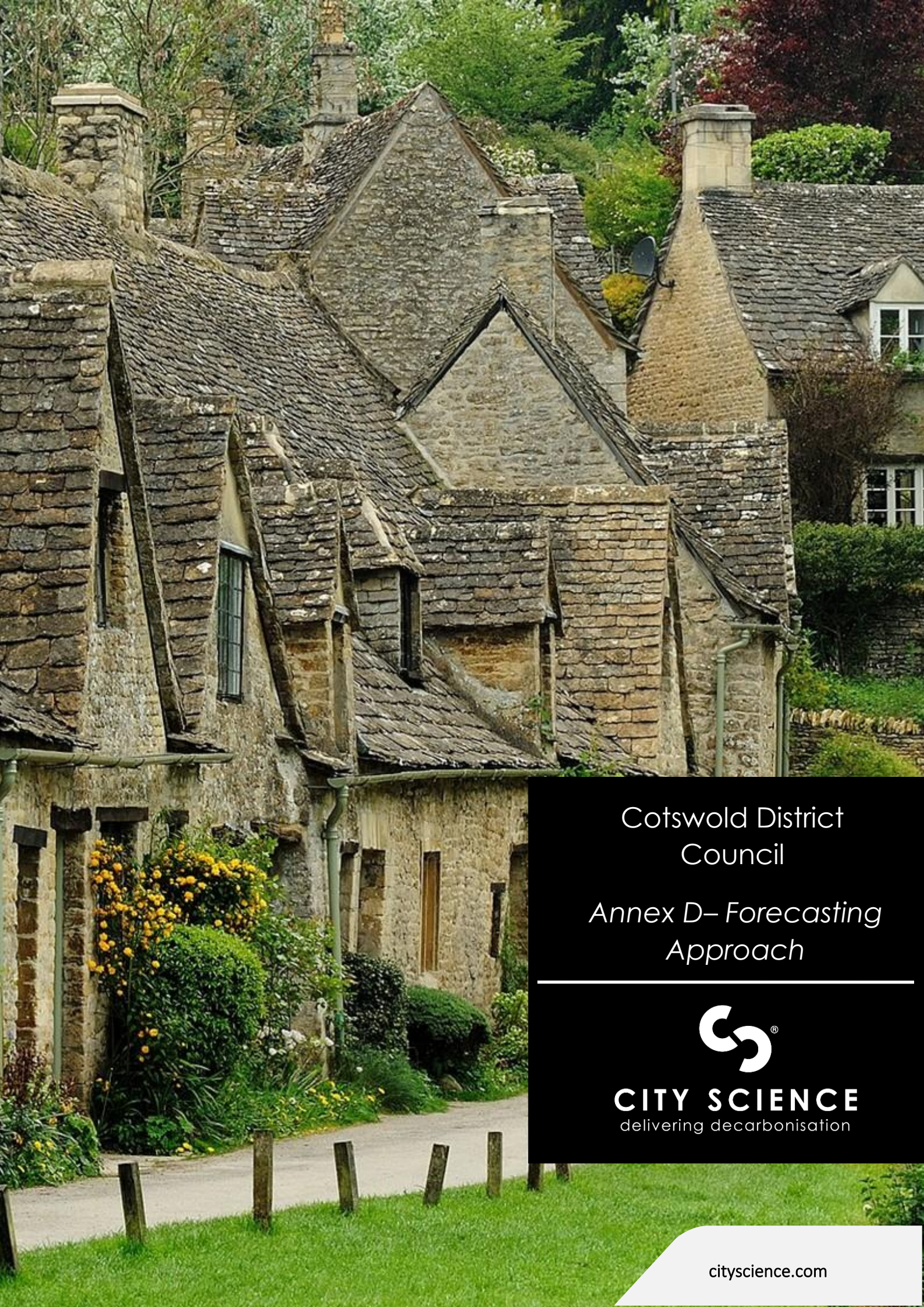

Cotswold District Council

Annex D– Forecasting Approach

CITY SCIENCE
delivering decarbonisation

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Contents

1 Introduction

1.1 Overview

City Science has been commissioned by Cotswold District Council (CDC) to support the development of the Regulation 19 transport evidence base for the Cotswold Local Plan. For this work, the Gloucestershire Countywide Multi-Modal Model (GC3M), owned by Gloucestershire County Council, has been identified as the most appropriate tool given its geographic coverage. The GC3M will be used to assess the impacts of Local Plan land use on the transport network and to test potential transport interventions to inform the strategic transport assessment. Figure 1-1 illustrates the extent of the GC3M and highlights the Cotswold District area within its boundary.

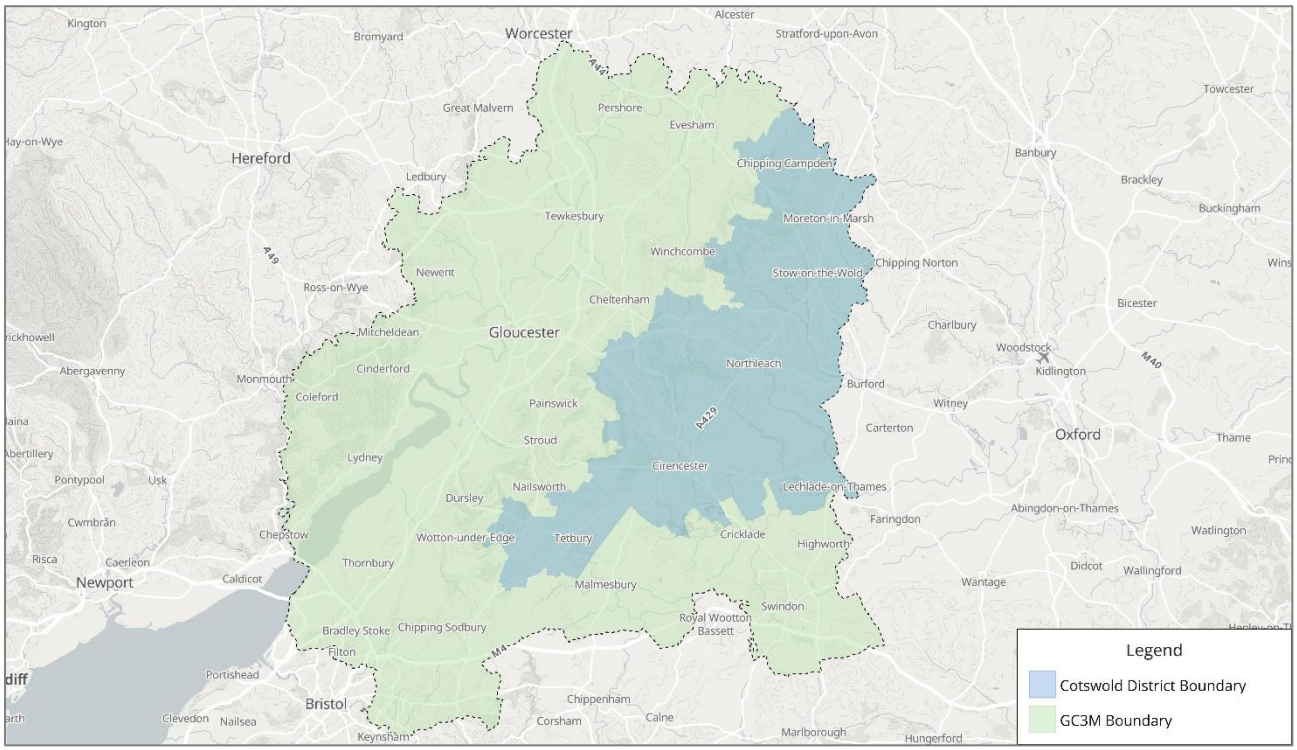

Figure 1-1: Extent of the GC3M and Cotswold District Boundary

1.2 Note Purpose

The purpose of this Technical Note is to set out the forecasting approach for the Cotswold local plan transport evidence base that will be undertaken by City Science. It has been prepared in advance of the forecasting work to give stakeholders a clear understanding of the planned methodology and to allow for any comments or agreed revisions before work begins.

This document provides an overview of the Gloucestershire County Multi-Modal Model (GC3M) to be used for the transport modelling of the Cotswold local plan transport evidence, with particular attention to forecasting considerations.

The note outlines how future-year modelling will be undertaken, covering:

- Selection of forecasting years
- Required model time periods
- Application of variable demand processes
- Preparation and use of an Uncertainty Log

- Development of a core scenario
- Development of a core minus scenario
- Development of the Preferred Spatial Option

1.3 Overview of Model

The GC3M is a strategic multi-modal model developed by AtkinsRéalis for Gloucestershire County Council. It is focused on the six Local Authority areas making up Gloucestershire (Cheltenham, Gloucester, Stroud, Cotswolds, Tewkesbury and the Forest of Dean). The model includes highway assignment in SATURN, and public transport and Variable Demand Models (VDMs) in VISUM.

1.3.1 GC3M Structure

The GC3M is a traditional four-stage model (trip generation, trip distribution, mode choice and assignment). Trip productions and attractions per model zone are segmented by trip purpose and person type. All demand modelling is conducted for a 24-hour neutral weekday

1.3.2 Demand Model

The VDM is a 24-hour logit-based model that determines both mode and destination choice. It does not include a time-period choice; instead, trips are allocated to time periods using fixed factors. Freight is represented by an origin–destination matrix in the base year, which can be growthed for future scenario years. The demand matrix captures all trips across all modes, including active travel modes.

1.3.3 Model Scenarios

The current base year of the model is 2019 and represents a neutral weekday (Monday to Thursday, 9th September to 17th October 2019). Future year forecast years have been built for 2031, 2041, 2046 and 2061. A present-day validation exercise has been undertaken to compare a November 2024 forecast (present) year against 2024 observed link counts and journey times.

1.3.4 Highways Network

Within the Area of Detailed Modelling and the rest of the Fully Modelled Area, the network and junctions are modelled in detail (e.g. simulation coding), including the representation of junction delay. Within external areas, links are coded using fixed speeds.

1.3.5 Public Transport Network

The public transport network consists of rail, bus and rail-based Park & Ride. The public transport model is timetable based and consists of a mix of services manually encoded and imported from General Transit Feed Specification datasets.

1.3.6 Modelled Time Periods

The GC3M highway model represents an average hour for the following time periods:

- AM peak hour - 08:00 to 09:00
- Inter peak average hour - 10:00 to 16:00
- PM peak hour - 17:00 to 18:00

The GC3M public transport model represents an average hour for the following time periods:

- AM average hour - 07:00 to 10:00
- Inter peak average hour - 10:00 to 16:00

PM average hour - 16:00 to 19:00

2 Forecasting Approach

2.1 Forecast Years

Future forecast year has been agreed with the Cotswold authorities and the Transport Working Group (TWG) prior to the commencement of forecasting work. The agreed forecast year is 2043, which represents the end of the plan period which is 15 years after assumed adoption in 2027.

The GC3M model already includes 2031, 2041, and 2046, so a new intermediate year will need to be created. Using 2043 has the added advantage of being consistent with the transport modelling forecast year for the Gloucester, Cheltenham and Tewkesbury Strategic Local Plan (SLP).

2.2 Model Time Periods

The main purpose of the future year modelling is to identify locations of stress within the network with the addition of local plan demand. As these will be identified at peak periods where there is additional demand on the network, this work will therefore make use of the GC3M modelled peak periods, namely:

- Highway
  - AM peak hour - 08:00 to 09:00
  - PM peak hour - 17:00 to 18:00
- Public Transport
  - AM average hour - 07:00 to 10:00
  - PM average hour - 16:00 to 19:00

2.3 Use of Variable Demand Modelling

The GC3M includes a Variable Demand Model (VDM) that assigns trip generation outputs to trip distribution and mode choice based on generalised travel costs. This allows both distribution and mode choice to adjust with forecast demand as future changes in demand or network conditions affect costs. For example, the VDM captures shifts in destination or mode to avoid congestion and enables reporting on changes in walking and cycling demand (though it does not assign routes for active modes).

The updated 2024 GC3M provides the baseline for assessing forecast Cotswold development scenarios. As such the 2024 demand matrix alterations and supply side updates will be incorporated into the forecast year models, which are currently developed from a 2019 GC3M VDM. On this basis, the core scenario VDM runs will be undertaken from the GC3M Foundation Case Scenario, as follows:

- GC3M Trip End Processing 2024-2043:
  - Derived from the difference between 2019-2043 and 2019-2024 to extract out the growth accounted for from the post-covid 2024 present year validation
  - Linear interpolation will be adopted if required to calculate growth between the available uncertainty log trajectory data and the available CTripEnd NTEM data sets (2021-2026, 2031-2036, 2041-2046)
- GC3M VDM run undertaken utilising:
  - GC3M Trip End Processing 2019-2043.

- Updated VDM parameter for 2043 (e.g. VOT and VOC)- based on GC3M spreadsheet "GC3M_Model Parameters_v0.9".
- NRTP22 growth - interpolated from the existing foundation case models.
- Fare *.tra file updated to represent real term growth to 2043- interpolated from the existing foundation case model.
- In summary the GC3M structure will remain consistent with the foundation case 2041 model with updates included for the change in forecast year (e.g. + 2 years) as well as the latest Uncertainty Log.

- Post VDM Adjustment:
  - Matrix growth derived from the GC3M VDM will then be applied to the 2024 models (AM/IP/PM) at a zonal level, using interpolation to account for the proportion of growth from 2024-2043 derived from the GC3M Trip End Processing and UL data.
  - Assignment undertaken utilising 2043 highway and PT networks - including 2024 present year updates and 2043 future changes.
  - Spatial strategies and sensitivities can then be tested incrementally from the 2043 core scenario.

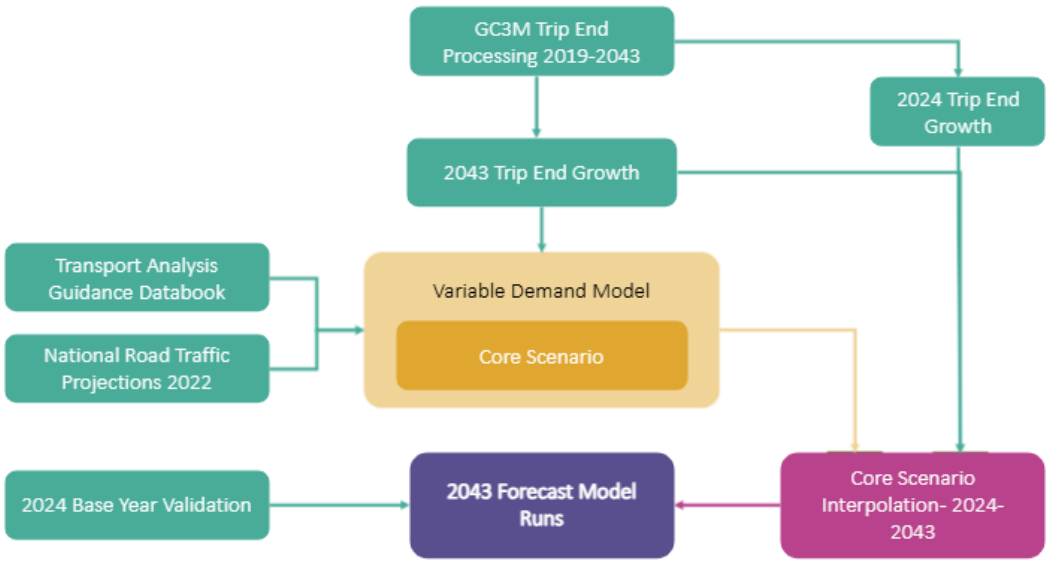

Figure 2-1: GC3M VDM Forecasting Methodology Overview

2.4 Forecasting Overview

Figure 2-2 below provides an overview of the Cotswold forecasting framework. These forecasts will form the foundation for the committed development and Cotswold spatial scenario trip generation, distribution, and modal split analysis.

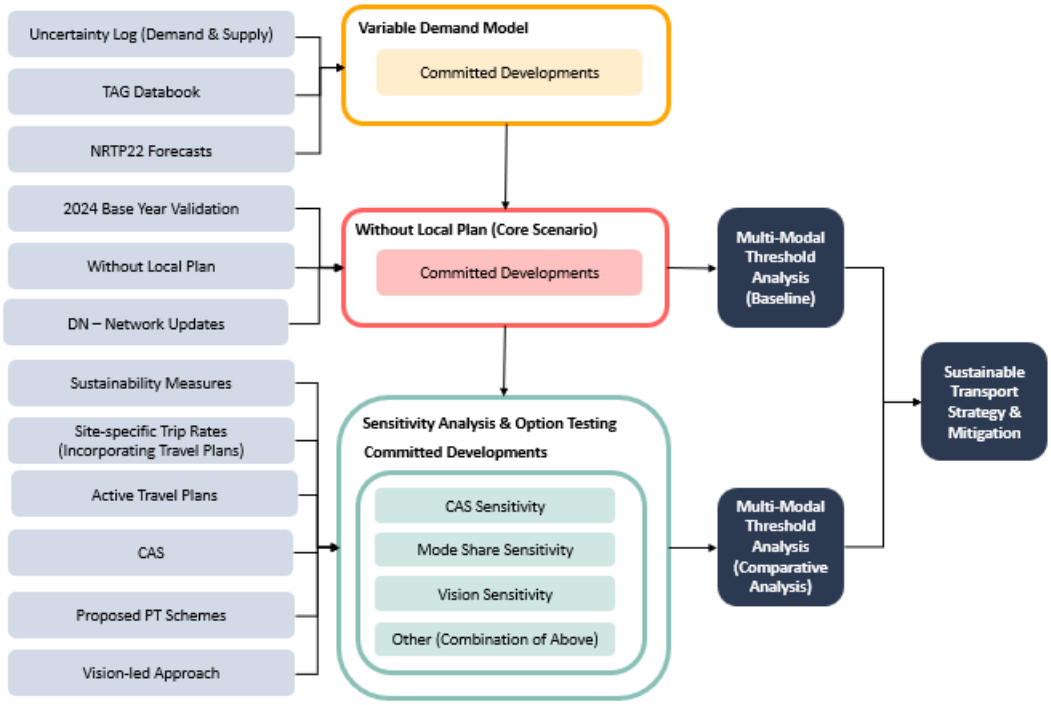

Figure 2-2: Forecasting Framework Overview

The development of the Without Local Plan (core) Scenario will be refined to incorporate assumptions that reflect local travel behaviour, particularly related to active travel and public transport.

These Without Local Plan (core) scenario model runs (see Chapter 3 for further details) will then feed into the scenario and sensitivity testing process. This will allow for testing some of the CAS, local uncertainty, Vision-led objectives, and non-core public transport schemes.

3 Without Local Plan Forecast Scenarios

This Chapter describes the approach taken to produce the Without Local Plan forecasts.

3.1 Uncertainty Log

The GC3M Uncertainty Log (version 2) has been prepared with input from the Local Authorities and AtkinsRealis to identify developments and transport schemes for inclusion in the Without Local Plan forecasts. In line with DfT TAG Unit M4, the core scenario reflects firm, funded policy commitments and published plans.

It includes all approved planning applications for residential and non-residential sites, detailing location (for zonal allocation), development quanta (dwellings or jobs), and predicted opening year. Where job numbers are unavailable, estimates are based on gross floor area and agreed look-up tables (e.g., Homes & Communities Agency). Large developments may be phased, and each entry is assigned a delivery likelihood rating (see Table 3-1 from DfT TAG Unit M4).

Probability of the Input	Status	Core Scenario Assumption
Near Certain: The outcome will happen or there is a high probability that it will happen.	• Intent announced by proponent to regulatory agencies. • Approved development proposals. • Projects under construction.	This should form part of the core scenario
More Than Likely: The outcome is likely to happen but there is some uncertainty.	• Submission of planning or consent application imminent. • Development application within the consent process.	This could form part of the core scenario
Reasonably Foreseeable: The outcome may happen, but there is significant uncertainty	• Identified within a development plan. • Not directly associated with the transport strategy/scheme but may occur if the strategy/scheme is implemented. • Development conditional upon the transport strategy/scheme proceeding. • A committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.	These should be excluded from the core scenario but may form part of the alternative scenarios
Hypothetical (H): There is considerable uncertainty whether the outcome will ever happen.	• Conjecture based upon currently available information. • Discussed on a conceptual basis. • One of several possible inputs in an initial consultation process. • A policy aspiration.	These should be excluded from the core scenario but may form part of the alternative scenarios

Table 3-1:Classification of Future Inputs (from DfT TAG Unit M4)

Uncertainty levels are influenced by factors such as planning status, political or commercial risks, policy impacts, and dependencies on other developments. Longer-term schemes typically carry greater uncertainty, so care is needed to avoid optimism bias. Determining these levels requires input from Local Authorities with local knowledge and experience.

In addition to demand (housing and employment developments), the Uncertainty Log records potential supply changes, including planned highway and public transport schemes. Like demand schemes, these are assigned a likelihood rating. Completed schemes are listed in Table 3-2, while Tables 3-3 to 3-6 summarise near-certain and more-likely highway, active mode, and public transport schemes for 2024–2043.

Highway Scheme Name
Elmbridge Transport Scheme, Gloucester
A417/A40 Barnwood Link
A40 Over Roundabout improvement (phase 2), Gloucester
Junction improvement A40 Longford roundabout, Gloucester
A38 Cross Key roundabout
West Cheltenham Transport Improvement P1 Arle Court
West Cheltenham Transport Improvement P2 (J11)
West Cheltenham Transport Improvement P3 Arle Court
West Cheltenham Transport Improvement P4 Arle Court
Arle Court Transport Hub (access improvements for all vehicles)
Twigworth Development Access (new roundabout on A38, and new roundabout within site)
Perrybrook Development Access (new roundabout on Court Road for site access)
Fiddington development A46/A438 mitigation
Innsworth Development Roundabout Improvement (new roundabout on A40)
Junction improvement A429 Cherry Tree junction, Cirencester
A46 / Kidnappers Lane, Cheltenham
M5 Gloucester Motorway Services
Land at Barnwood Link Road (Centre Severn – Barnwood)
Staverton crossroads junction (B4063 / B4634), Staverton
Highway improvement A435 corridor improvement, Bishops Cleeve
Highway improvement Thames Street / High Street, Lechlade on Thames
Junction improvement Highfield Hill including traffic calming, Lydney
Land west of Farm Lane, Shurdington. Site Access Junctions.
Parcel 3745, Land At Pirton Fields, Churchdown (new priority access junction)
Land At North Road West/Grovefield Way
M4 J16
M49 Avonmouth Junction
Land at Quedgeley Trading Estate
SA3 Land northeast of Draycott Cam - 3x site access junctions on Box Road, 1x site access junction on A4135

SA2 Land west of Stonehouse, site link road, and 3x new access points into development site

Table 3-2: Completed Highway Schemes (2019-2024)

Public Transport Scheme Name
Gloucester Transport Hub (includes new road layout, new junction access on Station Road, Gloucester, restricted access for Bruton Way)
Arle Court Bus Priority (Elmbridge Transport Scheme, Gloucester)
Cheltenham Transport Plan (new bus lanes)

Table 3-3: Completed Public Transport Schemes (2019-2024)

Highway Scheme Name	Probability
M5 J10 'all movements' access (including link road into Cyber Park)	More Than Likely
A38/A40 Coombe Hill Junction improvements	More Than Likely
A435 Cheltenham to Bishops Cleeve Cycleway Improvement Works, from Prince of Wales Stadium to Bishops Cleeve	More Than Likely
Gloucester to Cheltenham Cycle Route	More Than Likely
North West Cheltenham	Near Certain
West Cheltenham	Near Certain
Land At North Road West/Grovefield Way	Near Certain
Hunts Grove & Hunts Grove Extension - access points	Near Certain /More Than Likely
Land at Chesterton Farm, Cranhams Lane, GL7 6JP, Cirencester	Near Certain
A417 Missing Link	Near Certain
A46/Cheltenham Road Roundabout	Near Certain

Table 3-4: Future Core Scenario Highway Schemes (2024-2043)

Active Travel Scheme Name	UL Score
A38/A40 Coombe Hill Junction improvements	More Than Likely
A430 Llanthony Rd and St Ann Way (Southwest bypass) improvement, Gloucester)	Near Certain
Levelling Up Fund - Gloucestershire Sustainable Travel Corridor - 'Cycle Spine'	Near Certain / More Than Likely
Cheltenham Spa Railway Station Enhancements (includes cycle/pedestrian access onto A40 Landsdowne Road)	More Than Likely

Table 3-5: Future Core Scenario Active Mode Schemes (2024-2043)

Public Transport Scheme Name
A potential new station at Stonehouse Bristol Rd by Stroud District Council and Stonehouse Town Council
A new station just north of Standish Junction
A possible new bay platform at Cheltenham station
Extending the freight loop at Ashchurch for Tewkesbury south to create a third platform on the station

Midlands Rail Hub

Table 3-6: Future Potential Public Transport Schemes (2024-2043)

Table 3-7 shows the total number of dwellings per district as taken from the Uncertainty Log *(250911_GC3M_UncertaintyLogUpdate_v2.0).*

District	Total dwellings post 2019
Cheltenham	8,665
Cotswold	3,437
Forest of Dean	7,061
Gloucester	3,712
Stroud	16,257
Tewkesbury	15,147
Total	54,279

Table 3-7: Total dwellings post 2019 by district

The construction of an agreed and reliable Uncertainty Log is a key component of the future year modelling. Therefore, the final Uncertainty Log will be discussed in forthcoming TWG meetings.

3.2 Without Local Plan (Core) Scenario

A Without Local Plan core scenario will be built to test the central assumptions for future demand; it provides a common comparator against which to assess all projects and options against. Therefore, it is critical that it is built on published plans, reflects "firm and funded" government policy commitments, uses central projections of key demand drivers, is unbiased, is coherent and self-consistent, and is realistic and plausible.

The core scenario is not necessarily the most desirable scenario. It is one that reflects historic trends with regards to drivers of demand. It does not introduce fundamental shifts in the drivers of demand, or major technological, environmental or economic changes.

For the core scenario, growth will be unconstrained. For the purposes of the core scenario, those entries in the Uncertainty Log classed as "near certain" or "more than likely" will be used. This will apply to both the future demand and transport schemes identified in the Uncertainty Log. Additional trips will be calculated using the TEMPro Alternative Scenario functionality. The core scenario will use standard assumptions on growth and other trends, so will use national assumptions from the TAG Data Book regarding value of time, forecast fuel consumption and forecast non-fuel costs.

Heavy Good Vehicle demand will likely be uplifted from the 2019 base year to the proposed future year (2043) using the DfT National Road Traffic Projections 2022.

3.3 Alternative Scenarios

Whilst the Without Local Plan (core) Scenario is intended to form a sensible, consistent "common comparator", it is acknowledged that there are often significant and hard to quantify uncertainties associated with forecasting. If these uncertainties play out in practice, the forecasting should be able to show the viability of proposed mitigation. It is therefore important not to focus solely on the core scenario but to consider the wider "what if" scenarios.

The CAS are a set of seven pre-defined, cross-modal scenarios set out in DfT's TAG, used to explore national levels of uncertainties in transport forecasting and appraisal. These scenarios are designed to provide more depth than the standard High and Low Growth scenarios, and they consider factors like economic and demographic growth, regional imbalances, technological change and decarbonisation. The DfT's TAG Uncertainty Toolkit provides a description of each CAS, whilst the CAS Databook provides detailed assumptions and inputs for modelling each scenario. Each CAS alters various demand 'levers' within the model including trip generation (via TEMPro datasets), vehicle operating cost, value of time and car occupancy parameters. We recommend applying the specific CAS scenarios listed in Table 3-8.

Scenario	Narrative "This scenario captures a future where…."	Core Features or Components
High Economy	… productivity growth returns to its long-term trend, and people become richer than we currently expect. Migration, and population in general, increases above official forecasts.	**GDP:** 10% higher in 2050 relative to core assumptions **Population** - GB total reaches 77.7m by 2050 **Employment** - 12% higher in 2050 relative to core assumptions
Low Economy	… productivity growth fails to return to historic levels and inwards migration is subdued, causing low levels of total population growth.	**GDP:** 31% lower in 2050 relative to core assumptions Population - GB total reaches 64.6m by 2050 **Employment:** 7% lower in 2050 relative to core assumptions
Regional	…people leave London, the South East and the East of England in search of more affordable housing. As a result, there is lower employment and population growth in these regions relative to the rest of the country. Areas outside of the South increase their relative level of competitiveness through an increase in productivity.	**Population/ Households/ Employment:** Core redistributed, so that regions outside London, the South East and the East of England grow at least the growth rate of the whole country, if not already higher. London, the South East and the East of England are then adjusted downwards, so that the whole country's growth rate is maintained.
Behavioural Change	… people embrace new ways of working, shopping and travelling. Important behavioural trends which have emerged in recent years accelerate, in part because of the Covid-19 pandemic, which include: changes in the travel behaviour of young people; increased flexible working; and increased online shopping.	**Trip Rates:** Extrapolation of existing trip rate trends by purpose, meaning overall trips continue to fall, although some purposes do increase **Licence Holding:** Reduced rates among younger cohorts throughout forecast period Light Goods Vehicles, vans trips - increased, reflecting reductions in shopping trips and an increase in deliveries from online shopping.

Technology	.. road travel becomes far more attractive and accessible to road users because of a high take-up of connected autonomous vehicles (CAVs), which enter the fleet in the 2020s and make up to 50% of it by 2047.	**Trip Rates:** Elderly trips rates increase after 2031 **Licence Holding:** Rates increase after 2031 to over 92% by 2061, reflecting improved accessibility due to availability of CAVs **Electric Vehicles:** High uptake Value of time – perceived time cost of travel falls **Car Occupancy:** Reduced to account for zero occupancy (empty running) trips.
Vehicle-led Decarbonisation	… there is a high take up of electric and zero-emission vehicles (ZEVs). Tailpipe emissions fall. There is no intervention by government to increase electric vehicle costs, resulting in increasing road traffic.	**Electric Vehicles:** High uptake for both cars and freight, with no adjustment made to current costs **Public transport:** reduced as electric vehicles have a cost advantage
Mode-balanced Decarbonisation	… there is a high take up of electric and zero-emission vehicles (ZEVs). Tailpipe emissions fall. An unspecified intervention leads to electric vehicle costs being equalised with petrol and diesel costs, so that public transport modal share is maintained.	**Electric Vehicles:** High uptake for both cars and freight, with running costs (fuel and non-fuel) equalised to internal combustion engine vehicles. **PT:** Modal share higher than the core.

Table 3-8: Description of Common Analytical Scenario (Source TAG Uncertainty Toolkit)

A proportionate approach will be taken to sensitivity testing of national uncertainty - focusing on scenarios most relevant to the Local Plan context. While TAG is primarily designed for scheme appraisal and central government business cases, it is recognised that applying a forecast range can add value to Local Plan assessments. Of the CAS, those with the most relevance include Behavioural Change (e.g. increased flexible working and online shopping), and the two Decarbonisation Scenarios, which assess variations in electric vehicle uptake and the associated impact on public transport use. In line with, the core scenario VDM runs, CAS scenarios will be derived as follows:

- GC3M Trip End Processing 2024-2033/43:
  - CTripEnd NTEM CAS data sets will be adopted as an alternative data set to derive 2024, 2033 and 2043 sensitivity forecasts.
- GC3M VDM run undertaken utilising:
  - The core scenario runs with adjusted trip end forecasts, CAS NRTP22 growth assumptions and where required adjusted TAG parameters.
- Post VDM Adjustment:

- The relative change between NTEM core and CAS forecasts will be assessed and additional constraint factors will be applied to achieve the associated relative change to trip ends for AM, IP, PM modelled periods.

3.4 List of Scenarios (Without Local Plan)

Table 3-9 below outlines the proposed full list of future year scenarios without the local plan and the description and explanation of their purpose.

Scenario Name	Type	Description / Purpose
Without Local Plan (2033, 2043)	Core	Future Year comparator scenario as per standard DfT best practice including committed schemes and developments. This will be mot be constrained to the National Trip End Model. See section 3.2.
Behavioural Change (2043)	Sensitivity Test	To reflect national uncertainty regarding post covid trends regarding home working and shopping to provide a forecasting range with the core scenario. See section 3.3.

Table 3-9: Table of Future Year Scenarios without Local Plan

4 Preferred Spatial Option Forecasting Approach

4.1 Overview & Methodology

Chapters 2 and 3 outline the methodology for the Without Local Plan Core Scenario. The outputs from this model run will then feed into the Preferred Spatial Option testing, as shown in Figure 4-1.

As the Preferred Spatial Option includes a defined level of committed development, a Core Minus Scenario has been developed to isolate and assess the transport impacts of the proposed distribution of growth across the Cotswold area. To achieve this, the proposed Preferred Spatial Option allocations are applied to a 2043 Core Minus demand matrix. This 2043 Core Minus Scenario captures all forecasted growth between 2024 and 2043 except development within the study area. It includes:

- **Background Growth:** Across the external area and the wider Gloucestershire area will be derived from the 2043 Core scenario model
- **Cotswold Development Growth**: Will be set back to 2024 base year demand levels.

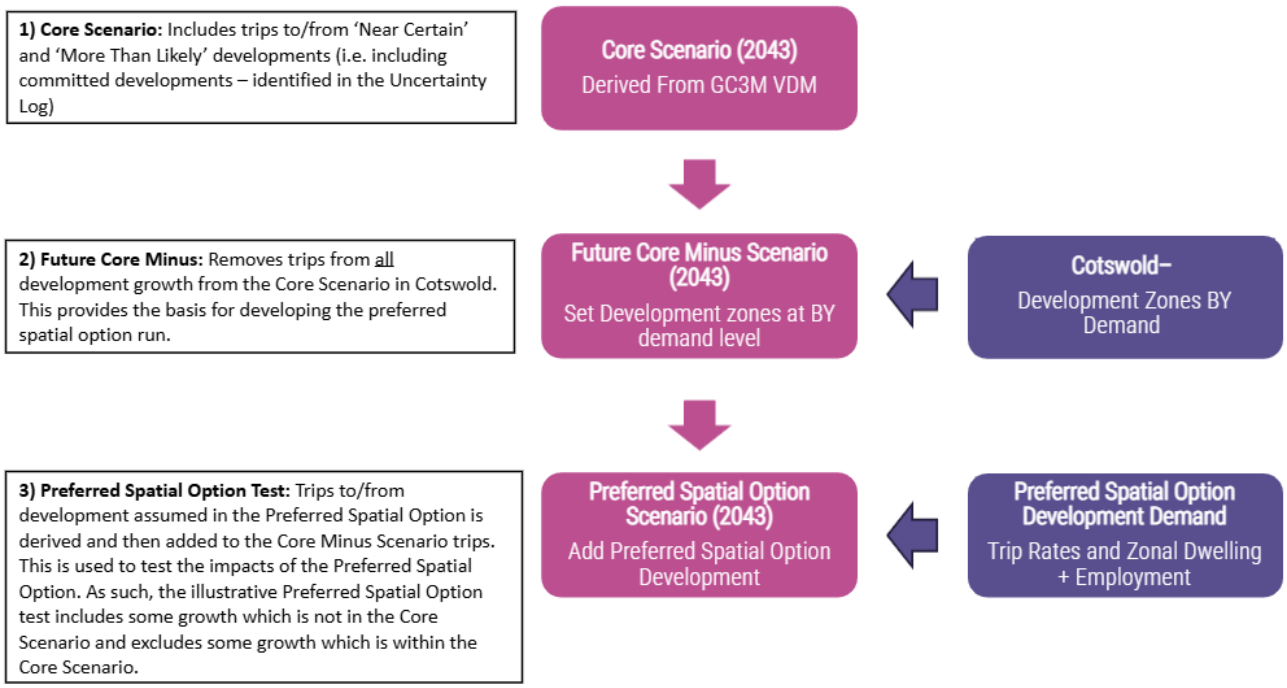

Figure 4-1: GC3M Preferred Spatial Option Forecasting Methodology Overview

Preferred Spatial Option developments will then be forecasted using site-specific trip rates to produce a Local Plan development matrix. The demand distributions for these sites will be taken from existing zones and adjacent zones from the Core Scenario model. Table 4-1 provides a summary of the Core Scenario, Future Core Minus and Preferred Spatial Option forecast model specifications.

Scenario	Background Growth	Cotswold COMMITTED development Growth	Local Plan Sites
Core (without local plan)	Yes	Yes, derived from GC3M UL	No
Future Core Minus	Yes	No	No
Preferred Spatial Option (PSO)	Yes	Yes	Yes, illustrative

Table 4-1: Future year growth specifications - Core Scenario, Future Core Minus and Preferred Spatial Option

5 Conclusion

5.1 Conclusion

This Technical Note describes the GC3M model, with a focus on issues relating to forecasting, and outlines the key aspects of the Without Local Plan forecast modelling process for the Transport Evidence Base for the Cotswold. It also highlights the areas that will require confirmation before modelling commences.