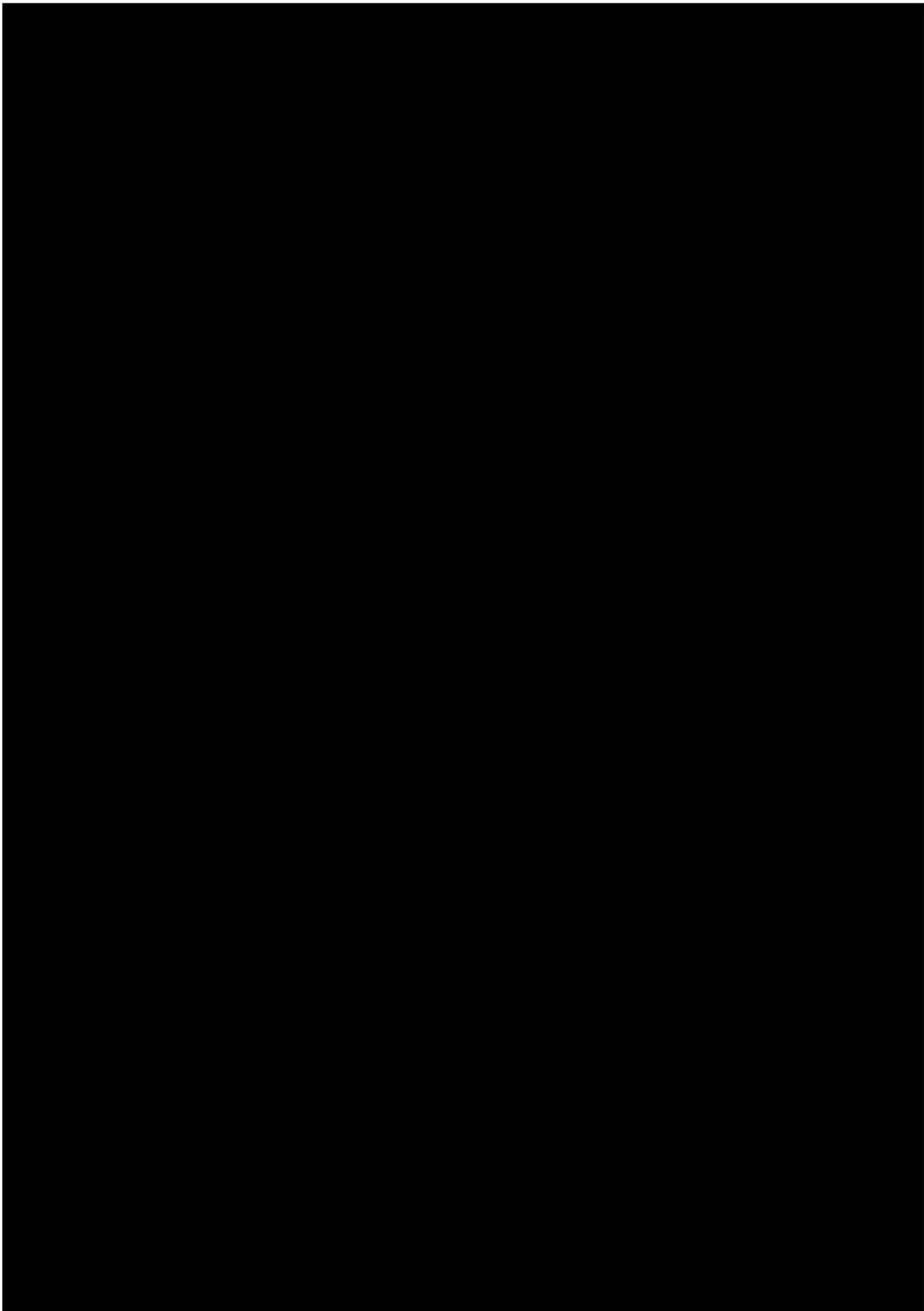
**ANNEX B**  
**Supplier Proposal**

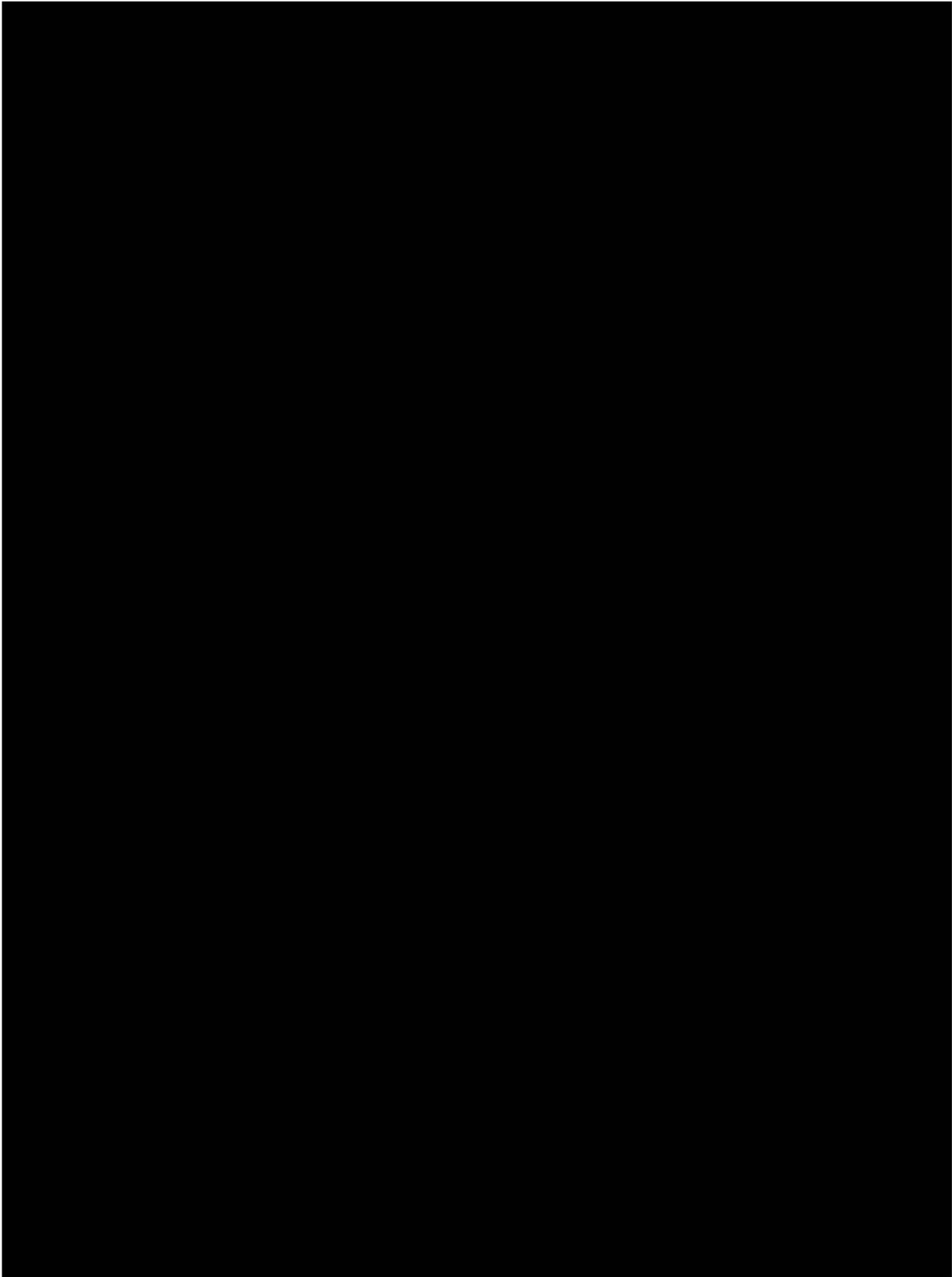


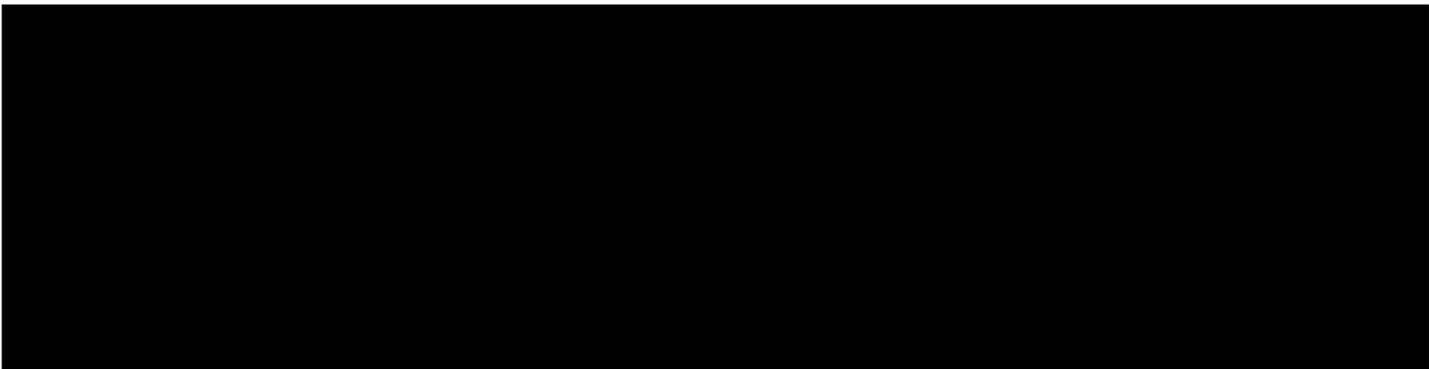




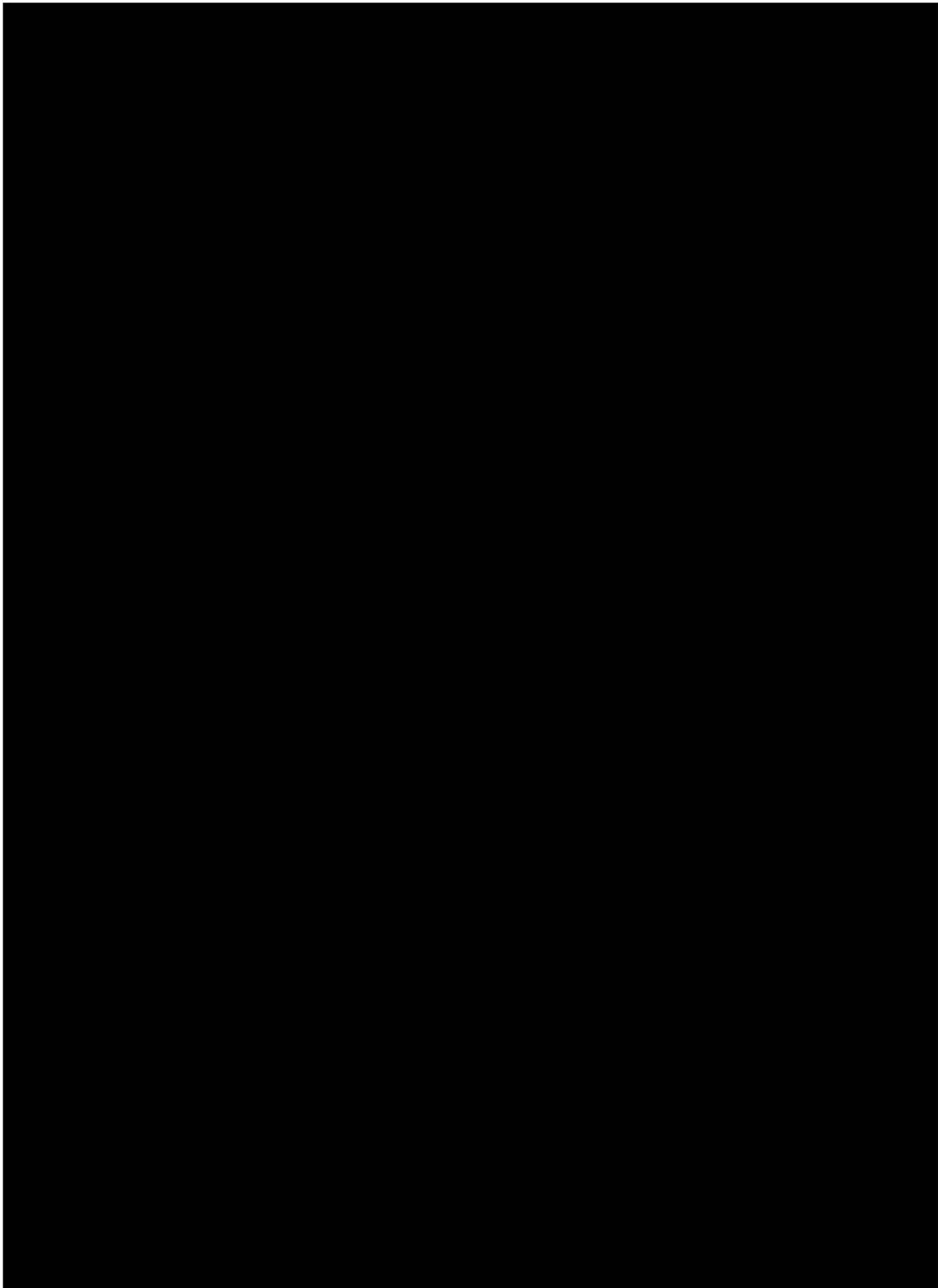


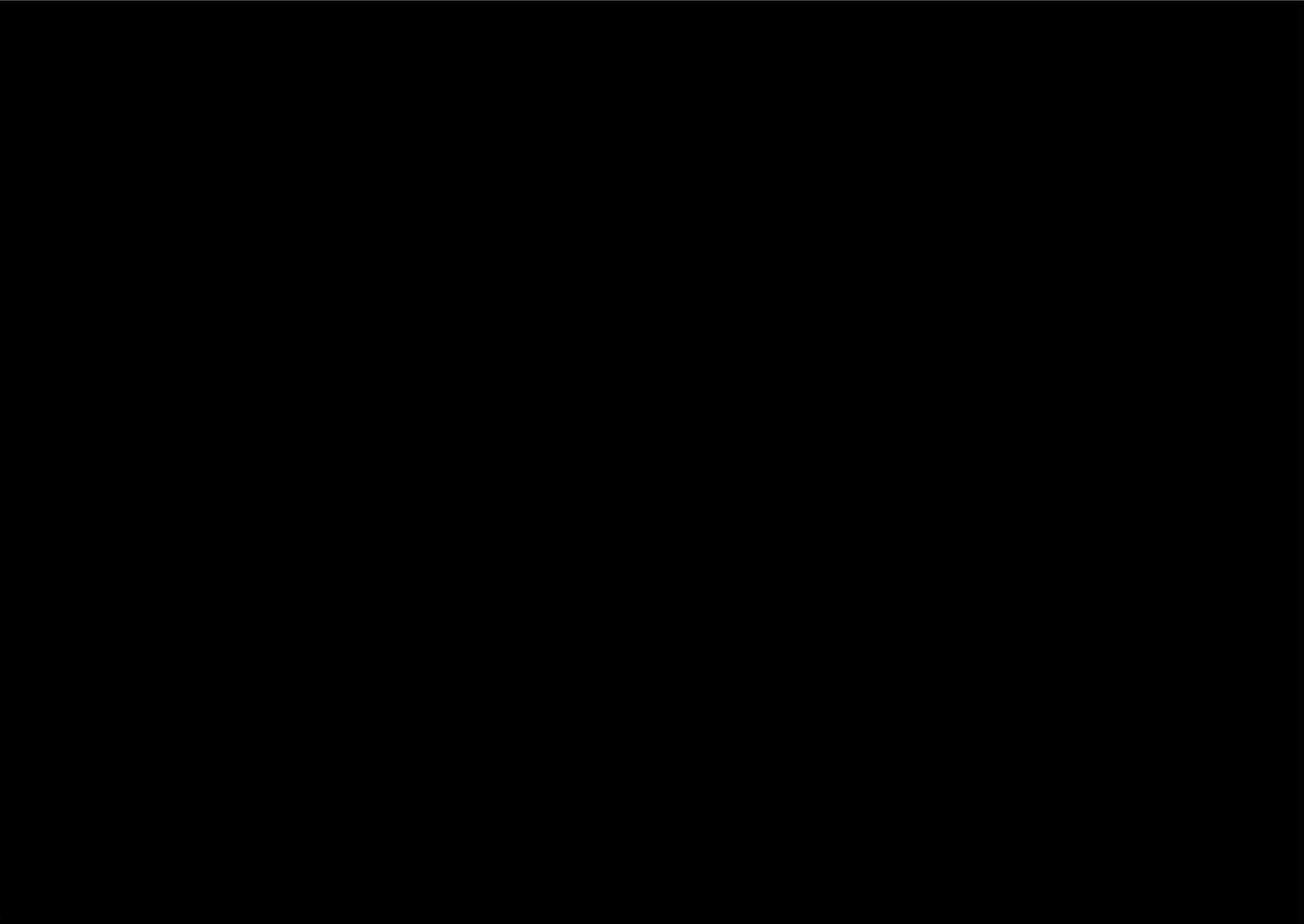


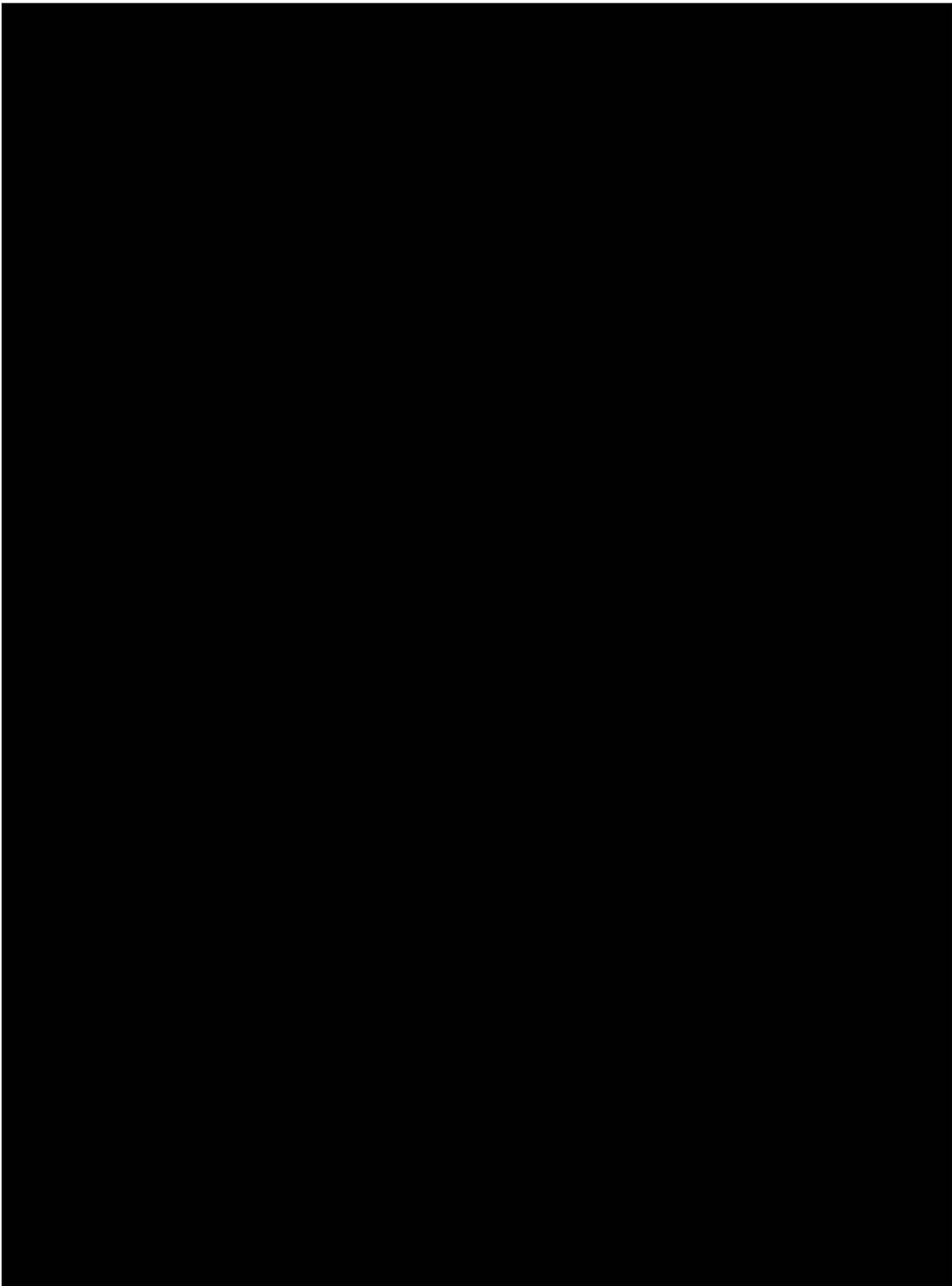


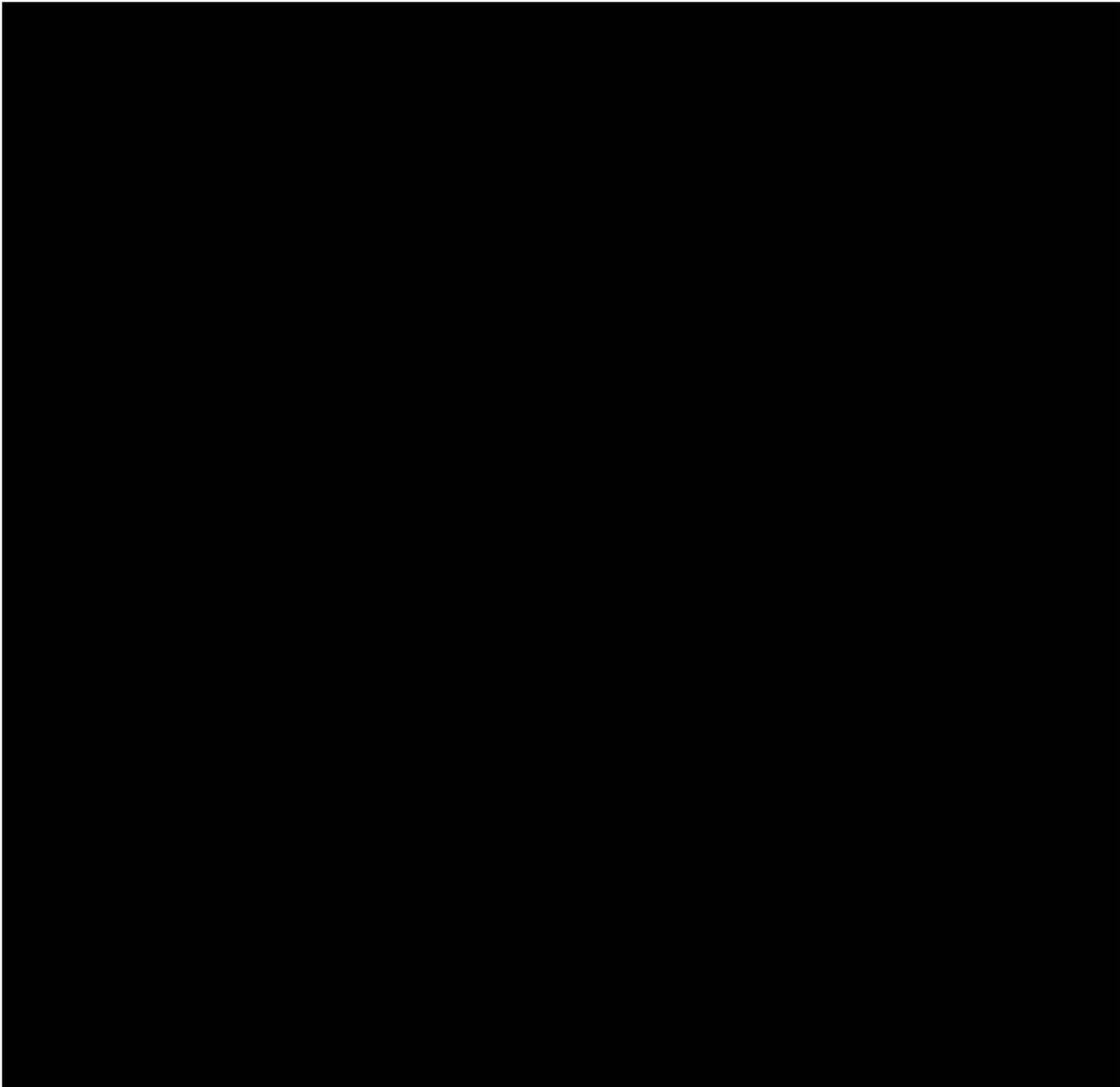












## Part 2: Contract Terms



Contract Terms v6.0