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Wiltshire Council



Melksham Bypass OBC

WC_MBP-ATK-GEN-XX-DP-ZX-000007

Risk Management Plan

31/03/21

AB

Notice

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This document has 23 pages including the cover.

Document history

Revision	Suitability	Purpose description	Originated	Checked	Reviewed	Authorised	Date
C01	AB	DF1.1	AA	TF	JG	AM	31/03/21

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1. Introduction

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.

The purpose of the Risk Management Plan, is to provide a management framework to ensure that levels of risk and uncertainty impacting the Melksham Bypass Highways Project are properly identified, reviewed and managed throughout the project lifecycle. The expectation is to create an environment and a context for proactively identifying and dealing with risks and issues. This includes prioritising and assessing risk so that the right resources can be applied in a timely manner for implementing mitigation plans to minimise risks or increase opportunities. This will include recording and communicating these risks, as well as the eventual close-out of specific risks and the project itself. It is written to interface with the Wiltshire Council Programme Risk Management Strategy, which defines the process for managing risk across the entire Melksham Bypass Programme.

This document describes the methods for identifying, analysing, prioritising, and tracking risk drivers, developing Risk Mitigation Plans and planning for adequate resources to handle risk. Also, it assigns specific responsibilities for the management of risk and prescribes the documentation, monitoring, and report processes to be followed.

2. Project Description

Improving north-south connectivity is a key challenge of the Western Gateway, and the A350 forms a primary north-south route connecting the M4 with the Dorset coast. It passes around the principal settlements of Chippenham and Trowbridge via the town of Melksham and the neighbouring village of Beanacre, and on to Westbury and Warminster. Growing congestion and delay on the A350 will, if left unaddressed, hinder the economic relationships between the north and south of the area. The proposed scheme is for a new road alignment for the A350 around Melksham, bypassing the village of Beanacre.

Wiltshire Council has been awarded funding to prepare an Outline Business Case for the delivery of the scheme.

The scheme is proposed to mitigate the following issues experienced on the A350 at Melksham:

- Limitations of the road network around Melksham – the layout of the road network means the A350 serves multiple functions. Journeys to and from the north and south of Melksham must pass through the town via the A350, or face significant diversions using other routes.
- Physical constraints in the ‘urban’ sections of the A350 in northern Melksham and Beanacre village – the A350 passes through residential areas with 30mph limits, is constrained by property frontages on both sides and there are several junctions in northern Melksham used, predominately, by local traffic to access amenities.
- Insufficient capacity of the A350 through Melksham to cope with current and projected future traffic volumes – significant peak period congestion is currently experienced on the Melksham-Beanacre sections, especially around Farmers and Semington Road roundabouts, and between Bath Road and the Leekes store.
- High collision rates along the A350 through Melksham - twelve serious collisions have been recorded between 2012 and 2016, with severity rates generally higher on the A350 compared to other roads in the area.
- Severance impacts on communities in Beanacre and northern Melksham – high traffic volumes using the route (including significant numbers of HGVs) exposes residents to noise and air pollution, and pedestrian access to local shops in northern Melksham and the town centre is restricted, which discourages walking and cycling along the route.

3. Risk Management Overview

The benefits of having a Project Risk Management plan include:

- Assignment of clear roles and responsibilities within the project team for risk management.
- Enhanced team communication and commonality of approach.
- Assisting project managers to understand the potential risk exposure, to develop a focused treatment plan to reduce the likelihood of risks occurring or to mitigate the impacts and to understand confidence in achieving project targets.
- Understanding the resource constraints and time dependencies.
- Support the allocation of project contingency funds and sufficiency of management reserve.
- Increasing the value of the project investment through identification and exploitation of opportunities.

The fundamental approach adopted in applying risk management is that it should not be viewed as an add-on to the project management process but rather, must be embedded into the project management process.

3.1. Risk Definition

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 suggested by the IRM definition.

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

3.2. Issue Definition

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 should not be confused for Risks. The understanding of these definitions is very important. Risks have an element of uncertainty, issues do not.

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. This Matrix should consider the programme roles and responsibilities as set out in Section the Wiltshire Council Programme Risk Management.

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

Table 4-1 - Risk Management Responsibility Matrix

4.1. Project Director

The Project Director is accountable for ensuring that the Project Team is aware of the Risk Management Plan and requirements for Risk Management. The document should be reviewed and updated at least annually and at key project milestones. 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.

4.2. Project Manager

The Project Manager is responsible for implementing the risk management process on their project. The Project Manager is also responsible for ensuring threats and opportunities are captured both from within the project team 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 is responsible for:

- Writing the Risk Management Plan
- Leading the quantitative risk analysis activities
- Supporting the team developing risk mitigation and contingency strategies
- Supporting project risk identification activities
- Facilitating the identification of new risks and review of existing risks
- 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 project communication through the execution of the risk management process

- Ensuring that project risk owners are managing identified risks in accordance with this Risk Management Plan
- Training project staff in risk responsibilities as required
- Briefing staff on any changes to the risk management process
- Proposing process improvements to this Risk Management Plan 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 Discipline Technical Lead (DTLs) best placed to manage it. If appropriate, the other DTLs 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 Risk Manager ensures risks are not duplicated.

4.5. Risk Owner

This Risk Management 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 DTLs, 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 Risk Management process for the Melksham Bypass project will follow that set out below in Figure 5-1.

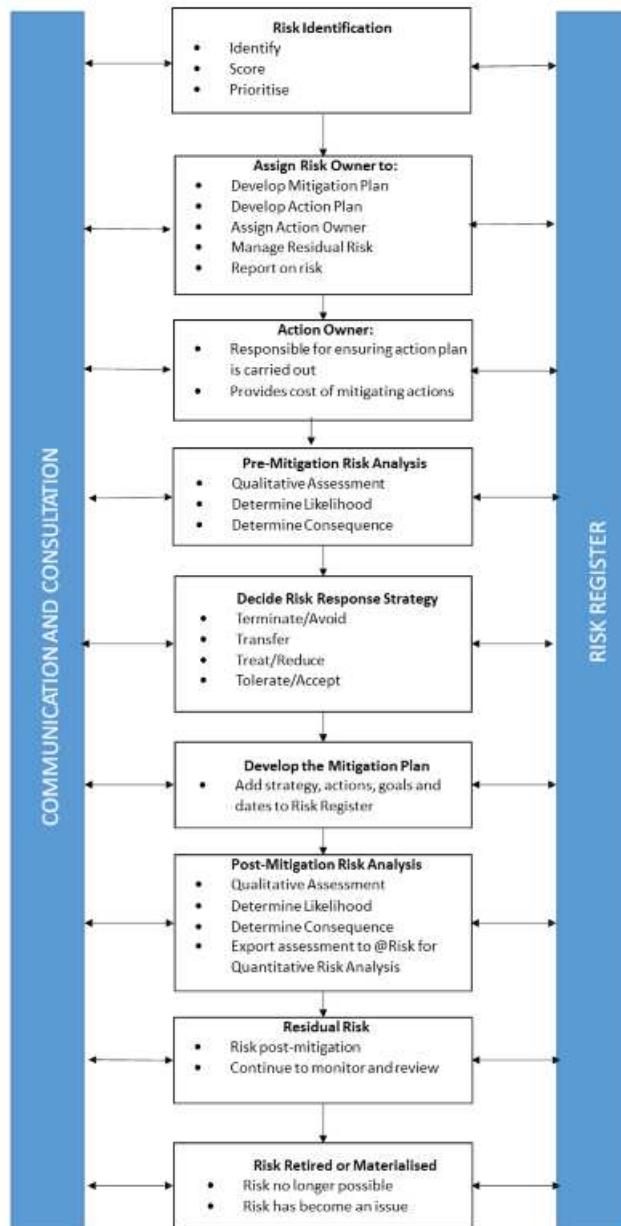


Figure 5-1 - Risk Management Process

5.1. Risk Identification

Risk identification is the process of examining the various project areas and each critical process to identify and document any associated potential risks. Throughout the project lifecycle, the Project Team shall continuously strive to identify new risks. This shall be accomplished through periodic and event-driven risk identification meetings. Nevertheless, all project staff are responsible for risk, and identification of risks should not be limited to risk specific 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.

All risks (threats and opportunities) which are identified as having a potential impact on the project are evaluated and each risk is further identified by the following “Risk Type”:

- Political and Policy

- Economic and Financial
- Statutory Process and Legal
- Design and Technical
- Environmental
- Stakeholder
- Procurement
- Construction
- Operation and Maintenance

The above topics of risks fit well under “project” risk that can best be managed by the Project Team. However, other categories of risk, if identified and are part of the Risk Management mandate for this project may need to be addressed and added to the scope of Risk Management/Services on this project. Risk identification meetings are usually conducted as structured mind map sessions and will include the Project Team, representatives from Wiltshire Council and, where appropriate, representatives from third parties such as the preferred contractor. Each meeting will systematically work through all areas and phases of the project (or the specific area and phase identified for the meeting) to identify:

- New risks and potential causes.
- Preliminary review of mitigation strategies.
- Assign Risk Owner; and
- Identify exposure period.

5.2. 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 Melksham Bypass project will use a ‘five by five’ matrix of five categories of probability and five categories of impact used to analyse a risk. These definitions are provided in Table 6

Quantitative analysis assigns values to individual risks, usually cost and time impacts, 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 [Risk Management \(atkinsglobal.com\)](http://atkinsglobal.com).

5.3. Risk Mitigation

The first step in mitigating a risk is to decide on the risk response strategy. Risks will be mitigated by a combination of impact reduction and/or probability reduction. The following types of risk mitigations have been defined below:

- Risk Avoidance
- Risk Transfer
- Risk Reduction
- Risk Acceptance

5.3.1. Risk Avoidance

The most ideal way to mitigate a risk is to avoid it altogether. Risk avoidance involves eliminating or significantly reducing the probability of a risk by circumventing the risk altogether. For example, one may avoid time zone risk by co-locating a team in the same office.

5.3.2. Risk Transfer

The responsibility for each risk that cannot be avoided must reside with the party who is best placed to manage it. Risks may be transferred externally or internally within the project team and this may result in additional costs as parties insure against the probability of the risk occurring.

5.3.3. Risk Reduction

When risk avoidance or transfer is not possible, risks may be effectively mitigated by implementing strategies and tactics that lower either the probability of occurrence, or the consequence or sometimes both simultaneously. Strategies to reduce the consequence of threats are preferred over reducing its probability of occurrence. Therefore, consequence of threats may be reduced by implementing stringent controls.

5.3.4. Risk Acceptance

Risk acceptance is the acknowledgment of the existence of a particular risk and a conscious decision to accept it without engaging further special efforts to mitigate it. This may occur immediately after the risk has been identified or after all reasonable efforts have been made, successfully or unsuccessfully.

5.4. Residual Risk

Residual risk or post mitigation exposure is the anticipated risk that will remain after all reasonable and cost-effective mitigation strategies have been implemented. Residual risks should be monitored periodically to reduce any potential exposure. Residual risks are part of the basis for contingency calculation.

5.5. Risk Retirement or Materialisation

Risks may be retired if and when the risk period is over and the risk has not occurred, or if the risk is mitigated to a point where the risk is eliminated or if it is determined by the Project Team that an identified risk is not considered a risk or is a duplicate of another risk. If a risk occurs, and cannot happen again, the risk will also be retired. If the risk may happen again during the lifecycle of the project, it will remain active.

The Project Team must effectively manage the impact should a risk occur. Specific plans may be prepared and implemented for those risks that materialize to reduce the impact. Lessons learned from each materialized risk will be reviewed and implemented accordingly.

Risks may be retired if and when the risk period is over and the risk has not occurred, or if the risk is mitigated to a point where the risk is eliminated or if it is determined by the Project Team that an identified risk is not considered a risk or is a duplicate of another risk. If a risk occurs, and cannot happen again, the risk will also be retired and transferred to the Issues Register. If the risk may happen again during the lifecycle of the project, it will remain active on both the Risk Register and Issues Register.

The Project Team must effectively manage the impact should a risk occur. Specific plans may be prepared and implemented for those risks that materialize to reduce the impact. Lessons learned from each materialized risk will be reviewed and implemented accordingly.

6. Risk Management Strategy

6.1. Risk Evaluation

The Melksham Bypass project will use the Atkins Risk Register to record the identification, description, treatment plans and analysis of risks. In addition, it is mandatory to update the Enterprise Advantage (EA) Risk Register with critical risks that are scored high for probability and severity, for both Divisional and Group Governance, which is the responsibility of the Atkins Project Manager. Data is summarised in EA using the scores from the Project Risk Register. The Project Risk Register is stored on ProjectWise in: [WC MBP-ATK-GEN-XX-RK-ZM-000001](#).

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 Melksham Bypass Project Risk Register scoring are shown in Table 6-1

Score Ref	Rank	Probability (%)		Impact Criteria				Reputation	Project Performance
				Cost Range (£)		Schedule Range (days)			
				Min	Max	Min	Max		
5	Very High	75	90	>1M		>90		Major national adverse media coverage.	Unable to deliver critical criteria.
4	High	50	75	500k	1M	60	90	Major local/minor national adverse media coverage.	Major impact on delivery of criteria.
3	Medium	25	50	250k	500k	30	60	Minor local adverse media coverage.	Partial delivery of criteria.
2	Low	10	25	100k	250k	14	30	Complaint trends.	Late or inconsistent delivery of criteria.
1	Very Low	1	10		100k		14	One off, limited complaints.	Negligible impact on criteria.

Table 6-1 - Risk Parameter Scoring

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 (PID) for the Risk Register to be used on the Melksham Bypass project is shown in Figure 5-2 and 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 Project Director for reporting.

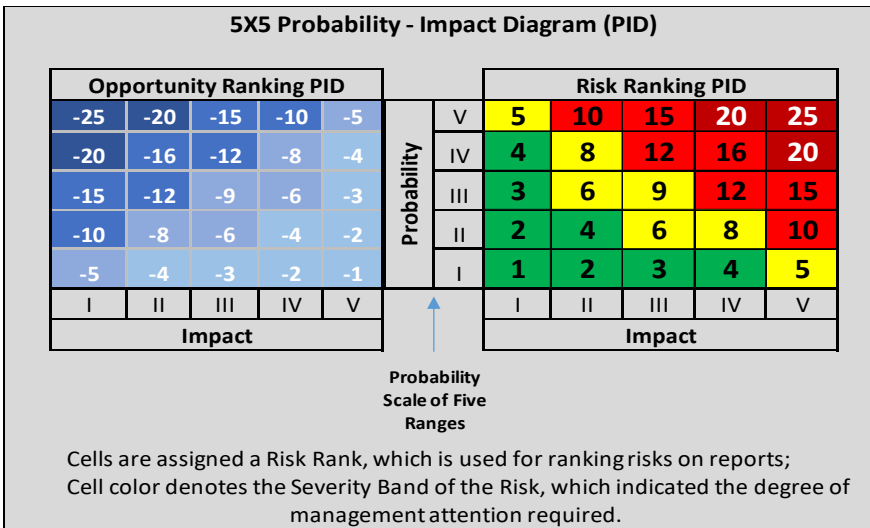


Figure 6-1 - 5x5 Probability Impact Diagram

Risk analysis (Section 5.2) 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 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 Project Risk Register.

Table 6-2 provides an outline of the minimum actions required of the Project Manager based on the severity score derived from qualitative assessment. These actions include appropriate reporting and escalation of risks within both Wiltshire Council and Atkins.

Severity	Action
Very High	Escalate to Wiltshire Council Organisational Level.
	Escalate to Atkins Business Unit and agree on appropriate management with Business Head.
High	Escalate to Wiltshire Council Programme Level and agree on appropriate management with Wiltshire Council Project Manager.
	Report to Atkins Business Unit.
Moderate	Manage at Project Level and report at Wiltshire Council Level.
Low	Manage and report at Project Level.

Table 6-2 - Actions prompted by severity level of individual risks

7. Risk Treatment

7.1. 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-treatment values and after treatment are post-treatment values.

7.2. 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 have been discussed in 5.3 Risk Mitigation.

The strategies available to manage opportunities are:

- EXPLOIT - take deliberate action to achieve maximum benefit from the opportunity.
- SHARE - take action to ensure the opportunity is shared, such as across the project team or with the supply chain.
- IGNORE - do nothing as the opportunity is too difficult or expensive to actively pursue.

7.3. 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.
- 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.

8. Risk Monitoring and Reporting

8.1. Risk Identification Reviews and Meetings

The identification, definition, analysis, and mitigation plans for risks will be captured in the Project Risk Register, which is managed by the Risk Manager. It is the responsibility of all those on the project to identify risks and notify the Risk Manager so that risks can be properly captured on the Risk Register.

The Project Risk Register will be discussed and updated on a monthly basis in a meeting between the Project Manager and the Risk Manager in order to ensure it is effectively maintained, reflects the current risk profile of the project and that actions are being tracked and carried out.

Risk Review Workshops will be carried out with Wiltshire Council and the project team at key hold points on the project to review and update the Risk Register as appropriate. As a minimum these workshops should be carried out on a quarterly basis, before proceeding to the next Project Stage and when key project decisions are required. As a minimum the following attendees should be at the Risk Review Workshop:

- Key Wiltshire Council Stakeholders
- Project Director
- Project Manager
- Design Manager
- Risk Manager

8.2. Risk Reporting

Reporting of risk should align with the Project requirements as defined in the Project Overview Plan [WC_MBP-ATK-GEN-XX-DP-ZM-000010](#) and Quality Management Plan [WC_MBP-ATK-GEN-XX-DP-ZX-000006](#). As a minimum the top 5 risks and status of treatment actions should be reported to the Project Management through risk review meetings.

9. Quantitative Risk Analysis

Cost and schedule risk modelling is employed on the Melksham Bypass project to ensure that the exposure to risk is understood; that the remaining contingency funds are expected to be sufficient to last to the end of the project; 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 9-1 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) and Quantitative Schedule Risk Analysis (QSRA) results inform the Project Manager of the current level of confidence in achieving the budget, key dates, cost range and earliest and latest achievable dates.

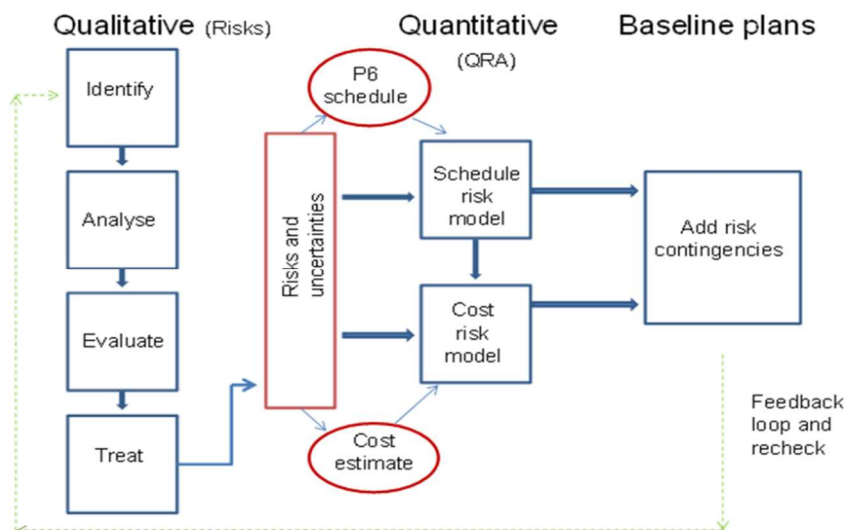


Figure 9-1 - Quantitative Risk Analysis

9.1. Quantitative Cost Risk Analysis (QCRA)

Quantitative Cost Risk Analysis (QCRA) to be undertaken at each Design Fix and as required by Traffic Economic team. The analysis 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 delivery, 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 P85 cost value will be used for internal Atkins risk cost reporting and Wiltshire Council Programme reporting purposes. For economic case P50 value will be used; P80 will be used for the financial case which is the outturn cost.

Appendix B 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.

9.2. Quantitative Schedule Risk Analysis (QSRA)

Due to the relatively low complexity of the project it is not proposed to employ Quantitative Schedule Risk Analysis for delivery of the Melksham Bypass Project. If delivery to programme is of particular concern to the Project Management Team, then this should be re-considered. Oracle Primavera Risk Analysis® software is used to conduct schedule risk analysis, so the programme is to be produced in this software. This package uses the deterministic project schedule in Primavera P6 (with single values for activity durations and defined milestone delivery dates) as the starting point for schedule risk analyses.

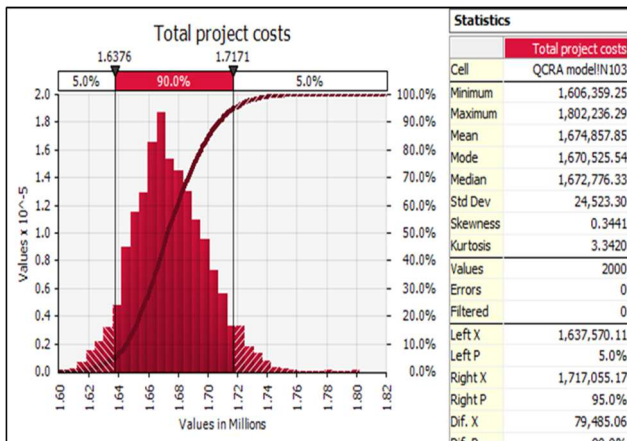
Appendices



Appendix A. Sample Risk Register

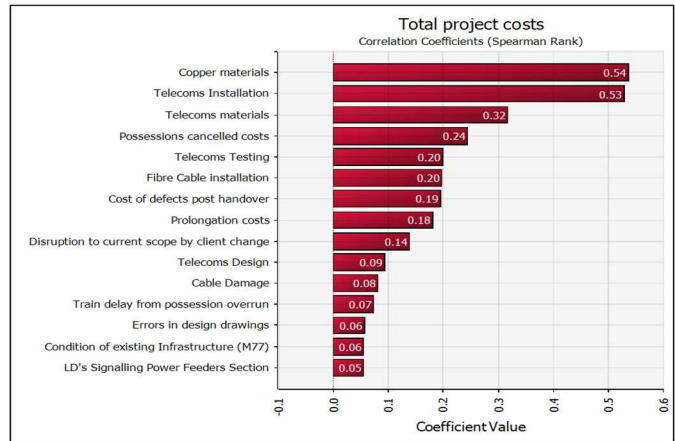
INDEX	FAITHFUL+GUILD	Project Name: SAMPLE TEMPLATE - PROJECT NAME , Review Date: ENTER DATE, Update Number: ENTER 1 FOR FIRST UPDATE	Spell Check	Risk Information										Current - Qualitative			Treatment Plan		User Fields		
ID	Risk ID	Date Identified	Risk Status	Threat/Opportunity	Risk Title	Risk Description	Risk Type	Risk Source	Risk Owner	Prob	Cost	Schedule	Score	Treat. Strategy	Treatment Plan	USER 1	USER 2	USER 3			
1	7	R001	1-Dec-15	1-Open	Threat	Risk 1 - Discovering hazardous material more than 600m offshore	During the survey, various areas have contaminations e.g. oil spill, mercury and lead	Technical	Construction	Dumming O	4 - High - 50%-75%	3 - Medium - 250K-500K	4 - High - 2months - 3months	15	Accept	Treatment Plan Risk R1			3-Dec-12		
2	30	R002	3-Feb-16	1-Open	Opportunity	Risk 2 - Potential Savings on Steel by Procure Pre-Cast Concrete Panels	Current estimate that there could be saved available to pre-cast concrete panels for this project. There are large amount of panels in the market. Risk could be lack of panels in the market to period making the bid to	Technical	General	Designer	5 - Very High - 75%-95%	5 - Very High - 1M	1 - Very Low - 4-2 Months	15	Accept	Treatment Plan Risk R2					
3	25	R003	4-Dec-15	1-Open	Threat	Risk 3 - Bid Price Higher than the Estimate		Market Factors	Market	Engineering	2 - Low - 15%-20%	5 - Very High - 1M	4 - High - 2months - 3months	15	Reduce	Treatment Plan Risk R3	1				
4	8	R004	9-Dec-15	1-Open	Threat	Risk 4	Risk Description_Risk 4	Market Factors	Design	Engineering	3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Transfer	Treatment Plan Risk R4					
5	9	R005	5-Dec-15	1-Open	Threat	Risk 5	Risk Description_Risk 5	Commercial	Design	Owner	3 - Medium - 25%-50%	5 - Very High - 1M	2 - Low - 2 weeks - 1 Month	15	Accept	Treatment Plan Risk R5					
6	50	R006	7-Dec-15	1-Open	Threat	Risk 6	Risk Description_Risk 6	Market Factors	Scope	Multi-D.	3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept	Treatment Plan Risk R6					
7	11	R007	8-Dec-15	1-Open	Threat	Risk 7	Risk Description_Risk 7	Reputational	General	Dumming O	3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Transfer	Treatment Plan Risk R7					
8	26	R008	9-Dec-15	1-Open	Threat	Risk 8	Risk Description_Risk 8	Financial	Early Works	Owner	3 - Medium - 25%-50%	2 - Low - 500K - 250K	4 - High - 2months - 3months	15	Accept	Treatment Plan Risk R8	2				
9	R009	10-Dec-15	3-Closed - Merged	Threat	Risk 9	Risk Description_Risk 9				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months		Accept				3			
10	R010	15-Feb-17	2-Closed - Retired	Threat	Risk 10	Risk Description_Risk 10				5 - Very High - 75%-95%	1 - Very Low - <100K	1 - Very Low - 4-2 Months		Accept							
11	R011	15-Feb-17	5-Closed - Impacted	Threat	Risk 11	Risk Description_Risk 11				5 - Very High - 75%-95%	2 - Low - 500K - 250K	2 - Low - 2 weeks - 1 Month		Accept							
12	25	R012	17-Feb-17	1-Open	Threat	Risk 12	Risk Description_Risk 12				5 - Very High - 75%-95%	2 - Low - 500K - 250K	2 - Low - 2 weeks - 1 Month	10	Accept						
13	27	R013	18-Feb-17	1-Open	Threat	Risk 13	Risk Description_Risk 13				5 - Very High - 75%-95%	2 - Low - 500K - 250K	2 - Low - 2 weeks - 1 Month	10	Accept			4			
14	32	R014	19-Feb-17	1-Open	Threat	Risk 14	Risk Description_Risk 14				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
15	13	R015	20-Feb-17	1-Open	Threat	Risk 15	Risk Description_Risk 15				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
16	14	R016	21-Feb-17	1-Open	Threat	Risk 16	Risk Description_Risk 16				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
17	15	R017	22-Feb-17	1-Open	Threat	Risk 17	Risk Description_Risk 17				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
18	50	R018	23-Feb-17	1-Open	Threat	Risk 18	Risk Description_Risk 18				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
19	17	R019	24-Feb-17	1-Open	Threat	Risk 19	Risk Description_Risk 19				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
20	50	R020	25-Feb-17	1-Open	Threat	Risk 20	Risk Description_Risk 20				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
21	19	R021	26-Feb-17	1-Open	Threat	Risk 21	Risk Description_Risk 21				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
22	38	R022	27-Feb-17	1-Open	Threat	Risk 22	Risk Description_Risk 22				0 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
23	21	R023	28-Feb-17	1-Open	Threat	Risk 23	Risk Description_Risk 23				3 - Medium - 25%-50%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
24	1	R024	1-Mar-17	1-Open	Threat	Risk 24	Risk Description_Risk 24				5 - Very High - 75%-95%	2 - Low - 500K - 250K	4 - High - 2months - 3months	15	Accept						
25	2	R025	2-Mar-17	1-Open	Threat	Risk 25	Risk Description_Risk 25				5 - Very High - 75%-95%	2 - Low - 500K - 250K	4 - High - 2months - 3months	15	Accept						
26	3	R026	3-Mar-17	1-Open	Threat	Risk 26	Risk Description_Risk 26				5 - Very High - 75%-95%	2 - Low - 500K - 250K	4 - High - 2months - 3months	15	Accept						
27	4	R027	4-Mar-17	1-Open	Threat	Risk 27	Risk Description_Risk 27				5 - Very High - 75%-95%	2 - Low - 500K - 250K	4 - High - 2months - 3months	15	Accept						
28	38	R028	5-Mar-17	1-Open	Opportunity	Risk 28	Risk Description_Risk 28				5 - Very High - 75%-95%	5 - Very High - 1M	4 - High - 2months - 3months	15	Accept						
29	22	R029	6-Mar-17	1-Open	Threat	Risk 29	Risk Description_Risk 29				5 - Very High - 75%-95%	3 - Medium - 250K-500K	2 - Low - 2 weeks - 1 Month	15	Accept						
30	28	R030	7-Mar-17	1-Open	Threat	Risk 30	Risk Description_Risk 30				5 - Very High - 75%-95%	1 - Very Low - <100K	2 - Low - 2 weeks - 1 Month	10	Accept						
31	29	R031	8-Mar-17	1-Open	Threat	Risk 31	Risk Description_Risk 31				5 - Very High - 75%-95%	2 - Low - 500K - 250K	2 - Low - 2 weeks - 1 Month	10	Accept						
32	20	R032	9-Mar-17	1-Open	Threat	Risk 32	Risk Description_Risk 32				5 - Very High - 75%-95%	3 - Medium - 250K-500K	2 - Low - 2 weeks - 1 Month	15	Accept						
33	5	R033	10-Mar-17	1-Open	Threat	Risk 33	Risk Description_Risk 33				5 - Very High - 75%-95%	4 - High - 500K - 1M	4 - High - 2months - 3months	15	Accept						
34	0	R034	11-Mar-17	1-Open	Threat	Risk 34	Risk Description_Risk 34				5 - Very High - 75%-95%	4 - High - 500K - 1M	3 - Medium - 3 weeks - 1 Month	15	Accept						

Appendix B. QCRA Outputs



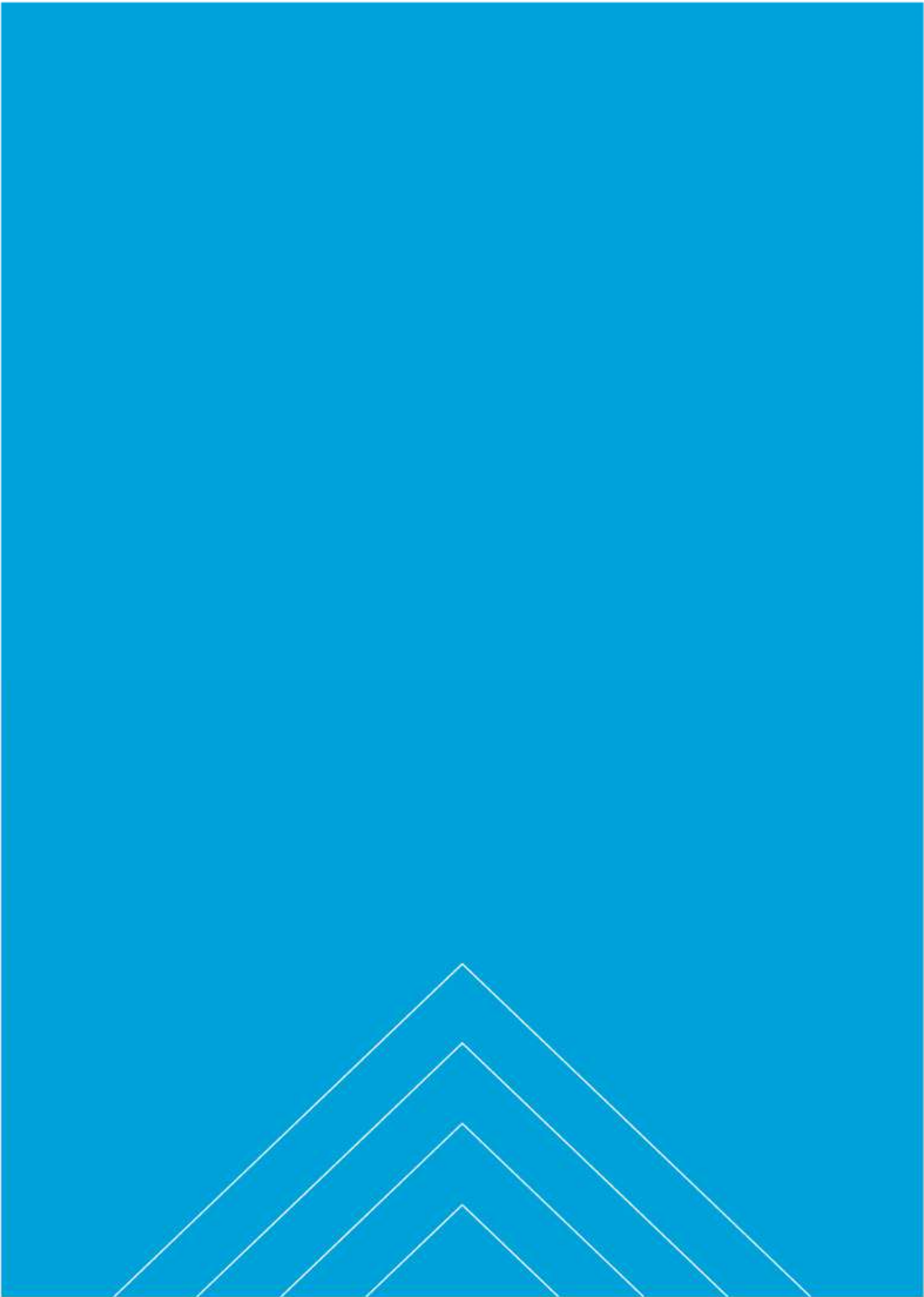
Total Project costs frequency and cumulative graph

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



Tornado graph of total project costs & risks

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.



3rd Floor, County Gate,
County Way, Trowbridge BA14 7FJ