



SNC • LAVALIN

M4 Junction 17 Improvements

Risk Management Plan (ISO 31000:2018)

Wiltshire Council

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WC_M4J17-ATK-GEN-XX-RK-ZM-000001

Notice

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Contents

Chapter	Page
1. Introduction	5
1.1. Project Overview and Objectives	5
1.2. Document Purpose	5
2. Background	7
3. Definitions	9
3.1. Definition of a risk	9
3.2. Definition of an issue	9
3.3. Definition of Risk Assessment	9
4. Roles and Responsibilities	10
4.1. Project Director	10
4.2. Project Manager	10
4.3. Risk Manager	10
4.4. Project Team	11
4.5. Risk Owner	11
4.6. Action Owner	11
5. Risk Management Process	12
5.1. Establish Context	12
5.2. Identify Risk	13
5.3. Risk Analysis	13
5.4. Evaluation	13
5.5. Risk Treatment	15
5.6. Risk Monitoring and Review	16
6. Quantitative Risk Analysis	18
6.1. Quantitative Cost Risk Analysis	18
Appendices	19
Appendix A. Sample Risk Register	20
Appendix B. Sample Monthly Dashboard	21
Appendix C. QCRA Output Samples	22
Appendix D. QSRA Output	23
Tables	
Table 4-1 – Programme Risk Management Responsibility Matrix	10
Table 5-1 - Risk Parameters used for the scheme	14
Figures	
Figure 2-1 – Showing the location of the scheme and proposed options A, B & C	8
Figure 5-1 - Risk Management Process	12
Figure 5-2 - PID for Risk Register Template Scored	14
Figure 6-1 - Quantitative Risk Analysis Process	18

Glossary

Action owner - an individual responsible for implementing an agreed risk action and reporting progress to the Risk Owner

@Risk® – a probabilistic modelling tool, added to Excel, used for cost risk assessments

Criticality Index – percentage time an activity is spent on the critical path during simulation

Cumulative or S curve – cumulative modelling graphical output showing dates/costs by probability

Distribution – how risk impacts are modelled (e.g. triangular, uniform, discrete, normal and lognormal)

Duration Sensitivity – a measure of how much a task duration affects completion in a simulation

Estimating Uncertainty – normal ranges of cost or duration (quantities, prices or productivity)

Expected Monetary Value – a rudimentary calculation for the expected value of a risk or set of risks, used when a Monte Carlo simulation has not been carried out, as an alternative method for calculating risk contingency

Fall-back Actions - a set of actions which will be taken only if the risk happens

Frequency Graph – graphical modelling output showing frequency of date/cost results by probability

Monte Carlo Simulation – probabilistic simulation of a Project with risks and uncertainties using random sampling of distributions

Oracle Primavera Risk Analysis® – a probabilistic modelling tool for schedule risk assessments

Project Risk Categorisation Tool – categorises risk level of Projects into Red, Amber or Green

Quantitative Risk Assessment – probabilistic cost and schedule risk modelling with results analysed

Risk Appetite – level of exposure Atkins Transportation is willing to accept on Projects

Risk Tolerance – the level of risk that the Programme can accept on individual risks

Risk Management Framework - principles, requirements and arrangements for managing risk

Risk Owner - an individual who manages a risk with accountability and resources

Risk Parameters – quantifies levels of probability & impacts that correspond to scores (1 to 5 or VL to VH)

Risk Register Template - an excel spreadsheet format used to record and update risks

Risk Response Strategy – the strategy for mitigating the risk (transfer, share, tolerate, treat or terminate)

Risk Scoring Matrix – a probability / impact matrix used to identify 'risk scores' for ranking by importance

Risk Workshop – a meeting to identify and analyse a Project's potential risks and opportunities

Tornado graph – graphical display of cost or schedule drivers in descending order (risks/tasks/costs)

Technical

Acronyms are explained within the text.

1. Introduction

1.1. Project Overview and Objectives

The M4 Junction 17 Improvements scheme has been selected and recorded within the Regional Evidence Base (REB) as one of the top 9 priority Major Road Network (MRN) schemes by the Western Gateway Shadow Sub-National Transport Body (SSTB). This is due to its ability to improve north-south connectivity in the area. The Strategic Outline Business Case (SOBC) was submitted in July 2019 to the Department for Transport (DfT) as part of the Western Gateway REB for consideration by ministers for receipt of an offer of funding.

The project objectives are:

- Reduce delay and improve journey time reliability at M4 Junction 17, supporting journeys on the SRN;
- Support the overall success of the A350 improvements programme (including MRN) by delivering complementary improvements at M4 Junction 17;
- Improve north-south connectivity on the A350 through improvements to M4 Junction 17, the gateway to the A350 from the SRN;
- Ensure that M4 Junction 17 has the capacity to accommodate planned and future growth in the A350 Corridor and in the A350 and Swindon M4 SWLEP Growth Zones, including the Chippenham Urban Expansion and the Wiltshire Local Plan Review; and
- Improve existing safety levels at M4 Junction 17, taking into account forecast traffic growth.

The case for investment at the junction is to deliver these improvements and help support better north-south connectivity in the area. The scheme is intended to build upon recently delivered Local Growth Fund (LGF) improvements at M4 Junction 17, which opened in May 2018. Overall, the LGF scheme aimed to alleviate peak period congestion and safety issues and to deliver capacity enhancements.

1.2. Document Purpose

Effective Risk Management is fundamental to successful Project delivery and the management of uncertainty. It applies at all stages of Project execution and is a fundamental part of Project Management.

This document, the Project Risk Management Plan (RMP), is a document that provides a management framework to ensure that levels of risk and uncertainty impacting the Atkins objectives, contractual obligations and liabilities are properly identified, reviewed and managed for the duration of the M4 Junction 17 Improvements Project.

Further information about risk management within Transportation division can be found in the Risk & Opportunity Management Plan which is found in TDW under Project Management / Mandatory documents. It includes risk management requirements at each stage of the Project lifecycle, being referenced and linked to Minimum Viable Governance (MVG).

The purpose of this Risk Management Plan is to describe the process, Scope of Services for Risk Management and the methodology used for implementing risk management for the M4 Junction 17 Improvements to contribute to achieving the Project objectives including:

- Establishing the context for Risk Management (Scope of Risk Management) - Planning Risk Management activities including:
- Identify the “categories” of risk to be managed – examples: Project Risk (PR); Business Risk (BR); and Event Driven Risk (EDR). Client’s Risk (Operation and operation readiness), HSE risk, etc;
- Address and allocate responsibilities in implementing the Risk Management approach through the “RACI” Matrix (RACI - Responsibility, Approval, Consulting and Information);
- Clearly identify which risk categories will be managed by the Atkins Project Team and which will be solely under **Wiltshire Council** responsibility.

The Risk Management approach applied to this Project includes;

- The process of identifying, analysing, mitigating, reporting and updating risks and issues;
- Addressing cost associated with the identified risks in terms of “risk exposure costs”, risk mitigation costs and other as required specific to this Project;
- Outlining organizational roles and responsibilities of all key Project Team Members;
- Reporting risks at different levels and for different purposes;

- Continuously monitoring and controlling risks by following up on mitigation plans and detailed action items in a timely manner;

2. Background

In June 2019, Atkins prepared an Options Assessment Report (OAR) for the MRN scheme which examined six options across three themes: public transport, improvements to the existing highway network and delivering additions to the highway network. The MRN scheme OAR short-listed three options, all relating to delivering improvements to the highway at M4 Junction 17:

- Option A: Widen A429 and B4122 approaches to M4 Junction 17 and deliver full signalisation.
- Option B: Widen all approaches to M4 Junction 17 and deliver full signalisation. The M4 offslips, A429, B4122 and A350 will be widened to provide additional capacity, while the northern and southern edges of the gyratory will be widened to accommodate additional lanes. The eastbound M4 on-slip will be widened to provide a longer merge.
- Option C: Widen overbridges at M4 Junction 17. Widen approaches to M4 Junction 17 and deliver full signalisation. Option C will build upon Option B but will widen the full gyratory to accommodate additional lanes.

Atkins and Wiltshire Council engaged with National Highways in June 2020, where a modification to Option B was discussed (Option B+). The modification incorporated three narrow lanes across the existing overbridges, delivering the benefits of Option C whilst keeping within the programme and budget constraints of the scheme. Option B+ has been selected as the preferred option to progress in the Outline Business Case (OBC).

- **Option B+ (preferred option): Provide three narrow lanes across the two overbridges at M4 Junction 17. Widen approaches to M4 Junction 17 and deliver full signalisation.**

The current MRN junction improvement scheme aims to accommodate and unlock planned and future growth in the Chippenham area through providing additional capacity at M4 Junction 17, and to provide effective junction performance once the future growth ambitions have been realised. National Highways also requested that Wiltshire Council provide evidence that Option B+ provides sufficient capacity for the Local Plan, (Housing Infrastructure Fund) HIF and MRN growth. Atkins is undertaking a separate sensitivity test using VISSIM to satisfy this requirement.

A diagram of the area covered by the M4 Junction 17 Improvement in Figure 2-1 below.

Scope

Refer to the Project Brief: [WC_M4J17-ATK-GEN-XX-PM-ZM-000001](#)

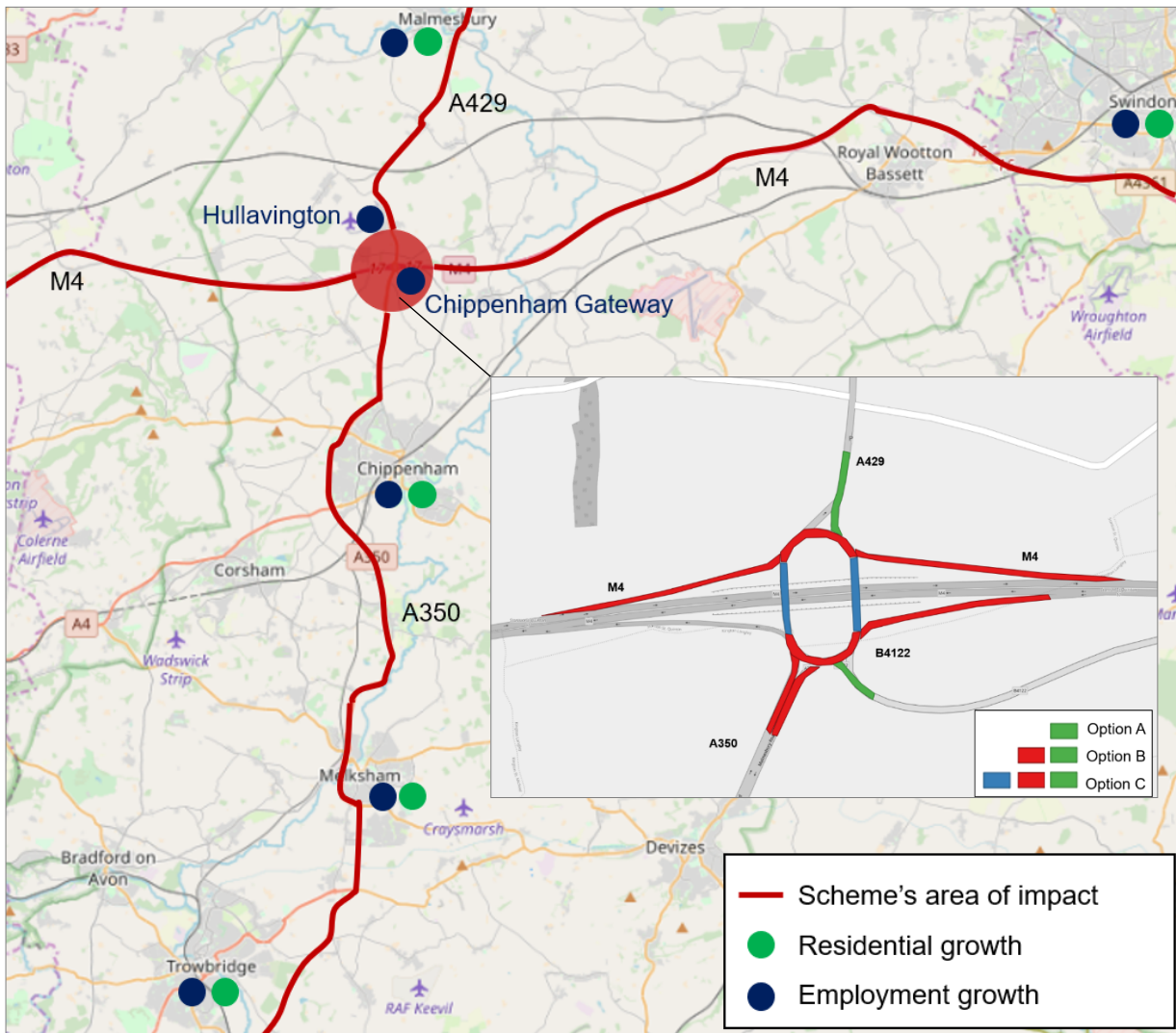
Organisation, Resources, Stakeholders and Interfaces

Refer to the Project Delivery Plan [WC_M4J17-ATK-GEN-DP-ZM-000001](#)

List of Deliverables

- Outline Business Case
- Modelling and Economics Report
- Construction Cost Estimate
- Risk Management Plan
- Risk Register
- Quantitative Cost Risk Analysis
- Project Schedule – Primavera P6
- Project Management Plan
- Procurement Strategy
- Text input to the public Web Page
- EIA Screening
- Phase 1 Habitat Survey
- Preliminary Ecological Appraisal Report
- GG119 Road Safety Audit
- GG142 WCHAR Assessment
- Departures from Standards Checklist

Figure 2-1 – Showing the location of the scheme and proposed options A, B & C



3. Definitions

3.1. Definition of a risk

The current standard for the definition of risk according to ISO 31000:2018, is “effect of uncertainty on objectives” and the Institute of Risk Management (IRM) Definition is that “risk is a combination of an event and its consequence. Consequence can range from positive to negative”. Risks include both threats and opportunities, with negative and positive impacts on objectives as suggest by the IRM definition.

The purpose of Risk Management is the creation and protection of value. It improves performance, encourages innovation and supports the achievement of the objectives.

3.2. Definition of an issue

An issue is a problem that currently impacts or is known will have an impact on the Project and is being managed by the Project Team. Issues are identified and managed through the Issues Management process and must not be shown on the Risk Register.

The understanding of these definitions is very important. Risks have an element of uncertainty, while issues do not. Atkins Transportation seeks to minimise risks (likelihood of occurrence and level of impacts) and maximise the ability to take opportunities. Atkins also seeks to manage the general uncertainties in the scope of work (including durations, prices, costs). However, uncertainty in scope is not a risk, as throughout the Project lifecycle there is a level of uncertainty so the probability of occurrence of uncertainty is 100%.

3.3. Definition of Risk Assessment

Risk Assessment is the overall process of risk identification, risk analysis and risk evaluation. Risk Assessment should be conducted systematically, iteratively and collaboratively, drawing on the views of stakeholders. It should use the best available information, supplemented by further investigation as necessary. An initial review of the context and constraints is essential. According to the British Standard ISO 31000:2018, the key steps are:

- Identification
- Analysis / Assessment
- Evaluation
- Treatment
- Monitoring and Review

A glossary of terms is included at the start of this document. For additional definitions and terms please refer to the Group Major Projects Unit (MPU) Glossary of Terms and Abbreviations; see link below.

http://axis.eu.atkinglobal.com/se/ourstandards/majorProjects/Pages/world_mpuglossary.aspx

4. Roles and Responsibilities

There are various staff resources and stakeholders involved in managing Project risks; in some cases, one individual may perform multiple roles within the process. The Responsibility Matrix below provides a summary of the key responsibilities and documents required for robust programme risk management and the individuals responsible (R), accountable (A), consulted (C) and informed (I) in management and delivery.

Table 4-1 – Programme Risk Management Responsibility Matrix

	Project Director	Project Manager	Design Manager	Risk Manager	Technical Leads	Wiltshire Council (Head of Major Highways Project)
R – responsible						
A – accountable						
C – consulted						
I – informed						
Develop Project Risk Management Plan (RMP)	A	R	C	R	I	
Implement RMP	A	R	I	C	I	
Risk Identification	R	A	R	C	R	C
Develop and Manage Risk Register	C	A	C	R	C	C
Arrange Risk Workshops	A	C		R		
Risk Reporting	C	A	C	R	C	C
Run the Quantitative Cost Risk Analysis	C	A	C	R	C	C

4.1. Project Director

The Project Director is accountable for ensuring that the Project Team is aware of the RMP and requirements for Risk Management. The document should be reviewed and updated at least annually. They are responsible for the approval of the document and have ultimate responsibility for the final decision on risk actions, including approving Risk Mitigation Plans and monitoring risks.

4.2. Project Manager

The Project Manager is responsible for implementing the risk management process and for ensuring threats and opportunities are captured both from within Atkins Transportation as well as from external sources, such as supply chain (contractors), clients, approval or regulatory bodies. The Project Manager is supported by a Risk Manager who provides advice, support and guidance as necessary.

4.3. Risk Manager

The Risk Manager (RM) is responsible for:

- Writing the Programme Risk Management Plan
- Supporting Project risk identification activities
- Facilitating the identification of new risks and review of existing risks
- Leading the quantitative risk analysis activities
- Supporting the team developing risk mitigation and contingency strategies
- Facilitating the proposal of mitigation strategies and contingency or fall-back plans
- Providing advice on escalating risks and identification and review of top-scoring risks
- Facilitating inter-Project communication through the execution of the risk management process
- Ensuring that Project risk owners are managing identified risks in accordance with this PRMP

- Training Project staff in risk responsibilities as required
- Briefing staff on any changes to the risk management process
- Proposing process improvements to this PRMP and risk management processes

4.4. Project Team

Identification of Project risks is the responsibility of everyone contributing to the Project. When a risk involves more than one design package, to ensure maximum control of risk, every effort is made to allocate the responsibility for risk control to the Package Manager best placed to manage it. If appropriate, the other Package Manager(s) will be asked to define and implement the actions to mitigate the risk insofar as this reduces the overall risk of the Project.

The Project Team participates in the risk identification process and discusses risk monitoring and mitigation activities at risk workshops and team progress meetings. A new risk may be identified at any time by the Project Team members for inclusion in the risk register; the RM ensures risks are not duplicated.

4.5. Risk Owner

This plan requires that a Risk Owner is assigned to each risk. The Risk Owner is an individual who is considered best placed to manage a risk, such as the Project Manager or a discipline leader, and has the appropriate accountability and resource. Risk owners are responsible for defining the risk treatment plan and for providing status reports. They are accountable for assigning Action Owners to treatment actions and ensuring agreed actions are progressed.

The Risk Owner shall be a member of the Project team and is the person identified by the Project Manager as responsible for managing an allocated individual risk.

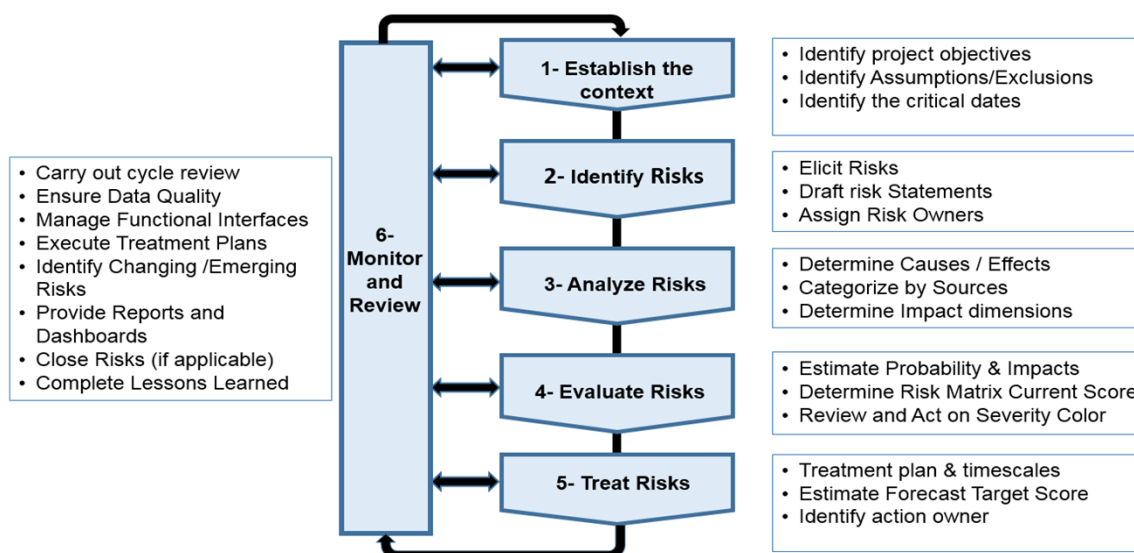
4.6. Action Owner

The Action Owner is an individual assigned by the Risk Owner who is responsible for implementing one or more risk treatment actions through to completion. In some cases, a single individual could act in more than one of the roles. For example, a Project Manager may be a Risk Owner and an action owner for certain risks. The risk owner must first accept ownership of the risk; then the Risk Owner defines the risk management strategy and agrees the actions and responsibilities with Action Owners to deliver this strategy.

5. Risk Management Process

The Project Teams will adopt the standard approach to risk management, compliant with ISO 31000: 2018 shown in Figure 5-1 below.

Figure 5-1 - Risk Management Process



5.1. Establish Context

Establishing the context includes defining the scope of the Project, the Project objectives and criteria to be used for assessing risks.

At Tender stage, prior to Stage Gate 1b, the Bid Manager will arrange the risk workshop. At Contract Award (Stage Gate 2) and thereafter, the responsibility falls to the Project Manager to liaise with the Risk Manager to arrange the risk workshops. The Bid Manager, Project Manager or the Risk Manager arrange the invitations, the venue and facilities.

Initially, the first risk workshop will include the Atkins Project Team to gain consensus of the internal risks and to identify potential client risks, with heads of discipline attending.

The risk workshop will commence by affirming a common view on objectives, specific goals and constraints related to the Project. These attributes should include the following:

- Project objectives
- Targets and KPIs
- Constraints (physical, operational and regulatory)
- Budget
- Timescale for Project completion
- Key interfaces with third parties
- Contractual obligations
- Stakeholders (including subcontractors)
- Key assumptions and dependencies
- Internal constraints (i.e. resources)

Once a Project that forms part of the Programme is in delivery risk workshops should include input from Wiltshire Council to ensure a common understanding of Project risk and that Risk Owners and Action Owners assigned are appropriate. A joint risk workshop involving the Atkins and Wiltshire Council Project teams should be carried out on monthly basis to coordinate risk management activities.

5.2. Identify Risk

The identification of threats and opportunities typically takes place in the risk workshop, with technical and engineering experts present; further workshops can occur at key stages or Gates. However, risk identification is a continuous process throughout the Project lifecycle. All Project staff are responsible, and identification of risks should not be limited to risk workshops but also through other means, including one-to-one meetings, technical meetings, progress meetings and review of lessons learned from previous similar Projects and programmes.

The Project context, including objectives and critical success criteria, is confirmed so that the participants are appropriately focused.

Risks are uncertain events that could affect the Project objectives, such as impacting quality or performance of delivery, late or reduced delivery, increased costs or other impacts such as reputation.

The wording or articulation of each risk should follow a simple three-step approach:

1. Identify all the causes of the risk (the circumstances that may give rise to the risk)
2. Explain the event (a description of what could happen)
3. Identify and list the impacts that may affect the Project objectives as a consequence of the event

Note, not all the causes or impacts necessarily occur if the risk happens, for example, the organisation's reputation may or may not be affected, or design rework may not always become critical or delay a key milestone. Areas to consider include capabilities, changes in external or internal context, limitation of knowledge and reliability of information, biases and assumptions of those involved. Not all risks are within the Project Team's control; if this is the case risks should be escalated as defined in Section 5.4 to ensure that risk and Action Owners are able to define and implement effective risk treatment.

5.3. Risk Analysis

The purpose of risk analysis is to understand the nature of a risk and its characteristics, including the likelihood of occurrence and the impact should a risk occur. Risk analysis involves a detailed consideration of risk sources, consequences, likelihood, events, scenarios and existing controls and their effectiveness. Other considerations include complexity and connectivity, time-related factors, the quality of the information used, the assumptions and exclusions made, any limitations of the techniques used and how they are executed.

Risk analysis can be qualitative or quantitative. In a qualitative analysis, definitions are assigned to risk impacts and probability in order of magnitude. The M4 Junction 7 Improvements Scheme uses a 'five by five' risk matrix of five categories of probability and five categories of impact used to analyse a risk. These definitions are provided in Table 5-1 of Section 5.4.

Quantitative analysis assigns values to individual risks, usually cost and time impacts, in order to run a risk simulation model and the potential impacts on cost and time of the risks identified by the Project Team. The process of carrying out this analysis is detailed in Section 6.

5.4. Evaluation

M4 Junction 17 Improvements Scheme will use the Faithful and Gould EZRisk Tool to record the identification, description, treatment plans and analysis of risks.

It is mandatory to complete the Enterprise Advantage Risk Register, for both Divisional and Group Governance, including Group Risk audits, Transportation Division or SNC Lavalin risk audits and EA performance reporting. Data is summarised in EA using the scores from the main risk register following an update.

The EZRisk and Transportation risk registers are uploaded to EA monthly and saved with a date stamp to the Documentation folder.

The probability and impacts for each risk are quantified for both pre-mitigated and post-mitigated scenarios. A single percentage value e.g. 30% is used for pre-mitigated probability and another for post-mitigated, e.g. 10%.

The Risk Register uses automatic scoring once the risk probabilities and impacts are quantified, using the relevant banding levels (risk parameters). The only exceptions are performance or quality impacts, where suitable words for levels of impact are used for the risk owner to determine the qualitative score, then the qualitative score is input directly into the performance/quality impact level field, e.g. a 3 for medium level performance would indicate a significant criterion is not met.

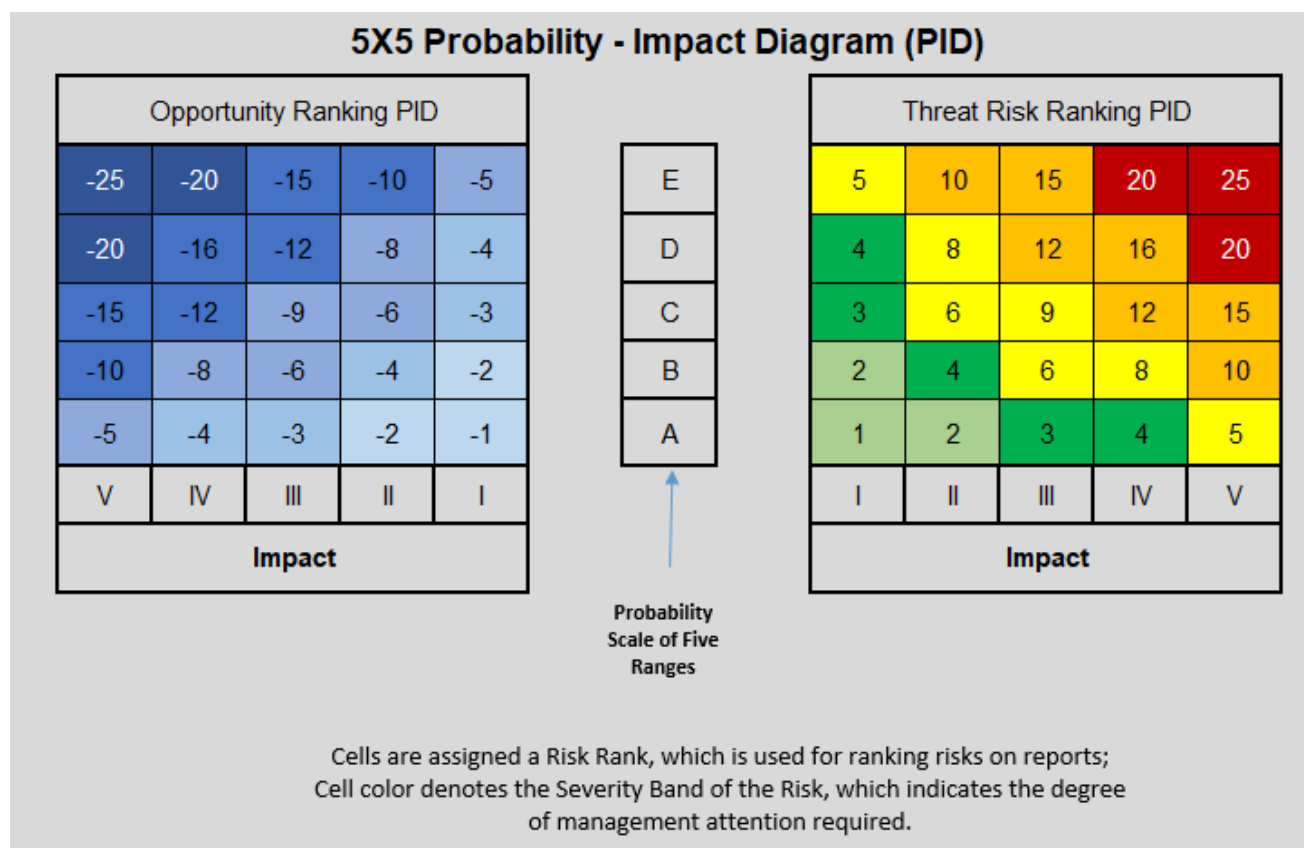
The risk parameters set for qualitative analysis with the risk register scoring are shown in Table 5-1.

Table 5-1 - Risk Parameters used for the scheme
Standard Scoring Scheme

Score Ref	Rank	Probability	Impact Criteria					Rank
			Cost Range	Schedule Range [Delay]	Reputation	Benefits	Objective	
5	Very High	75%-99%	> 1M	> 3months	Major National or Statewide adverse media coverage affecting ANA and Group	>3months	Unable to deliver major business commitments	>16
4	High	50%-75%	500K - 1M	2months- 3months	Major local / minor National or Statewide adverse media coverage affecting ANA	2months- 3months	Major impact on delivery of existing commitments and constraint on growth	>9
3	Medium	25%-50%	250K - 500K	1 month- 2 months	Minor local adverse media coverage	1month- 2 months	Partial delivery of business objectives	>4
2	Low	10%-25%	100K - 250K	2 weeks - 1 Month	Complaint Trends	2 weeks - 1 Month	Late or inconsistent delivery of business objectives	>2
1	Very Low	0%-10%	1 - 100K	< 2 weeks	One off limited complaints from clients or public	< 2 weeks	Negligible impact on business objectives	<=2

Risks are further evaluated using a scoring matrix or Probability Impact Diagram (PID), the highest risk impact score and the probability score is used to obtain a single value Risk Score for each risk. The risks, when reordered from high to low risk scores, ranks them in order of importance, or significance to the Project.

The Probability Impact Diagram (PID) for the EZRisk tool used on the M4 Junction 17 Improvements scheme is shown in Figure 5-2, puts emphasis on the magnitude of the risk impacts rather than that of the probability. This is because it is more important to focus on managing a risk with a very low probability that could have a significant impact on the Project objectives, than it would be for one with a very high probability and very low impacts. Therefore, the scoring mechanism skews the risk scores towards level of impact. The resulting risk scores in the matrix have no intrinsic meaning – they rank the risks so that the top risks are apparent to the Project Manager and Senior Management for reporting.

Figure 5-2 - PID for Risk Register Template Scored


Risk analysis (Section 5.3) provides an input to Risk Evaluation, to decisions on whether the risk needs to be treated and how and on the most appropriate risk management strategy. The purpose of risk evaluation is to inform and support Project and Project decisions. The Project Team will need to consider whether additional actions are required to consider risk treatment options, undertake further analysis to understand the risk, maintain existing controls or reconsider objectives.

Decisions should take account of the wider context and the actual and perceived consequences to external and internal stakeholders. The outcome of the risk evaluation should be recorded, communicated and validated using the Risk Register.

Table 5-3 provides an outline of the minimum actions required of the Project Manager based on the severity score derived from qualitative assessment.

Table 5-3: Actions prompted by severity level of an individual risk

Severity	Action
Very High	Escalate to Business Level & Wiltshire Council (Head of Major Highways projects) and agree on appropriate management
High	Report to Business Level and agree on appropriate management if requires
Medium	Manage at Project Level and agree on appropriate management if requires
Low	Manage and report at Project Level

5.5. Risk Treatment

5.5.1. Risk Treatment Overview

The treatment of a threat is a means to prevent or reduce Project overspend, delayed deliverables or reduced performance levels; it will promote activities that will help to avoid or reduce adverse impacts or the chance of these events happening. In contrast, treatment of an opportunity will aim to improve the chances of realising the opportunity and maximising the cost saving, accelerated timescales or improved quality of the Project output.

Risk treatment will identify clearly what can be done to reduce the threat, either to an acceptable level or to remove it completely and increase opportunity. The cost of the treatment actions should be included in the baseline. However, if the treatment strategy is not effective and has to change, new treatment measures could affect the cost outturn and may impact the schedule, and this should be considered in the ongoing analysis and management of risks. When risk treatment actions are carried out, assessment of any residual risk values remaining is recorded in the risk register. The value of probability and impacts before treatment are termed pre-mitigated values and after treatment are post-mitigated values.

5.5.2. Treatment Strategies

Once risks have been assessed, a Risk Treatment Plan must be prepared. A Treatment Plan establishes how the Project will address the probability of a specific risk and the magnitude of its impacts. Treatments should be designed to mitigate or prevent the issue occurring, be independent from the risk sources, be dependable and auditable.

The strategies available to manage threats are:

- **TRANSFER** - Transfer the threat to a third party to take ownership and responsibility, such as to an insurance company or escalate internally to a corporate entity outside the Project. Risk transference does not eliminate the threat.
- **ACCEPT** - Where control over the threat or mitigation will be disproportionate to the benefit gained or where no mitigation is possible, the only strategy will be to tolerate or accept the risk. However, some fall-back plans will be decided in advance to deal with the impacts in case the risk occurs.
- **REDUCE**- The most common strategy is to mitigate or treat the threat. Most risk mitigation strategies aim to reduce the risk impacts to acceptable levels or to reduce the probability that they will occur.
- **AVOID** - An action taken to completely avoid the risk and therefore to terminate it. Whilst it is the preferred method of threat treatment it is a less frequently used strategy, as few risks can be eliminated entirely.

The strategies available to manage opportunities are:

- **EXPLOIT** - take deliberate action to achieve maximum benefit from the opportunity.
- **IGNORE** - do nothing as the opportunity is too difficult or expensive to actively pursue.

5.5.3. Risk Treatment Actions

The aim of risk treatment is to reduce the probability of a risk occurring or to reduce the level of impacts that could result if the risk occurs. There are three types of treatment or mitigation actions:

- **ACTION** - A physical task with a defined deliverable or outcome. The actions should be SMART: Specific, Measurable, Achievable, Realistic and Timely and with an owner identified.
- **CONTROL** - On-going monitoring, stakeholder engage or procedure changes.
- **FALLBACK ACTIONS** - A set of actions which will be taken only if the risk happens.

The success of the actions taken will be monitored on a regular basis to check effectiveness. If the actions are not improving towards achieving the post-mitigated values, then alternative actions or strategies will be considered.

Each identified treatment action needs an Action Owner responsible for ensuring that the actions are executed to plan within the timescales or costs. The Action Owner reports progress of these actions to the Risk Owner.

5.6. Risk Monitoring and Review

Risk owners, supported by the Action Owner, will keep track of identified risks and analyse each risk regularly to determine whether the probability, impacts, treatment strategies or actions need to be amended. This may be owing to treatment progress, better information about the risk becoming available, external or other Project events. The risk owner will define and agree any revised strategies or plans for mitigation actions. Risk reviews are mandatory and must be held each month, unless agreed otherwise on a month-to-month basis, to ensure changes in risk profiles are visible.

The objectives for the risk review meetings are to:

- Review the high priority risks
- Review status of and progress against the Risk Treatment Plans
- Identify gaps and area overlaps
- Review Target Risk Levels and future review dates for the Risk Treatment Plans
- Decide whether the risk treatment strategy needs to change
- Discuss how identified risks impact key Project decisions
- Consider risks which need to be escalated or those near to a trigger point
- Review the documentation of new risks and prioritise as appropriate

A reassessment of the risk register may be needed if the scope of work changes. This could have an impact on the level of risk contingency needed to complete the Project. This is carried out as part of a Stage Gate 3a Review.

If a risk occurs, and the risk has a fall-back plan, the Project Manager and the Risk Owner will consider activating the fall-back plan. When a risk impacts the Project, the impacts, whether to time, cost or consequential performance and remedies, will be treated as an issue that will be managed and transferred to the Issue Register.

If an impacted risk cannot occur again, it will be closed. However, if the risk could occur again, the risk will remain open, even if the risk event is managed separately as a Project issue or change item.

When risks impact, the effects will be reported in the Project Statement Review (PSR), recorded in the risk register with dates, delay impacts, cost and performance effects.

All risks will be monitored, tracked for both treatment action progress and impact events until they are past the trigger point and can be closed.

Management will be notified monthly of important changes to risk status, new risks, and overall health of risk process on the Project. A Top 5 Risk list is also included as one of the components of monthly report for Project Manager's review.

5.6.1. Risk Reviews and Frequency

5.6.1.1. Risk Meetings

- Joint Initial Risk Review Meeting: Lead by the Risk manager and involve the Project Director, the Project Manager, Technical Leads and Wiltshire Council representatives. The meeting focuses on introducing the project context, objective and key performance indicators and identifying the risks, their cases and impacts.
- Joint Risk Register Review Meetings – lead by the Risk Manager; undertaken on a monthly basis. Includes the Project Manager, Project Manager, Wiltshire Council representatives and all Risk Owners. The focus is on reviewing major risks, identifying new risks, closing out risks as appropriate, ensuring all risks have owners, a treatment plan and that owners are managing risks as defined by the agreed treatment plan.
- QCRA Risk Review Meetings- led by Risk Manager; undertaken on a quarterly basis; involves Discipline Leads, Package Managers, Project Controls Manager; focus is on estimating the cost of potential risk to the Project using Monte-Carlo analysis to calculate a P80 risk value.
- Internal Risk Register meetings – arranged by the Risk Manager, when necessary, involves the Project Manager and any relevant stakeholders. The aim is to fill any gaps in the risk register prior to the formal joint risk review meetings.

5.6.1.2. Reports and Communication

- Project Risk Register – managed by Risk Manager; updated and published internally within Project only and circulated on a monthly basis. Example in Appendix A.
- Project Dashboard Report - managed by Risk Manager; published monthly for Project manager. Example in Appendix B.
- Project QCRA Report - managed by Risk Manager; updated and published internally within Project and circulated on a monthly basis. Example in Appendix C.
- Project Board presentation – managed by Project Manager with assistance of Risk Manager for external communication.

6. Quantitative Risk Analysis

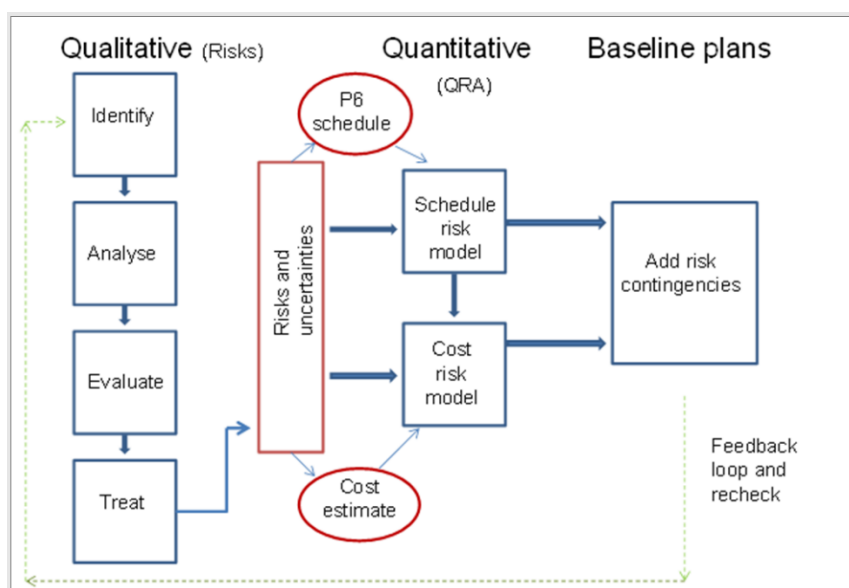
Cost and schedule risk modelling is employed on the M4 Junction 17 Improvements scheme to ensure that the exposure to risk is understood; that the remaining contingency funds are expected to be sufficient to last to the Projects' and Project end; and to understand the confidence the Project has in meeting delivery dates, including whether current plans are likely to be achieved or not.

When carrying out quantitative risk assessments, the opportunities are excluded from the modelling for risk contingency calculation. However, risk models can be re-run with opportunities included as a scenario. The results will indicate the benefits that could be achieved if these opportunities are implemented. It provides an incentive to develop and promote the most favourable opportunities to pursue, with necessary approvals.

The risk process for qualitative analysis (to develop the risk register) and quantitative risk modelling is shown in Figure 6-1 below. It is a live, iterative process - the risks are reviewed regularly, the cost and schedule risk contingencies will be re-checked at key points in the Project life cycle, or at the request of the Project Manager.

For the risks identified for quantitative analysis, the cost to implement the treatment strategy will be estimated wherever possible to establish the validity of the treatment costs. The Quantitative Cost Risk Analysis (QCRA) result informs the Project Manager of the current level of confidence in achieving the budget, key dates, cost range and earliest and latest achievable dates.

Figure 6-1 - Quantitative Risk Analysis Process



6.1. Quantitative Cost Risk Analysis

Quantitative Cost Risk Analysis (QCRA) uses two types of risk as inputs into the risk model: estimating uncertainty and discrete risks. In order to analyse the impact of cost on these two types of risk, the Risk Manager must work with the Project Manager and other members of the Project delivery team forming part of the Project, to estimate the cost range of impacts for both the estimating uncertainty and discrete risks. The only difference in the inputs is that discrete risks relate to uncertain events which require a probability of occurrence to be estimated; whereas estimating uncertainty relates to the uncertainty associated with planned scope and has 100% probability.

The results of the analysis show the level of confidence of achieving the planned Project costs. It also identifies the individual discrete risks which could have the greatest impact on achieving Project success, and the most significant cost uncertainty headings, via a Tornado graphical output. The P80 cost value will be used for internal SNC Lavalin risk cost reporting purposes and the P50 and P80 values reported to Wiltshire Council.

Appendix C shows a typical frequency distribution chart, presenting the range of total Project costs with corresponding confidence levels (probabilities) and a cumulative curve. An example of a Tornado Graph showing the top cost influencers to total Project costs is also shown. Tornado graphs can be displayed for estimating uncertainty, Project risks or total Project costs

Appendices



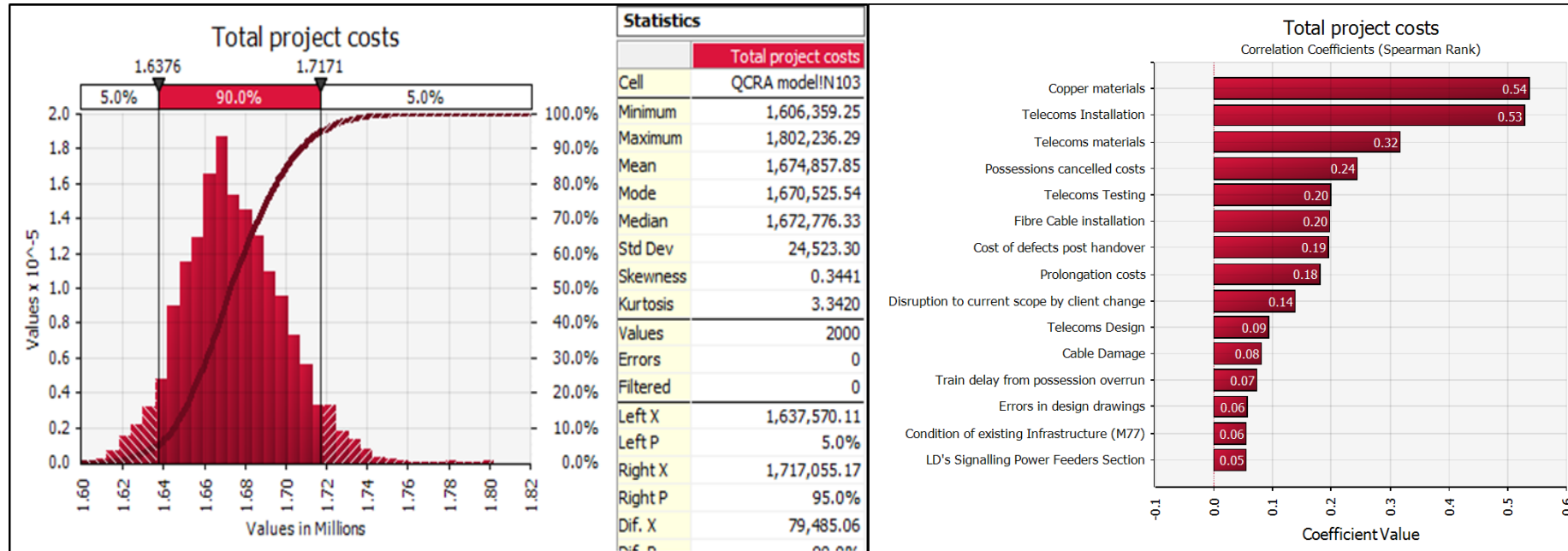
Appendix A. Sample Risk Register

Project Name: Shepperton Project Scheme Review Date: July 20, 2017 Reporting Month: Jul-17 Type of Project: Large Project - Revenue >£10M																																					
Project Risk Register																																					
Order	Risk ID	Month Raised	Risk Status	Risk Title	Risk Type	Discipline	Risk Owner	Cause	Risk Event	Effect	Risk Sources	Pre-Treatment Impact				Assessment Notes	Treatment Plan				Post-Treatment Impact																
												OS	ES	LS	LS		OS	ES	LS	LS	OS	ES	LS	LS	OS	ES	LS	LS									
1	17	Apr-17	Open	Poor performance of Atkins on the project will result in LD's	Technical	Subcontract	Nick Clarke	1. Delays in system production 2. Contractual section completion dates	The project may miss section completion dates for which penalties may apply	1. Section completion dates achieved late 2. Cost of LD's to Network Rail 3. Client lack of confidence of Atkins achieving Electrologix projects to plan	General	5	5%	5	5	21	£300,000	£500,000	£972,000	1. Develop an action plan for mitigating the impact delay (Ongoing) 2. QRisk on Modified Software programme to determine likely impact of recent changes (By end of July 2017)	Nick Clarke, Andreas Antury	31-Aug-17	1	2%	5	5	21	£300,000	£500,000	£972,000	Y	Y					
2	22	Jun-17	Open	Maintenance spares that have not been accounted for initially	Acquisitions/D	Procurement	Nick Clarke	1. Material spares required by the RAM	The number of required spares may be higher than anticipated	1. Long lead time to procure materials. 2. Additional cost	Construction	5	80%	3	4	14	20	£50,000	£75,000	£100,000	1. Arrange a meeting to discuss the strategy for provision of spares (Completed on 6 July 2017) 2. Agree a spares list (Expected by end of August 2017).	Nick Clarke	31-Aug-17	3	40%	2	4	14	18	£10,000	£20,000	£30,000	30	45	60	Y	Y
3	18	Apr-17	Open	Atkins design errors and CAT 3 (design not accepted)	Technical	Engineering	Stephen Murton / Ford Uddin	1. New technology 2. Design not following the codes and standards	The design may be rejected	1. Design delays causing Procurement delays (Check whether this is the case) 2. Additional time and cost required to review and re-design	Design	2	20%	3	4	17	£30,000	£75,000	£150,000	1. 3 Week re-work on each design submission for Hampton Level crossing lighting, PSP design and 600 V power distribution, E&P design submissions 2. Atkins discipline engineers learning lessons from previous failed design submissions (Ongoing) e.g. Upper Waterloo sub-station	Steve Murton	31-Aug-17	2	20%	3	4	17	£30,000	£75,000	£150,000	30	45	60	N	Y		
4	6	Aug-16	Open	Rework from previous GRIP stages	Technical	Engineering	Stephen Murton / Ford Uddin	1. Inherent design errors 2. Rework from previous GRIP stages.	Errors or omissions may result in rework in Grip 5.	1. Cost and programme delays as result of rework to design impacting construction and testing programme	Scope	2	20%	4	4	17	£150,000	£200,000	£300,000	1. Pre-IDC reviews for all major design packages (Attain GRIP Form 8) 2. Risk assessment for Shepperton GS 8 to include detection of design errors from previous grip stages 3. Site Acceptance Testing (SATS) Auto-configuration (December 2017)	Steve Murton / Ford Uddin	31-Aug-17	2	20%	4	4	17	£150,000	£200,000	£300,000	30	45	60	N	Y		
5	9	Aug-16	Open	Additional principles testing requirements (i.e. Mathematical model alignment)	Technical	Engineering	Mick Crook	1. Mathematical model not validated against principles testing	Mathematical model may not be aligned to control tables / principles testing. Alterations may be required. Principle Testing usually in 3 phases towards the end of the project but due to new Technology additional testing might be required in Principle Cycle stage	1. Programme delay 2. Extension of key staff 3. Cost overrun (Additional testing and development of model / additional principles testing)	Design	4	70%	3	4	14	£50,000	£75,000	£150,000	1. Insufficient data in terms of estimates 2. Confirm the principle testing requirements on development projects (Old Oak Common, CREWE and Chisworth) to be able to obtain more accurate assessments (ongoing monitoring) 3. New software tool is being developed (Automated test process) (ongoing monitoring) 4. Aim to make system to have a difference list (ongoing monitoring)	Mick Crook	30-Sep-17	2	20%	3	4	14	£50,000	£75,000	£150,000	35	45	60	Y	Y		
6	16	Apr-17	Open	Existing Barrier bases (Hampton Level Crossing) unsuitable for reuse	Technical	Engineering	Stephen Murton / Ford Uddin	1. Existing base unsuitable to accept plug coupled cables	The base may need to be a) Modified to accommodate cable entry or b) Signalling detailed design may need to be modified	1. Programme Delays (Impact to commissioning programme) 2. Cost of re-design 3. Additional site works with increased costs	Scope	4	60%	3	4	14	£50,000	£75,000	£150,000	1. Site investigation to determine the available capacity (Carried out in June 2017) - An agreement that all the level crossing bases could be reused only if modifications to the base is carried out at the time of the commissioning 2. Revised level crossing GA has been produced following the site visit (July 2017) 3. IDC and has been submitted to NR for acceptance (this includes the alteration of the barrier bases)	Steve Murton, Steve Murton	31-Aug-17	2	25%	3	4	14	£50,000	£75,000	£150,000	30	45	60	Y	Y		
7	23	Jul-17	Open	Signal Stage Works decoupled by NR causing delays to commissioning	Technical	Engineering	Stephen Murton / Ford Uddin	1. Track access availability 2. Fault failure during commissioning. 3. Cable tray alterations to workout in structure	Risk that Signal Stage works may take longer to achieve a changeover	1. Potential delay to handover in commissioning programme 2. Commissioning overrun 3. Additional costs of delay	Construction	2	20%	2	3	12	£10,000	£25,000	£50,000	1. Meeting held to assess the probable causes and impacts (26 June 2017). 2. Response sent to NR following the meeting (July 2017)	Steve Murton / Ford Uddin	31-Aug-17	2	20%	2	4	14	£10,000	£25,000	£50,000	10	30	60	N	N		
8	12	Aug-16	Open	Lack of key resources or competency	Staff/HR	Project Controls	Evette Howard	1. Lack of signalling, systems or engineering resources (e.g. ETE/E&P/Civils) available when needed 2. Other projects competing for the same resources (e.g. Old Oak Common, Chisworth, NW)	lack of resource availability at every stage of the project (GRIP5 8) may cause programme delays	1. Additional cost of re-work 2. Delay in submittals	Design	3	50%	2	3	13	£10,000	£35,000	£50,000	1. Recruit new software design resources (Ongoing) 2. Use competent subcontractor for critical positions (Ongoing) 3. Change of methodology to current verification processes (Ongoing) 4. Automation of certain aspects of the verification process (Ongoing)	Evette Howard	31-Aug-17	2	30%	2	4	14	£10,000	£30,000	£50,000	30	40	60	Y	Y		
9	13	Aug-16	Open	Constrained procurement timescales	Acquisitions/D	Procurement	Jule Hendry	1. MMS (Materials Master Schedule) is incorrect (i.e. Materials not identified) 2. Delay in getting signage and post on time	Unable to provide an accurate pricing estimate	1. Procurement delays 2. Additional cost (e.g. Additional material / equipment that was not identified) 3. Delay to construction	Construction	4	60%	2	3	14	£15,000	£20,000	£30,000	This is for the whole of the project including MMS Week 34 (Major installation works) 1. Identify additional equipment missing from the MMS (week 13) - (Completed on 22.06.17) 2. To sort out the materials required for location case build - Free issued materials to be purchased (To be delivered by August 2017). 3. Some EIS materials will not be now delivered in August. EW raised with the project team (June 2017)	Jule Hendry	31-Aug-17	2	20%	2	4	14	£15,000	£20,000	£30,000	30	50	60	N	Y		
10	15	Apr-17	Open	Failure to request site access as previously planned (e.g. Week 13 Possession)	Commercial	Project Management	Evette Howard	1. Poor document preparation and planning by Atkins 2. Design delays 3. Main gate (e.g. FSP, Signal Head material, Telecom location cases, JDCS, etc.) not available	Site access denied by NR including possessions (e.g. Week 13 possession)	1. Programme delay 2. Cost overrun including cost of procurement due to late ordering etc.	Construction	2	30%	3	4	17	£50,000	£125,000	£150,000	1. Possession overruns potentially there could be another possession 2. Attend T3 possession/planning meetings to meet NR possession requirements (When required according to OWPV Delivering Works Within Possessions) 3. Attend weekly construction meeting (Atkins/NR) to discuss issues 4. Having the visibility latest Network Rail possession plan (Once an update is done) 5. Incomplete works done by other NR subcontractors will need to be done by Atkins (e.g. Civils) 6. Interface milestones have been added to the programme in relation with these issues raised by the construction team (Completed in May 2017)	Evette Howard	31-Aug-17	2	20%	2	4	14	£10,000	£30,000	£50,000	15	40	60	Y	Y		
11	3	Aug-16	Open	Budget overrun due to Estimating shortfalls	Finance	Project Management	Nick Clarke	1. Scope missed or underestimated 2. Architectural errors or omissions 3. Gaps in estimates arising from interfaces between disciplines	LOE to complete the project is underestimated	1. Poin conatol 2. Reputational impact	Scope	5	80%	3	3	13	£50,000	£75,000	£150,000	Currently 30k overrun for signalers desk and signal equipment. 1. Gap review of GRIP 4 design prior to contract award (Completed) 2. Collaborative program and scope development (Ongoing) 3. Preliminary IDC meetings to better align designs (Ongoing) 4. Job Cards to be developed for all deliverables - (Not relevant). Team to understand what the expectation is from NR. This is done through the Engineering	David Uddin / Steve Murton	31-Aug-17	5	80%	3	3	13	£30,000	£50,000	£75,000					Y	N	
12	11	Aug-16	Open	Management of Alstom subcontract	Commercial	Subcontract	Bryan Paton	1. Poor scope definition 2. Poor performance for ICC and Electrologix interface 3. Technical issues delaying works	Alstom as one of the main subcontract (supplier of Protocol converter system) delaying the programme	1. Programme delay 2. Technical issues and re-design/re-work		2	25%	3	3	12	£10,000	£50,000	£75,000	1. Appointment of design project manager (Completed in May 2017) 2. Identification of change opportunities and negative PMs (Ongoing)	Nick Clarke, Bryan Paton	31-Aug-17	2	15%	3	3	12	£10,000	£50,000	£75,000	10	20	30	Y	Y		

Appendix B. Sample Monthly Dashboard

Report Month Jul-17			Risk Information			SCORING			Top 10 Risks (Post-Treatment)																							
Total Risks Status			Total Risks Type			Heat Map - Pre-Treatment			Risk Order	Risk Event	Post-Treat Sc	Previous Score	Plan Owner	Due Date																		
Risk Status	Number of Risks	% Total	Status Risk Type	Number of Risks	% of Total																											
Open	21	88%	Acquisitions/Disposals	2	8%				1	Poor performance of Atkins on the project will result in LD's	21	21	Nick Clarke, Andres Antury	31-Aug-17																		
Retired	0	0%	Commercial	6	25%	<table border="1"> <tr><th>Score</th><th>VH</th><th>H</th><th>M</th><th>L</th><th>VL</th></tr> <tr><td>Current</td><td>1</td><td>1</td><td>0</td><td>2</td><td>0</td></tr> <tr><td>Target</td><td>1</td><td>10</td><td>3</td><td>0</td><td>1</td></tr> </table>			Score	VH	H	M	L	VL	Current	1	1	0	2	0	Target	1	10	3	0	1	2	Maintenance spares that have not been accounted for initially	18	19	Nick Clarke	31-Aug-17
Score	VH	H	M	L	VL																											
Current	1	1	0	2	0																											
Target	1	10	3	0	1																											
Merged	1	4%	Business Continuity	0	0%	<table border="1"> <tr><th>Score</th><th>VH</th><th>H</th><th>M</th><th>L</th><th>VL</th></tr> <tr><td>Current</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>Target</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr> </table>			Score	VH	H	M	L	VL	Current	0	1	0	1	0	Target	0	1	0	1	0	3	Atkins design errors and CAT 3 (design not accepted)	17	17	Steve Murton	31-Aug-17
Score	VH	H	M	L	VL																											
Current	0	1	0	1	0																											
Target	0	1	0	1	0																											
Closed - Mitigated	0	0%	Market Factors	0	0%	<table border="1"> <tr><th>Score</th><th>VH</th><th>H</th><th>M</th><th>L</th><th>VL</th></tr> <tr><td>Current</td><td>0</td><td>1</td><td>1</td><td>2</td><td>0</td></tr> <tr><td>Target</td><td>0</td><td>1</td><td>1</td><td>2</td><td>0</td></tr> </table>			Score	VH	H	M	L	VL	Current	0	1	1	2	0	Target	0	1	1	2	0	4	Rework from previous GRIP stages	17	17	Steve Murton / Forid Uddin	31-Aug-17
Score	VH	H	M	L	VL																											
Current	0	1	1	2	0																											
Target	0	1	1	2	0																											
Closed - Impacted	2	8%	Reputational	0	0%	<table border="1"> <tr><th>Score</th><th>VH</th><th>H</th><th>M</th><th>L</th><th>VL</th></tr> <tr><td>Current</td><td>0</td><td>0</td><td>3</td><td>3</td><td>0</td></tr> <tr><td>Target</td><td>0</td><td>0</td><td>2</td><td>0</td><td>1</td></tr> </table>			Score	VH	H	M	L	VL	Current	0	0	3	3	0	Target	0	0	2	0	1	5	Additional principles testing requirements (i.e. Mathematical model alignment)	17	17	Mick Crook	30-Sep-17
Score	VH	H	M	L	VL																											
Current	0	0	3	3	0																											
Target	0	0	2	0	1																											
Total	24	100%	Technical	12	50%	<table border="1"> <tr><th>Score</th><th>VH</th><th>H</th><th>M</th><th>L</th><th>VL</th></tr> <tr><td>Current</td><td>1</td><td>0</td><td>0</td><td>2</td><td>0</td></tr> <tr><td>Target</td><td>1</td><td>0</td><td>0</td><td>2</td><td>0</td></tr> </table>			Score	VH	H	M	L	VL	Current	1	0	0	2	0	Target	1	0	0	2	0	6	Existing Barrier bases (Hampton Level Crossing) unsuitable for reuse	17	19	Pat McLoughlin, Steve Murton	31-Aug-17
Score	VH	H	M	L	VL																											
Current	1	0	0	2	0																											
Target	1	0	0	2	0																											
			Staff/HR	1	4%	<table border="1"> <tr><th>Score</th><th>VH</th><th>H</th><th>M</th><th>L</th><th>VL</th></tr> <tr><td>Current</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>Target</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> </table>			Score	VH	H	M	L	VL	Current	0	0	0	0	0	Target	0	0	0	0	0	7	Signal Stage Works descope by NR causing delays to commissioning	17	-	Steve Murton / Forid Uddin	31-Aug-17
Score	VH	H	M	L	VL																											
Current	0	0	0	0	0																											
Target	0	0	0	0	0																											
			Finance	3	13%	<table border="1"> <tr><th>Score</th><th>VH</th><th>H</th><th>M</th><th>L</th><th>VL</th></tr> <tr><td>Current</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>Target</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> </table>			Score	VH	H	M	L	VL	Current	0	0	0	0	0	Target	0	0	0	0	0	8	Lack of key resources or competency	17	17	Evette Howard	31-Aug-17
Score	VH	H	M	L	VL																											
Current	0	0	0	0	0																											
Target	0	0	0	0	0																											
			PI Claims	0	0%	<table border="1"> <tr><th>Score</th><th>VH</th><th>H</th><th>M</th><th>L</th><th>VL</th></tr> <tr><td>Current</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>Target</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> </table>			Score	VH	H	M	L	VL	Current	0	0	0	0	0	Target	0	0	0	0	0	9	Constrained procurement timescales	17	19	Julie Hendry	31-Aug-17
Score	VH	H	M	L	VL																											
Current	0	0	0	0	0																											
Target	0	0	0	0	0																											
			Environmental	0	0%	<table border="1"> <tr><th>Score</th><th>VH</th><th>H</th><th>M</th><th>L</th><th>VL</th></tr> <tr><td>Current</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>Target</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> </table>			Score	VH	H	M	L	VL	Current	0	0	0	0	0	Target	0	0	0	0	0	10	Failure to request site access as previously planned (e.g. Week 13 Possession)	17	17	Evette Howard	31-Aug-17
Score	VH	H	M	L	VL																											
Current	0	0	0	0	0																											
Target	0	0	0	0	0																											
						<p>Executive Summary</p> <p>Project Scope: The Feltham re-signalling project is the renewal of all signalling assets controlled from Feltham Area Signalling Centre (ASC) and Wokingham Signal Box (SB). The project proposes to renew 9 RRIs with new centralised ElectroLogIXS (CBI) interlockings controlled from Basingstoke ROC. Feltham area was last re-signalled in 1974 and the infrastructure is now suffering from severe degradation, obsolescence and unreliability. The maintainer has, for a number of years, been undertaking a continuous programme of spot renewals in an attempt to maintain the life of the assets. The Shepperton Branch is the first stage of Feltham Area Re-signalling project. It is the section of line between Fulwell and Shepperton, includes 8KM of Rail, 6 Stations and 2 substations. The Shepperton Branch has been selected to be an accelerated trial of the ElectroLogIXS interlocking, Newgate Barrier Machines, Auto Re-configurable Power supply and IECC Scalable control system. The purpose of this stage is to demonstrate successful trial of the new ElectroLogIXS interlocking and wider system integration prior to the migration to Basingstoke ROC.</p> <p>Key Commercial Issues:</p> <ol style="list-style-type: none"> 1- General increase in materials costs 2- The extended project duration leads to higher indirect cost 																										
<p>Top 10 Risks - Discipline</p> <table border="1"> <tr><td>Project Management</td><td>0</td></tr> <tr><td>Project Controls</td><td>1</td></tr> <tr><td>Engineering</td><td>5</td></tr> <tr><td>Procurement</td><td>2</td></tr> <tr><td>Subcontract</td><td>1</td></tr> <tr><td>Construction</td><td>0</td></tr> </table>			Project Management	0	Project Controls	1	Engineering	5	Procurement	2	Subcontract	1	Construction	0				<p>Cost Exposure: (based on July QCRA)</p> <p>-15 of 21 (open) risks were identified to have cost impact and included in the QCRA analysis</p> <p>Schedule Exposure: ElectroLogIXS Software programme to have a QSRA once the resource plan is complete. Expected by August 2017.</p>														
Project Management	0																															
Project Controls	1																															
Engineering	5																															
Procurement	2																															
Subcontract	1																															
Construction	0																															

Appendix C. QCRA Output Samples



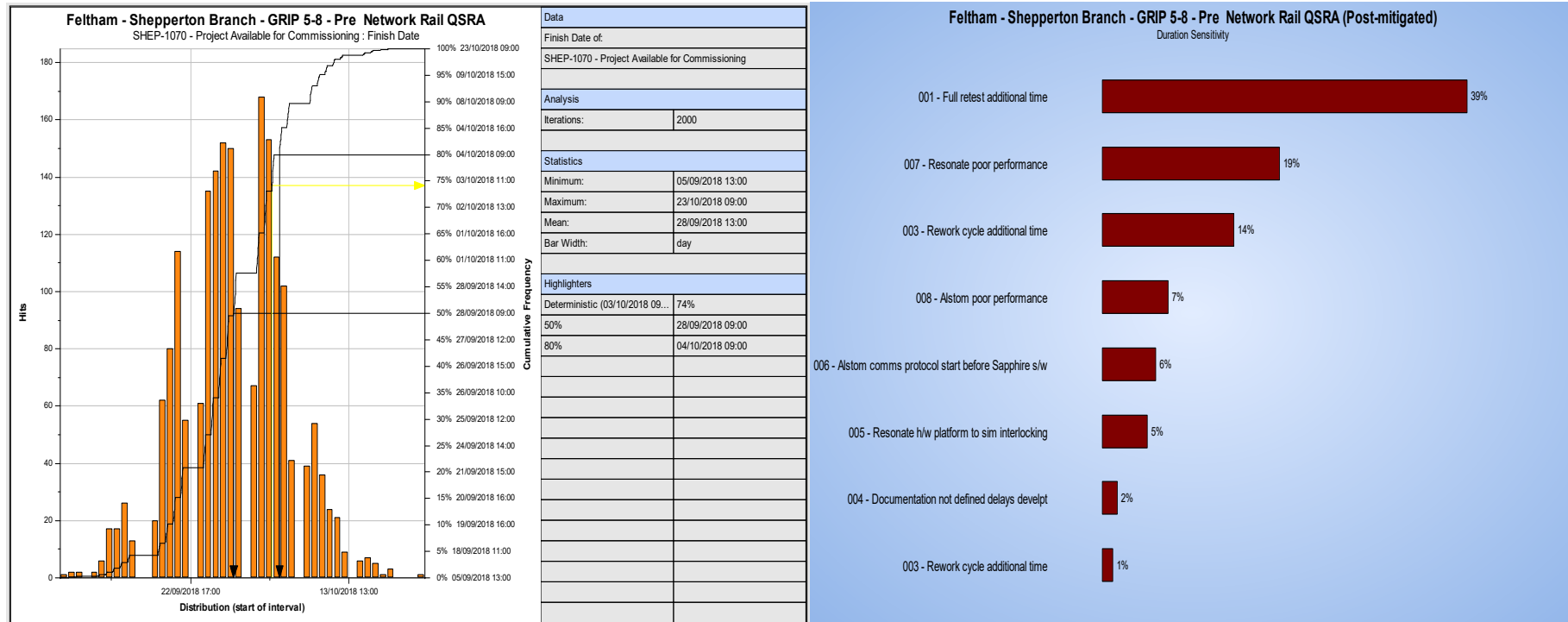
Total Project costs frequency and cumulative graph

Tornado graph of total Project costs & risks

A typical frequency distribution chart, presenting the range of total project costs with corresponding confidence levels (probabilities) and a cumulative curve.

A typical example of a Tornado Graph showing the top cost influencers to total project costs. Tornado graphs can be displayed for estimating uncertainty, project risks or total project costs.

Appendix D. QSRA Output



Frequency graph with cumulative S curve

Comparing the planned date (highlighted in yellow), with the range of output for a key milestone, a time risk contingency at a confidence level e.g. 80% can be determined. The planned date for completion will be highlighted on the frequency graph if it is within range. If it is not within the output range, the project has zero chance of meeting the date.

Tornado graph with key schedule activities driving risk

Tornado Graph output from the schedule risk model, displaying the top schedule driving risks – i.e. those which could affect the project end date the most, to the extent that their duration sensitivity indicates.

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