

Major Enhancements evaluation approach

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1. Introduction

1.1. Introduction to Major Enhancements

We undertake evaluation of all our Major Enhancements. These are currently defined as all the schemes individually named in the Road Investment Strategies. We have run this programme of evaluation since 2002 and we are able to undertake overview analysis that covers the previous Programme of Major Projects and the TPI (Targeted Programme of Improvements).

1.2. Introduction to POPE – post-opening project evaluation

Evaluation is the systematic assessment of the design, implementation, and/or outcomes of an intervention. It involves understanding how an intervention is being, or has been, implemented and what effects it has, for whom and why. It identifies what can be improved and seeks to estimate the overall impacts and cost-effectiveness of an intervention.

POPE is National Highways application of this. We revisit the major enhancements after they have opened to understand the outturn impacts and to estimate the value for money they represented.

1.3. Why evaluate major enhancements?

At each key decision stage throughout the planning process, our projects are subject to rigorous appraisal¹ to provide justification for their continued development. All the expected impacts of the project, both positive and negative, are recorded in a Benefits Register.² They are also summarised in an Appraisal Summary Table (AST)³ which is presented in the project's business case to allow judgements to be made about the overall value for money of the proposed investment.

We undertake POPE to compare the expected impacts of a project with the observed (outturn) impacts after construction has been completed and the project is open to road users. POPE goes beyond monitoring progress against targets. It also provides us with opportunities to explore which aspects of a project, and the tools used in its appraisal, are performing better or worse than expected, and how they can be improved. Applying a standardised methodology to evaluate our major enhancements enables us to review impacts across programmes and portfolios through meta- analysis.

Our objectives for POPE can be summarised as follows:

- To clearly communicate the benefits and impacts of our projects to our customers.

¹ Appraisal is a key tool in our decision-making process to help ensure success and realise our corporate and project objectives. It considers all aspects of potential investment options and assesses the relevant associated benefits, costs and risks, and presents them in a format appropriate for decision makers so that they can make informed judgements and choices.

² In line with our 'Benefits Management Manual' (2018).

³ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/427081/tag-worksheet-appraisal-summary-table.xlsx

- To provide high quality analysis of our projects' impacts that are consistent with the Department for Transport's (DfT) Transport Analysis Guidance (TAG) the HM Treasury's Green and Magenta Books, and project specific objectives.
- To identify, describe and explain the differences between the forecast and outturn impacts.
- To provide evidence to verify or improve our appraisal methods and tools.
- To learn from evaluation insights to inform future investment decisions.
- To give stakeholders confidence in our ability to deliver projects that provide value for money.

When our interventions work well, we want to celebrate success and replicate this elsewhere. When they don't, we must be transparent, learn and improve. We need to understand whether our investments deliver value for money and represent the best use of our limited resources.



Figure 1: Value of POPE of Major Enhancements

POPE is a requirement of the Project Control Framework (PCF) which we use in the development and delivery of our Major enhancements⁴. The current POPE method has two key timeframes for data collection and analysis:

1.4. Purpose of this document

This evaluation guidance note sets out National Highways' approach for post-opening evaluations of major enhancements. It sets out what level of evaluation is considered proportionate and aims to drive consistency between evaluations to maximise the value and usefulness of each review.

Annex 1 sets out how this approach document relates to other evaluation guidance.

⁴ The project control framework is a management approach to major projects drawn up jointly by Department for Transport (DfT) and National Highways to help us work together.

1.5. Ownership of this document

This approach has been drawn up by National Highways' Evaluation Group and approved by National Highways Evaluation Steering Group, a cross-divisional group who oversee evaluation within National Highways.

Any questions on the approach to Major Project evaluation, should be directed to evaluation@nationalhighways.co.uk.

2. POPE approach to Major Enhancements

2.1. What is the scope of POPE?

Our ambition is to evaluate all the AST impacts of our major enhancements, where it is possible and proportionate to do so⁵. In general, we focus on:

- the scheme's objectives
- traffic growth
- journey times and reliability
- safety (changes in personal injury collisions)
- environment (including a site visit and covering all relevant environment objectives)
- economic assessment of value for money

Other impacts, such as other social impacts, may be included, as required, by individual projects⁶.

The appraisals for major enhancements tend to assess impacts over long-term periods covering 30 to 60 years. We evaluate a project after it has opened (typically at three years after opening) to inform judgements about the likely benefits over the entire appraisal period.

The scope is set out in the project's BREP (Benefits Realisation and Evaluation Plan). We adopt a proportionate approach in our POPE studies and focus on the core objectives, sufficient to provide accountability and enable us to learn as an organisation. As such, there are some aspects which currently are out of scope. We have an ongoing programme of methodological development to support us in enhancing the coverage of our evaluation approach, for example, in assessing wider economic impacts, social value, and customer experience. As these methods are developed, tested, and refined they will be added to our suite of evaluation tools to deploy in major project evaluation where appropriate.

There are two key aspects to the POPE process:

- **Collection of pre-construction baseline data** – The collection of pre-construction data associated with a project to support a post-opening evaluation.

⁵ The full range of objectives are detailed in the DfT's appraisal summary table. (<https://www.gov.uk/government/publications/webtag-appraisal-tables>).

⁶ For further information on the social impacts included in transport appraisal refer to TAG guidance: <https://www.gov.uk/government/publications/webtag-appraisal-tables>

- **Three-year after study** – Refers to the completion of a three-year after evaluation which sets out a comparison of the forecast and outturn impacts of a project against each of the impacts considered in appraisal⁷. Where possible, the value for money is re-forecast based on the observed benefits⁸.

Additionally, we periodically undertake overview analysis where we look collectively at the results from a larger sample of the evaluations to identify programme level trends.

2.2. Defining each evaluation

The evaluation for each major enhancement scheme is set out in its BREP (Benefits Realisation and Evaluation Plan).

All our POPE studies of major enhancements will attempt to evaluate:

- the scheme's objectives
- traffic growth
- journey times and reliability
- safety (changes in personal injury collisions)
- environment (including a site visit and covering all relevant environment objectives)
- economic assessment of value for money

The BREP will contain the specific details, for example which locations and routes will be included and any key stakeholder concerns the evaluators should be aware of.

When it's appropriate to widen the scope to include other impacts, this will also be detailed in the BREP. The principles used to decide when this is appropriate are set out below.

Proportionality	
Potential contribution to the evidence base	Is there a current gap in understanding or data about this impact? Will the information gathered be useful (either to National Highways or an external partner)?
Stakeholder interest	The evaluation should focus on items where there is a customer for the findings.
Evaluation priorities	It is not pragmatic to measure every outcome of every scheme. Effort should be focussed on

⁷ The Department for Transport (DfT) Transport Analysis Guidance (TAG) defines a set of impacts that should be considered. <https://www.gov.uk/government/publications/webtag-appraisal-tables>

⁸ Previously we undertook evaluations at one and five years after opening. We have moved to a single three years after evaluation as there is often insufficient data at one year after to draw significant conclusions. A three years after study addresses this and enables us and customers to access timelier results, rather than waiting until five years after.

	corporate targets, KPIs and PIs, and where there is need for evidence to justify future investment.
Key impacts	Is this impact related to as scheme objective?
Efficient evaluation	Logic maps can be helpful to identify what measurable variable can proportionately give an indication of the impact.
Constraints	
Data availability	If data is either not available or of an insufficient quality
Method availability	Is there a suitable method available? Does that method have the confidence of the evaluation's customers?
Costs	
Resources	How much funding is available for the evaluation? What internal staff resource is available?
Sampling	where it is not cost-effective to undertake detailed monitoring and evaluation, a sample-based approach could be used. Careful consideration should be given to what sampling method will provide representative results.
Existing data	Are there existing data sources which could be utilised to reduce the cost of collecting new data for the evaluation.

2.2 Roles and responsibilities

The project team are responsible for producing the BREP, with support from the Evaluation Group and their Benefits and Value Management team and input from specialists such as Transport Planning Group, Environment Group and Economics Group as required.

The evaluation will be undertaken by Evaluation Group and where surveys or Technical Partner support is required, this will be funded through Evaluation Group.

As set out in HMT's Green Book⁹, spending public money comes with a responsibility for evaluating the outcome of that spend. The responsibility for undertaking appropriate evaluation therefore sits with the senior responsible owner for the expenditure. This approach document assists in fulfilling this responsibility in a consistent and proportionate way across the Major Enhancements portfolio.

⁹ <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>

3. Traffic Evaluation

In our traffic evaluations we look at whether a project has delivered road user impacts relating to changes in traffic volumes, average speeds, journey times and journey time reliability. The results of our traffic analysis feeds into our economic assessment of the project. We use our observations to re-forecast the expected monetised benefits and help us determine whether the project is delivering the anticipated value for money. The results also feed into our environmental analyses to determine the project's impacts on noise, air quality and greenhouse gases.

The sections below summarise the elements which are included in a standard POPE. The detailed methods are set out in the POPE traffic methodology paper.

3.1. How do we define the scope of the traffic evaluation?

We initiate our traffic evaluations by planning and undertaking a thorough data collection exercise for both before and after the construction of the project. We review the appraisal forecasting data and consult with internal stakeholders to agree the definition of the evaluation study area, which will enable us to determine which impacts can be attributed to the project. We will focus on the project extent, and, depending on project type, we may also include local roads, where the appraisal forecasts substantial changes in flows or journey times or there are environmental or community sensitivities.

The traffic impacts we consider are set out below.

3.2. Impact on traffic volumes

We assess a project's impact on traffic volumes and movements in a study area including:

- changes in average traffic volumes throughout the day on the sections of the road relating to the project
- changes in traffic volumes on the local road network (for projects where impacts were expected)
- reassignment of traffic to the strategic road network from the surrounding road network impacted by the project

To contextualise and isolate a project's impact on traffic volumes in its study area we compare our observations to a counterfactual estimate. This is our estimate of what traffic conditions would have been had the scheme not been implemented¹⁰ and uses data from the road traffic statistics in Great Britain produced by the Department for Transport (DfT)¹¹ for road type and region.

¹⁰Evaluations undertaken prior to 2024 would have presented a comparison of flows before versus after, with commentary to give context about the changes that could be expected to have occurred in the intervening time period if the project had not been implemented. We have now moved to explicitly presenting a counterfactual estimate.

¹¹ <https://www.gov.uk/government/collections/road-traffic-statistics>

In addition to the whole day average weekday traffic (AWT) we consider the traffic changes throughout the day, especially looking at peak times and interpeak periods.

We use data for a neutral month¹² in both pre-construction and post-opening periods. Some projects require us to also look at a specific non-neutral time period. For example, a project implemented on the route to a holiday destination may have been designed to accommodate high levels of traffic demand in summer months. We would therefore analyse changes in traffic trends during these key periods in addition to the neutral month.

For the scheme section flow data usually comes from sensors on the road network. We also use data collected from local authorities and/or from counts commissioned from specialist companies, especially when looking to understand a project's impact on the local road network.

Screenlines¹³ are used to assess broader vehicle movements and identify whether any reassignment has occurred and, potentially, to determine whether there has been a change in rat-running near a project.

Once we have estimated the impact of the scheme on traffic flows, we compare these to the forecasts made as part of the appraisal process. This helps us to learn about the strengths and weaknesses of our appraisal processes.

3.3. Journey times impact

The analysis of journey times requires the definition of key routes within the study area, typically a route through the improved section and any other routes significantly impacted. The key time periods¹⁴ also need to be defined as journey times vary throughout the day. The time periods are picked to align with those used in the appraisal forecasts. Journey time data for the relevant routes and time periods is usually sourced from satnav datasets, although other sources will be explored if this is not available.

To understand the impact of the scheme we make an estimate of counterfactual journey times. We do this using assumptions about growth of traffic flows and applying the theoretical change in speed that this growth would relate to, using standard speed-flow curves. We make a comparison between the counterfactual journey times and those observed after a project has been implemented, for each route/direction, and various time periods.

To better understand a project's impact on journey times we may compare speeds along the defined routes, by direction and by time period, before and after a project has been implemented. It can be particularly helpful to understand where drops in speed are located to help identify reasons for changes in journey time. Changes are reported in miles per hour and we use harmonic averages¹⁵ in our calculations.

¹² A 'neutral' month is defined as one least affected by seasonal effects and so best represents average traffic for a whole year.

¹³ Screenlines are imaginary boundaries comprised of a set of traffic count points on a road network which define a broad traffic movement corridor, for example a project and several parallel routes

¹⁴ Typical examples of time periods are the AM peak, interpeak, PM peak, overnight, and weekend.

¹⁵ The harmonic mean is one of several kinds of average, typically it is appropriate for situations when the average rate is desired. The harmonic mean can be expressed as the reciprocal of the arithmetic mean of the reciprocals of the given set of observations.

We assess the accuracy of the forecasts by comparing them to observed data. If forecasts are not available for the same year as the observations, we use linear interpolation (assuming a straight line between the opening year and the next closest year we have forecast for) to provide a forecast for the relevant year to match our observed data¹⁶.

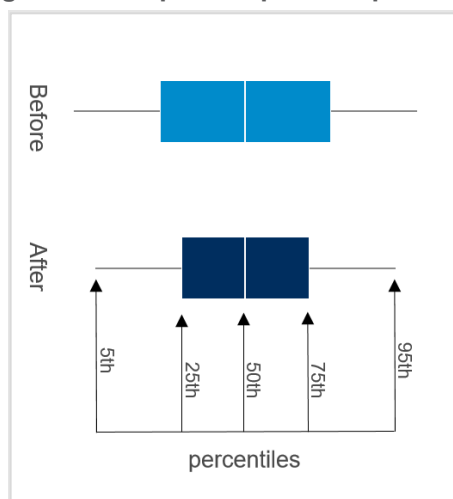
We compare the 'do minimum' (or without project) forecasts with our estimate of the counterfactual based on pre-construction observed data¹⁷. We also compare the 'do something' (or with project) forecasts with post-opening observed data. We then compare the difference between the 'do minimum' and 'do something' forecasts with the difference between the counterfactual and post-opening observed data.

3.4. Impact on journey time reliability?

Journey time reliability refers to how consistent journey times are along a route. If the range of journey times has reduced, we interpret this as the journey times having become more reliable.

To understand a project's impact on journey time reliability, we look at the spread of journey times along the route, before and after a project has been implemented and illustrate change per quartile using box plots (see Figure 2). This is a way of representing the median average and the quartiles of the data and allows us to illustrate and compare the changes in the range of journey times along the project extent. If the box plot narrows, the less variance there is between trips and hence the more reliable a journey is likely to be.

Figure 2 Example box plot composition¹⁸



We can also assess reliability using other metrics:

¹⁶ We previously compared the nearest forecast year to our evaluation year where we had observed data in order to avoid linear interpolation of speeds. Having undertaken research into the size of error linear interpolation could introduce to our results, we now understand that the impact of this assumption introduces in minimal.

¹⁷ Evaluations undertaken prior to 2023 would not have calculated a counterfactual estimate, but rather just presented a comparison of before and after journey times.

¹⁸ A percentile is one of 100 equal groups into which the data has been divided, according to the distribution of values of a specific variable, in this case journey time. A quartile is one of four equal groups of the data. In Figure 2, the 5th percentile marks the point in the distribution of journey times along the project extent in a defined period where only 5% of journeys are longer than this journey

- **Planning time index (PTI).** This is a reliability measure which represents the amount of additional travel time (over and above free-flow or normal conditions) that a motorist should expect to allow when planning their journeys to ensure they will arrive on time¹⁹. Comparison of the change in PTI on a project can give an indication of the impact of a project on journey time reliability and provides a metric that can be more easily used in meta-analysis.
- **Route stress.** This is the ratio of observed annual average daily traffic (AADT) to congestion reference flow (CRF).²⁰ We report it as a percentage and assess whether it falls within the range of 75% to 125%. This allows us to comment on congestion even if no journey time data is available.

Although less intuitive to understand, these have the advantage of producing a metric which can be compared between schemes.

time, and the 95th percentile marks the point in the distribution where 95% of journeys are shorter than this journey time. Any values lying outside these two points are deemed outliers.

¹⁹ A PTI of 2 would mean the motorist should allow double the amount of time it would take to make the journey if the road was completely clear to be 95% confident of arriving on time. It is calculated as the 95th percentile journey time divided by the free flow journey time.

²⁰ CRF calculation is detailed in the Design Manual for Roads and Bridges (DMRB) and is a measure of the performance of a link between junctions. As stated in DMRB, "The Congestion Reference Flow (CRF) of a link is an estimate of the Annual Average Daily Traffic (AADT) flow at which the carriageway is likely to be 'congested' in the peak periods on an average day".

4. Safety evaluation

Safety on our network is one of our primary objectives. We aim to reduce the loss of life, injuries and damage to property which can result from collisions on our network. To assess the extent to which our projects achieve their safety objectives and contribute to the provision of a safe network for road users, we look at the changes in various aspects of safety on the project extent and on surrounding roads within a defined study area based on the appraisal. We monitor changes in personal injury collisions (PIC) over set periods of time and at the changes in the severity of collisions. We also account for changes in traffic flows by considering collision rates.

Safety trends can be influenced by several factors. To help us understand the impacts of a project, we make comparisons of safety-related trends before and after the implementation of a project, and we make comparisons between the outcomes of a project and counterfactual scenarios. A counterfactual scenario estimates the safety trends that would likely have occurred had a project not been implemented. We also look at how a project's safety outcomes compare to what was expected from the appraisal forecasts. To ensure our analyses are robust, we undertake statistical significance tests using chi-squared tests²¹ to give confidence that there has been a significant change between the counterfactual and observed trends.

4.1. How do we define the scope of the safety evaluation?

We define the study area for our safety evaluation based on the area that was considered in the pre-construction appraisal which supported the business case for the investment. As well as this 'wider area' we also highlight the impacts on the 'project extent'.

4.2. Impacts on road user safety

National Highways holds a database of collisions, casualties and the vehicles involved in these incidents. This is a validated version of a database produced annually by the Department for Transport²². It comprises collision reports provided by the various police forces, local authorities, and transport bodies such as Transport for London. The reports are produced by police officers when they respond to personal injury collisions on public roads. Those collisions that result in injuries are recorded and categorised in the dataset by the severity as either fatal, severe, or slight. Those collisions that do not result in injury are not included in the dataset, so they are not available for analysis.

This dataset is known as STATS19 and forms the basis of national statistics for road casualties and is used both nationally and locally for various road safety purposes. Since 2012, police forces have been moving to using new data

²¹ A chi-squared test is a standard statistical tool we use to help us to determine whether those differences we find in our comparisons are due to chance or are significant and establish the degree of confidence we place in that significance. We employ the tests to ensure our analyses are robust. Note - changes that are not identified as significant can still be real.

²² <https://data.gov.uk/dataset/cb7ae6f0-4be6-4935-9277-47e5ce24a11f/road-safety-data>

collection systems²³. (called CRaSH²⁴ and COPA²⁵) with the objective of eliminating the “uncertainty in determining severity that arises from an officer having to make their own judgement”.²⁶

The Department for Transport (DfT) and Office of National Statistics (ONS) have developed a methodology²⁷ for collision and casualty severity adjustments when comparing timeseries analysis where a police force has transitioned to injury-based reporting mechanisms²⁸.

We review the forecasting data from the appraisal (Economic Appraisal Report) and use the observed data to check the accuracy of the modelling. We also undertake meetings with key stakeholders to help identify any impacts on roads which may not have been noted in the appraisal documentation.

We assess the impacts of a project on road user safety by looking at the changes in personal injury collisions (PICs) and collision rates between the pre-construction and the post-construction periods. We focus on collisions and not casualties because the number of casualties per collision are randomly variable and any change in the numbers is unlikely to be a response to the project.

To reduce the influence of the random nature of collisions, we look at the trends in PICs over several years – a minimum of three years is required to provide robust results.

We compare the annual average number of PICs from the post-opening periods with a counterfactual estimate. This is calculated by adjusting the data from the pre-construction period to provide the range of collisions likely to have occurred without the project taking place²⁹. The difference between the counterfactual and observed post-opening data is then used to inform judgements on a project’s likely safety impact.

Collision rates are calculated to take into consideration changes in traffic flows. As with collision numbers, we compare the after observation with a counterfactual estimate. To create a counterfactual scenario, we adjust the observed pre-construction collision rate by applying changes seen in the background trends to it. We then estimate how the adjusted pre-construction collision rate might have changed over time.

²³ <https://www.gov.uk/government/publications/guide-to-severity-adjustments-for-reported-road-casualty-statistics/guide-to-severity-adjustments-for-reported-road-casualties-great-britain#guidance-on-severity-adjustment-use>

²⁴ Collision Reporting and SHaring system

²⁵ Case Overview Preparation Application

²⁶ ‘Reported Road Casualties, Great Britain: 2018 Annual Report’ (Department for Transport, 2018).

²⁷ <https://www.gov.uk/government/publications/guide-to-severity-adjustments-for-reported-road-casualty-statistics/guide-to-severity-adjustments-for-reported-road-casualties-great-britain#guidance-on-severity-adjustment-use>

²⁸ As of September 2021, these reporting systems had been adopted by 26 out of 43 police forces in England

²⁹ Since the late 1990s collision numbers in the UK have declined despite increasing volumes of traffic. To account for this and to more accurately determine whether any change in collision numbers can be attributed to a project we pose the question: what is likely to have occurred had a project not been implemented? To answer the question, we create a counterfactual scenario in which we estimate the number of collisions which would likely have occurred over the evaluation timeframe had the project not been constructed. We can then calculate the net difference between the collision numbers of the observed post-construction period and those of the counterfactual scenario.

- We assume that traffic flow trends would follow the regional background traffic growth patterns had the project not been implemented.
- We calculate the collision rate for the appropriate type of road motorway (differentiating between conventional motorways, conventional motorways with high traffic flows, and smart motorways).
- We apply regional trends for collision rates.
- We use the chi-squared test to create a counterfactual range (rather than a single number estimate). This enables the counterfactual results to be interpreted with a greater appreciation of the levels of certainty

4.3. Impacts on collision severity

The casualty data published by the Department for Transport categorises collisions by severity, that being 'slight', 'serious', and 'fatal'. From this a measure called the fatal and weighted injuries (FWI) index is produced. It is a combined measure of casualties adjusted for severity. A fatal collision is weighted at 1.0, a serious collision at 0.1, and a slight collision at 0.01. The weighted numbers are summed over the severity categories, resulting in a single metric for the road section in a given time-period.

The FWI index can be further standardised against traffic flow, to show the likelihood of a fatality equivalent per hundred million vehicle miles travelled. This metric is expressed as FWI per hundred million vehicle miles travelled (FWI/hmvm). We calculate and compare FWI/ hmvm for equivalent periods of time before and after a project's construction to see whether it has improved against the measure.³⁰

We aim to use consistent data sources in our analysis on the effects of traffic flows on collision severity to ensure we make proper comparisons. Changes in the recording of incidents by police forces (see 4.1), can limit the scope of our analysis depending on when the new recording systems were adopted. Where a new recording system was adopted during the post-opening monitoring period, we would limit the time series assessed to that covered by the old system. However, the methodology changes do not impact our ability to monitor fatal collisions as these are not impacted by the change in recording system.

4.4. How do we assess a project's performance compared to expectations?

We assess the accuracy of the forecasts by comparing them to observed data. We compare the 'do minimum' (or without project) forecasts with our estimate of the counterfactual based on pre-construction observed data. We also compare the 'do something' (or with project) forecasts with post-opening observed data. This information is used when we monetise safety benefits.

³⁰ We use a tool called the FWI Calculator to determine the FWI Index. We input the aggregated number of casualties classed by severity, the total number of collisions and pre-construction and post-opening average annual daily traffic flows. A formula then calculates the FWI Index.

5. Environmental evaluation

We take a proportionate approach in our environment evaluations, with the level and focus of analysis determined by several factors. The key factors are:

- project type and complexity
- the availability of data and information to provide appropriate baselines for comparison
- the availability of post-opening data and any health and safety issues which could restrict the scope of our site visits

For most major enhancements, our evaluations consider the predicted impacts of the project and compare them against the outcomes observed three years after construction. Information on the predicted impacts is gathered from the original business case and supporting evidence including the environmental appraisal³¹ and the environmental assessment³². Evidence on the observed impacts comes from a combination of a site visit to view the impacts in their real-world context and a review of any available supporting information. This usually includes any monitoring reports or surveys commissioned by the project and information on ongoing maintenance and inspections.

Our site visits seek to:

- observe the impacts of the project at a sample of locations along the project
- to confirm the degree to which the mitigation measures proposed have been implemented
- to assess the effectiveness of the mitigation measures at three years after and the prospect that they will deliver the desired design year³³ outcome

For some environmental topics³⁴ where changes in traffic characteristics influence the impact, observed traffic data will be obtained, and used to evaluate the project outcome.

The results of our analysis are recorded against each of the TAG environmental topics. We then report on whether we consider the observed outturn impacts to be 'as expected', 'worse than expected' or 'better than expected' as compared to the forecast impact reported in the Appraisal Summary Table (AST). Where insufficient evidence is available to determine the outcome, for example mitigation has yet to establish or monitoring data is unavailable, we record this as 'too early to say'. We also incorporate assessment of some social impacts³⁵ into the environmental evaluation. This is because the environmental site visit often provides an opportunity for us to observe the impacts that occurred and the mitigation put in place.

We collect both primary and secondary data to undertake evaluations. We obtain primary data from site visits and from the traffic surveys that support our traffic evaluation. The site visits include observations and photographs of the impacts of a

³¹ <https://www.gov.uk/government/publications/tag-unit-a3-environmental-impact-appraisal>

³² <https://www.standardsforhighways.co.uk/search/54b0eb69-fd65-4fa5-a86b-7313f70b3649>

³³ Usually 15 years after.

³⁴ Air quality, noise and greenhouse gases.

³⁵ <https://www.gov.uk/government/publications/tag-unit-a4-1-social-impact-appraisal>

project. It also considers various aspects of the design, the construction and the progress of embedding the project into the physical landscape. The data is geotagged for mapping and geospatial analysis.

We obtain our secondary data from documents and reports produced both during the project appraisal process and after construction during the aftercare period. Depending on the project, these documents can include: the Environmental Assessment Report, Environmental Scoping Report, Environmental Statement (ES), Environmental Management Plans (both construction phase and handover phase), Landscape Management and Maintenance Plans, as-built drawings, AST and TAG worksheets and post construction monitoring reports such as those for species surveys, and any relevant archaeological reports. This list is not exhaustive.

5.1. Scope of environmental and social impact evaluation

We usually incorporate 11 environmental and three social impacts³⁶ topics into the scope of our environmental evaluations:

- Noise impacts
- Air quality impacts
- Greenhouse gases
- Impacts on landscape
- Impacts on townscape
- Impacts on the historic environment
- Impacts on biodiversity
- Impacts on water environment
- Physical activity impacts
- Journey quality impacts
- Severance impacts

The following sections give an overview, with more detail specified in our POPE environmental evaluation methodology.

5.2. Evaluation of noise impacts

We evaluate noise impacts of our projects by looking at the outturn traffic flows to see whether they are roughly as predicted. We don't currently undertake any new noise surveys.

If we find that there have been changes in traffic beyond the following thresholds, then we assume that the traffic impacts for noise are either 'worse than expected' or 'better than expected'. The thresholds are:

- where traffic flows (number of vehicles >1,000 per day) are 25% more or 20% less
- where average speeds differ by at least 10 kph

³⁶ Physical activity, journey quality and severance

- where the percentage of Heavy Duty Vehicles (HDVs) differs by at least 10%

If we see changes in at least two of the above parameters, we then try to calculate whether the observed roadside noise level differs from that using the forecast traffic data. We calculate it using observed annual average traffic flows. Noise levels within 1dB of the forecast are deemed 'as expected'.

We also consider existing noise survey/monitoring information where available.

If any noise mitigation is proposed by the environmental assessment, we would aim to confirm it was provided. During the site visit we check its location and physical characteristics. We check its technical properties by consulting as-built documentation. If the detailed mitigation specifications aren't available in the as-built documentation, we will try to obtain further information from the project team covering:

- the noise insulation performance of barriers (usually confirmed by a certificate of conformity)
- the road surface type, including whether a low noise surface was laid

Environmental Statements and traffic forecast reports generally only contain traffic flow forecasts for the opening year and for the design year, which is, 15 years after opening. We therefore need to interpolate the forecasts to undertake the three-years after evaluations. We may have to consider the impact on the annual average traffic flows of any major developments which have subsequently been built.

5.3. Evaluation of impacts on local air quality

We assess local air quality by looking at the outturn traffic flows to see whether they are roughly as predicted. We need to interpolate traffic forecasts for the POPE year from the forecasts for the opening and design years. This is so that we can make fair comparisons with the observed traffic data.

If traffic falls below the following thresholds, a detailed evaluation of air quality can be scoped out.

- Where outturn AADT flows are less than forecast by 5,000 or more, the Project is 'Better than Expected' for air quality.
- Where outturn AADT flows are within 5,000 of the forecast (whether above or below), the Project is 'As Expected' for air quality.

If one or more road links under consideration have an outturn AADT flow of 5,000 or more than forecast, the Project is subject to further air quality evaluation, as there is a risk that the air quality assessment underestimated the significance of the potential air quality impacts of the Project. However, increased traffic does not necessarily reflect an increased risk of significant air quality impacts, as the air quality baseline is an important consideration. Therefore, a simple risk analysis exercise is carried out, considering a worst-case predicted concentration of nitrogen dioxide (NO₂) in the Environmental Statement (factored to represent the POPE year, as air quality generally improves with time), alongside the worst-case predicted difference in traffic data, to identify a worst-case scenario of expected NO₂ concentration in the POPE evaluation year.

The outcome of the risk analysis is 'low risk – as expected' or 'high risk- worse than expected' on the basis of whether the worst-case expected NO₂ concentration is above or below the relevant air quality standard. In the case that a 'high risk' is identified, an air quality specialist will undertake a more detailed risk analysis, specifically considering the likelihood that the worst-case traffic data and the worst-case predicted concentration intersect, alongside local monitoring and other external factors, to confirm whether the Scheme's air quality assessment underestimated the significance of air quality impacts or not.

5.4. Evaluation of greenhouse gas impacts

Changes in greenhouse gas emissions of a project are caused by changes in fuel consumption by vehicles. These changes will be related to all the different changes in traffic flows, speeds and composition across the road network affected by a project. We only have a limited amount of observed traffic data beyond the strategic road network, so we cannot evaluate with confidence the total change in emissions caused by a project. Instead, we base our evaluation on a comparison of forecast and observed traffic data along the project footprint. We use the emission factor toolkit published by DEFRA³⁷ to calculate total emissions to gain insight into the accuracy of the predicted emissions along the project footprint.

The DEFRA method requires the following inputs:

- link length (in kilometres)
- average daily traffic (ADT) flow
- average speed (in kilometres per hour)
- road type classification (for example, motorway, A road, etc.)
- percentage of HDV traffic

For the three-years after evaluation, we use interpolated forecast data. Where we have insufficient traffic data, we will attempt to qualitatively evaluate the outcome acknowledging any limitations involved.

5.5. Evaluation of the impacts on landscape/townscape

Planting and landscaping are usually important components of our road projects. They provide valuable landscape integration, screening, habitat protection and improved visual amenity and we can assess them during site visits. However, they need a minimum of three years to become established and usually 15 years before they fully mature and deliver the full mitigation benefits. Our evaluations will usually provide an overview of the forecast and observed impacts, confirm if mitigation measures have been implemented as planned, and record any substantial changes to design. We will take photographs of various key features taken from different viewpoints including a sample of locations predicted by the environmental assessment to be affected. Where the assessment included photomontages³⁸, we will attempt to replicate them. We will then use the evidence gathered during the site visit along with any information we have on the condition of the mitigation

³⁷ <https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html>

³⁸ These are locations where the assessment produced a visual representation of what the project would look like at different time periods. Usually, the winter opening year and the summer design year.

planting and proposed future maintenance to determine whether the forecast outcomes are likely to be met.

5.6. Evaluation of biodiversity impacts

Managing biodiversity impacts is an important element of our projects. To evaluate these impacts, we review as-built drawings, ecological monitoring reports and other project documents and use the site visit to confirm the status and likely performance of any pertinent mitigation measures (for example, ponds and new habitats, mammal underpasses).

5.7. Evaluation of impacts on the historic environment

The management and preservation of our cultural heritage is an important part of our projects. To evaluate the effects of our projects, we gather information on the predicted impacts and proposed mitigation from the environmental assessment. We then undertake a site visit to identify if the impacts arose and whether the mitigation is in place and effective. For impacts on archaeology, we will review the findings of any published archaeology reports. We will use the report to assess the success of any mitigation measures employed.

5.8. Evaluation of the impacts on the water environment

Our new road projects normally require a range of relevant mitigation measures (highway drainage, balancing ponds, pollution control, road surface water treatment systems) and sometimes morphological enhancements to receiving watercourses (for example, meanders to offset culvert length), and measures to reduce flood risk. Our evaluations focus on confirming the mitigation measures have been implemented during a site visit and will seek to confirm that the mitigation measures are being maintained, operating effectively with no signs of pollution, sedimentation or erosion. We would use any water quality data if it were available in our assessment. If we found any pollution issues, we would notify the relevant project team/legacy team and relevant authorities.

5.9. Evaluation of impacts on physical activity

We look at whether any changes to the public rights of way network required by a project have been implemented to assess impacts on physical activity. We would review the as-built drawings and any copies of the audits focussed on users such as walkers, cyclists and horse riders (WCH) or vulnerable users. During site visits, we would try to qualitatively assess impacts on WCH, but we do not carry out any new surveys unless changes in physical activity was an objective of a project, and there was a specific need for data.

5.10. Evaluation of impacts on journey quality

We look at the provision of facilities for drivers, for example, lay-bys, service areas, views from the road and new signage, and we consider the qualitative changes to driver stress using data on congestion, journey times and accidents. We use the site visit to qualitatively assess the success of any relevant measures.

5.11. Evaluation of impacts on severance?

We look at whether any changes to footpaths, rights of way, bridges, lighting or vegetation caused by the project have changed the level of severance experienced by local communities. This includes how a project may have affected access to community facilities and services. The site visit is used to qualitatively assess these impacts, and they are then compared with the changes predicted in the project appraisal.

6. Evaluation of other impacts

We are aware that schemes have impacts beyond the standard evaluation topics detailed here. We are developing and piloting methodologies to enable us to evaluate:

- Impact on active travel
- Impacts on the wider economy
- Customer experience
- Social value

Where schemes have either an objective relating to one of these topics or a significant impact in that area, we will consider their inclusion in a pilot evaluation.

7. Value for money

7.1. What is 'value for money'?

When we invest in a major road improvement project we must show that it will be a good use of public funds and will deliver 'value for money' (VfM). VfM is defined to be "the optimal use of resources to achieve the intended outcomes".³⁹ It requires us to build a business case which demonstrates that objectives will be achieved, money will not be wasted, and that the expected benefits exceed the costs.

At each decision stage we assess how much VfM a project is likely to deliver and summarise it in a VfM statement. This statement considers the whole scheme-life (usually assumed to be 60 years) and will contain a project's benefit-cost ratio (BCR) and allocate the project a VfM category⁴⁰. The Benefit Cost Ratio (BCR) provides an indicative economic measure to decision makers that is calculated by dividing the value of the monetised impacts (or benefits) of a project by its costs⁴¹. The VfM category provides a more holistic measure to decision makers by accounting for the additional non-monetised benefits generated by the project, which can in some instances be substantial.

In our evaluations we undertake a combination of quantitative and qualitative approaches to understand the extent to which VfM has been achieved. For some impacts we are able to provide a reforecast estimate of the monetised value. For other impacts, or in situations where data is limited, we will undertake a qualitative analysis to reflect the project's value for money⁴².

Most of the economic benefits from a major highways project accrue from journey times savings and collision reductions. Our evaluation methodology assumes that the change in the observed traffic flows, journey times and collisions in the first three years of a project's life can be associated to its predicted long-term economic benefits.

7.2. How do we monetise journey time benefits?

Our analysis of the traffic impacts of a project will usually provide information on the changes in journey times on the key routes at different times of day. Our analysis will also provide information on how many vehicles were using the route at those times of day before and after a project's implementation. We use this information to calculate a 'vehicle hours saving' value.

We assume those road users already using the route gain the full journey time benefits of the project. For any additional road users present in the 'after' scenario, we apply the 'rule of a half'. This is a standard technique set out in DfT's Transport Analysis Guidance (TAG)⁴³.

³⁹ National Audit Office <https://www.nao.org.uk/about-us/our-work/value-for-money-programme/>

⁴⁰ The Department for Transport defines six 'value for money' categories ranging from 'very poor' to 'very high': <https://www.gov.uk/government/publications/dft-value-for-money-framework>

⁴¹ As per HM Treasury's Green book 'Central Government Guidance on appraisal and evaluation', a 'present value' is used for both benefits and costs. This means that all the monetary values are compared in the same price base (for example, 2010 prices) and are 'discounted' to the same year (for example, 2010).

⁴² Refer to section 2 for further details and explanation of the counterfactual estimate.

⁴³ <https://assets.publishing.service.gov.uk/media/63174538d3bf7f792bcbf1a6/tag-unit-a1.3-user-and-provider-impacts.pdf>

The project will usually have been appraised over a 60-year project life, so we estimate what the outturn benefits would have been over 60 years. We do this in one of three ways:

- **Capitalisation.** We monetise the vehicle hour benefits in the opening year using standard values of time issued by DfT and then apply a standard capitalisation factor. We use the same values that are used for the appraisal of small projects. These account for future traffic growth which will also benefit from the project. The value is then discounted. This is a standard procedure to enable benefits that happen at different points in time to be combined.
- **Discount.** This method is similar to capitalisation, but is used when evaluation evidence leads us to query the underlying relationship between traffic and benefits. If we are not able to judge what the impact of future traffic would be on the benefits, we assume that the observed benefits do not change over the lifetime of the scheme. The only calculation that is performed on the benefits stream is that it is discounted to provide a standard 'present value of benefits' that is comparable with the 'present value of costs'.
- **Profile method.** The capitalisation and discounting methods don't reflect the expected shape of the benefits profile over the project life. Some schemes are expected to deliver their maximum benefits, not in the opening year, but at some point in the future. The profile method considers what proportion of the vehicle hour benefits have materialised in the opening year. This proportion is then applied to the forecast opening year benefits. This difference is then applied to the forecast monetised saving in the future years. Discounting is applied to the calculation at each step allowing the total 60-year benefit to be estimated.

We use a decision tree to determine which of the three methods is used to re-forecast the monetised journey time benefits. This considers the observed data we have available as well as the information from appraisal and analyses the relationship between them to determine the most appropriate method to use.

7.3. How do we monetise reliability?

We use two tools in the appraisal of a project to estimate the journey time reliability benefits. These are INCA (incident cost-benefit analysis)⁴⁴ and MyRIAD (Motorway Reliability Incidents And Delays)⁴⁵. For POPE, we monetise reliability by re-running INCA or MyRIAD with the outturn traffic flows to obtain an updated estimate of the monetised benefit.

7.4. How do we monetise indirect tax revenues?

Indirect Tax Revenue (ITR) is the change in revenue to the government resulting from a project's implementation. For our projects, indirect tax is derived primarily from fuel consumption. A project may result in changed fuel consumption due to:

⁴⁴ <https://www.gov.uk/government/publications/inca-user-manuals-and-downloads>

⁴⁵ <https://highways.sharepoint.com/sites/TPGInformationandResources/SitePages/Software-and-Tools.aspx>

- changes in speeds (resulting in greater or lesser fuel efficiency)
- changes in the distance travelled
- increased road use

It is difficult to accurately calculate the fuel used in a study area, therefore we base our calculation method on the difference between forecast and observed estimated fuel consumption on the scheme extent. We apply the ratio of forecast:observed to the monetised ITR forecast to provide an outturn monetary value for ITR.

We use standard TAG vehicle category splits to estimate the composition of the traffic flow and apply standard TAG fuel consumption parameters to calculate the forecast and observed change in fuel consumption.

7.5. How do we monetise vehicle operating costs?

For most projects, the vehicle operating costs (VOC) and indirect tax revenues (ITR) are both very closely linked to changes in fuel consumption. Their impacts are of similar sizes but fall on opposite sides of the benefits balance. So that, if there is increased fuel consumption, VOC will increase too due to road users paying more for fuel (a disbenefit), but the increased fuel consumption will also generate more indirect tax in the form of fuel duty collected by the HM Treasury (a benefit, under current guidance).

We firstly calculate our estimate of outturn ITR and then apply the ratio of forecast:outturn change in ITR to the forecasts VOC estimate an outturn monetised value for VOC.

7.6. How do we monetise safety benefits?

We analyse monetised safety benefits by calculating the net difference between the average numbers of personal injury collisions per year in the counterfactual scenario and observed numbers in the post-project period. We then compare this with the net difference predicted between the 'do minimum' (without project) and 'do something' (with project) scenarios in the opening year. We adjust the observed data to account for the background trend in collision reduction. This difference between the predicted and observed impacts is then monetised using SAR guidance⁴⁶ for the appraisal period and by the primary road type of the improvement. The monetary value is then added to the forecast saving for the area over the appraisal period to give the outturn safety impact.

7.7. How are other impacts taken into account?

When considering an investment's value for money we also take into account benefits which we are not able to monetise. For each project we need to consider which other impacts might be relevant, and to do this we reference the appraisal and consider:

- Any qualitatively appraised impacts which were moderate or large (either beneficial or adverse) – these will be commented on.

⁴⁶ SAR (Scheme Appraisal Report) is a spreadsheet-based tool which records the results of a TAG-based appraisal of a small highway improvement project (typically under £10 million).

- Any impact qualitatively appraised as slight but evaluated as worse/better than expected – these might also be relevant.
- An impact appraised as neutral (unlikely to be relevant).
- If wider economic impacts weren't appraised – they might still be relevant if the project is near a 'functional urban area' (these are listed on DfT website).

It is where the outturn BCR is within 0.1 of a value for money threshold where we need to pay particular attention (note that none of the above are likely to shift the BCR more than 0.1).

7.8. How do we assess scheme costs?

We compare the outturn construction, operation, maintenance, and renewals costs against how much the project was expected to cost prior to construction.⁴⁷ The expected costs used in our post-opening project evaluations are the investment, operation, maintenance, and renewals costs that supported the Stage 5 Business Case.⁴⁸

For major enhancements, we obtain outturn costs from colleagues in Commercial and Procurement Directorate to ensure consistency.⁴⁹

For our post-opening project evaluations, we use present value costs (PVC) in a 2010 base year. Some older projects were appraised using a 2002 base year, in which case we convert it so that it is comparable with other projects.

7.9. Providing context to the outturn value for money?

In the summary reporting for POPE, the calculations of value for money are presented in terms of the standard DfT value for money categories⁵⁰, which range from very high to very poor.

As part of the original business case, a range of scenarios are forecast for the project during appraisal. In POPE, we only consider the main 'core' scenario which assumed standard traffic growth statistics provided by the DfT as part of the Road Traffic Forecast (RTS) dataset. In appraisal there are 'low' and 'high' growth scenarios in addition to the core case.

In some cases, outturn traffic growth may be higher or lower than what was considered in the 'core' scenario. It is unlikely that a sufficient level of detail is provided as part of the traffic forecasting package to use a different scenario through the evaluation, however this can be addressed in value for money section by considering the reforecast BCR calculated in evaluation in comparison to the range of BCRs that was expected in the different scenarios. This gives context to the investment and allows for a range of expected outcomes, depending on what level of growth has been observed.

⁴⁷ The scope of POPE methodology includes construction costs but does not monitor longer-term maintenance costs.

⁴⁸ National Highways projects follow a seven-stage lifecycle. Stage six refers to the construction period, therefore the estimate at the end of stage five is the cost that informed the decision to go ahead with construction.

⁴⁹ To account for inflation, we use a GDP deflator tool to estimate its impact.

⁵⁰ <https://assets.publishing.service.gov.uk/media/5f6237408fa8f5106d15640c/value-for-money-framework.pdf>

8. Reporting the evaluation

Evaluations undergo analytical assurance to explain the level of confidence that readers can have in the analysis presented. If analysis receives a 'red' rating it will not be published as we do not have sufficient confidence in it.

In all other cases, our evaluations of Major Enhancements are published on our website⁵¹ as these projects have significant numbers of external stakeholders who are may be interested to understand the project outcomes.

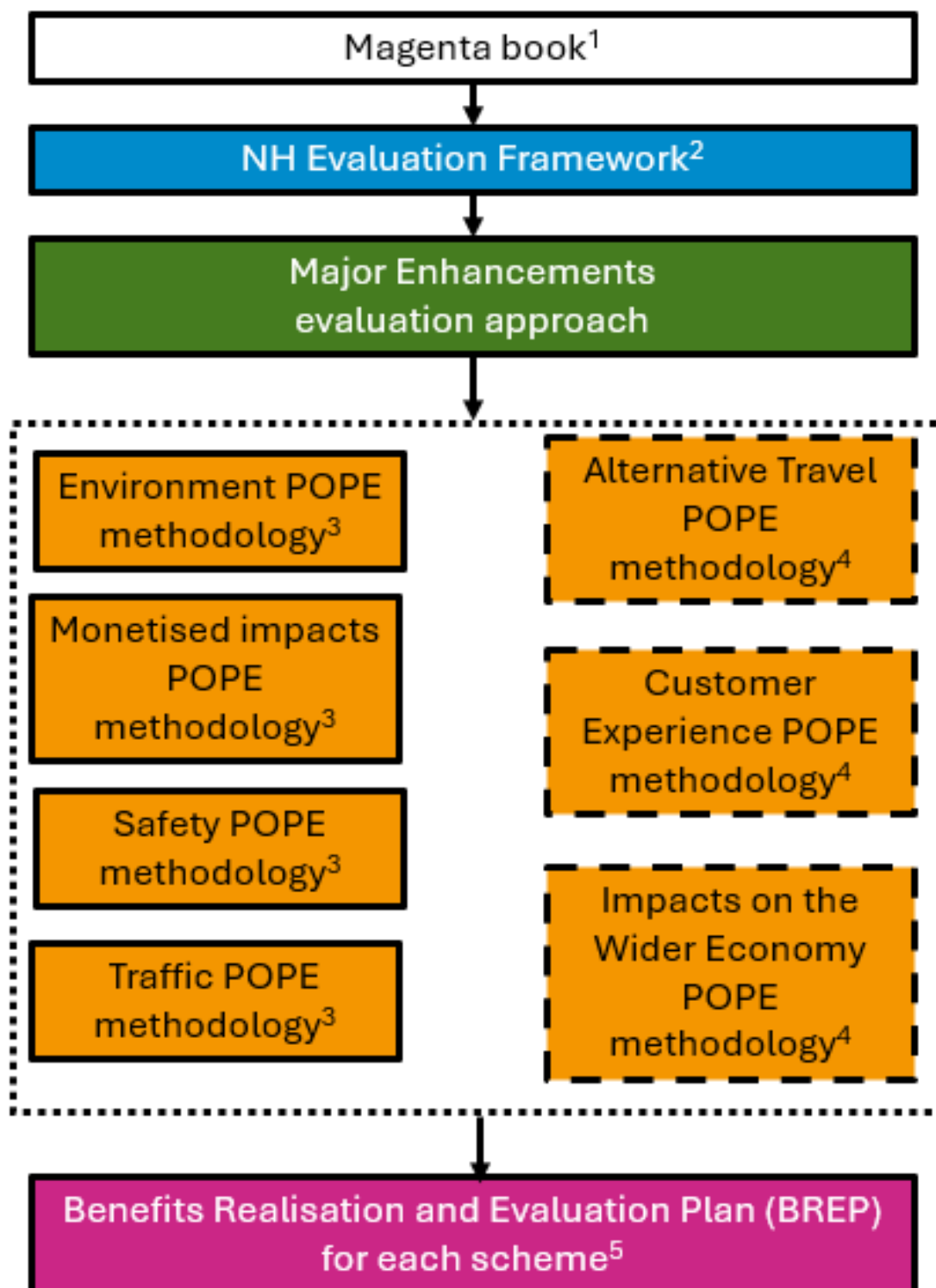
In addition to publication, the evaluation findings are also widely disseminated internally, in particular via an evaluation findings workshop, to which project teams, those operating the network and those advising on appraisals are invited.

Relevant senior directors are advised of the key findings and a summary of the findings is shared with the Evaluation Steering Group, who are the cross-divisional group who oversee evaluation within National Highways.

Key metrics from each evaluation are recorded in a database to enable us to periodically undertake an overview of findings from a range of evaluations.

⁵¹ <https://nationalhighways.co.uk/our-roads/post-opening-project-evaluation-pope-of-major-schemes/>

Annex 1 – evaluation guidance map



¹ HM Treasury guidance on what to consider when designing an evaluation.

<https://www.gov.uk/government/publications/the-magenta-book>

² Currently being drafted

³ Currently being updated – latest version available on [Evaluation Group sharepoint page](#)

⁴ Under development

⁵ Refer to Project Control Framework [product description](#)

If you need help accessing this or any other National Highways information, please call **0300 123 5000** and we will help you.

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