MOTT MACDONALD

Medway Estuary and Swale Coastal Flood and Erosion Risk Strategy

Technical Appendix N - Risk Register

May 2018

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	25/09/17	L Wiggins	B Riley	Z Hutchison	For review and comment
B	29/03/18	L Eyres	B Riley	Z Hutchison	Final report following consultation
C	15/05/18	L Eyres	B Riley	Z Hutchison	Final report

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Contents

1 Introduction

The Environment Agency has appointed Mott MacDonald (MM) to develop the Medway Estuary and Swale Coastal Flood and Erosion Strategy (hereafter known as MEASS), with the aim of providing a Flood and Coastal Risk Management (FCRM) Strategy for the Tidal Medway Estuary, the Swale Estuary, and the Isle of Sheppey. The aim of MEASS is to assess how to best manage the coastline to protect people, properties, designated habitats, and agricultural land from coastal flood and erosion risk. As with all flood and coastal risk management work, the wider impacts must be considered. This means that the best technical solutions for defences need to be found, while also considering the impacts and benefits for local communities, the environment, and the cost to the tax payer.

1.1 Why the Strategy is being developed

There are currently coastal flooding and erosion risks to the communities and landowners around the Medway Estuary and Swale. Aging flood defences, rising sea levels and climate change mean that coastal flood and erosion risk to people, properties, habitats, and agricultural land will significantly increase in the coming years. Over the next 100 years it is predicted that 17,226 properties will be at an increased risk of tidal flooding (up to a 0.1%AEP event) within the MEASS area.

Currently most of the Strategy frontage is defended, especially around the Isle of Sheppey to protect the important port at Sheerness, and along the tidal River Medway to protect the Medway Towns. A significant proportion of the defences in the area are nearing the end of the design lives and the risk of failure during a storm event is high. However, it is not sustainable in the long term to continue to maintain all of the defences in their current position. Therefore, MEASS will assess how this risk can be best managed, in line with government guidance, to deliver the most sustainable FCRM management approach.

The strategy area has large extents of both intertidal and freshwater habitats which are both nationally and internationally designated. Intertidal habitat is at risk as sea levels rise, ‘squeezing’ it against the existing defences. Freshwater habitat is at risk from the failure of the defences, resulting in the inundation of saltwater, as well as the increased overtopping which could be associated from sea level rise. Therefore, MEASS is also legally obliged to assess how the adverse impacts to these designated habitats can be mitigated by realigning defences or creating compensatory areas in other locations.

1.2 Strategy Area

The Strategy area includes the Isle of Sheppey, the tidal extents of the Medway Estuary and the Swale estuary. The boundaries of the strategy area are:

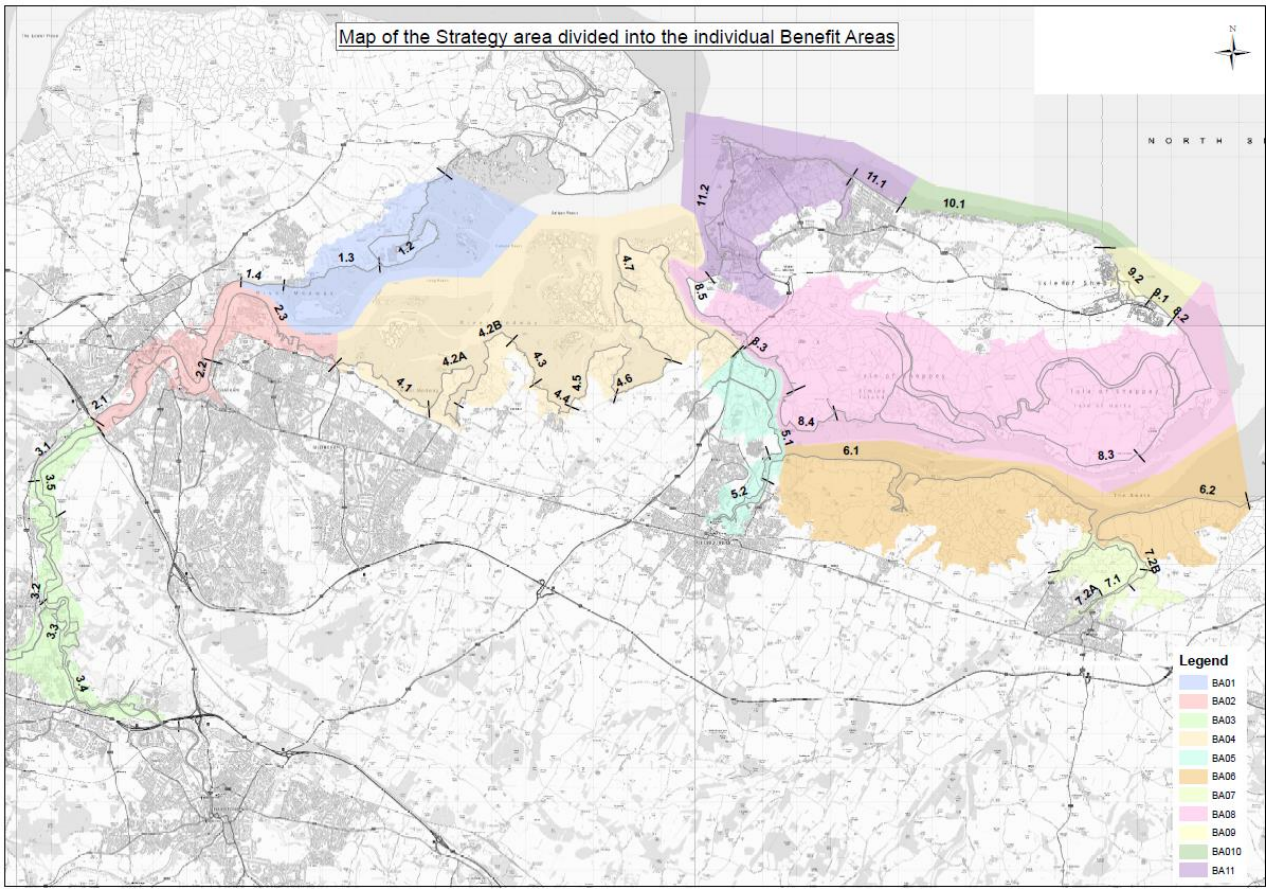
- Allington Sluice as the upstream tidal limit of the Medway;
- the village of Stoke on the Hoo Peninsula; and
- the Sportsman Public House on Cleve Marshes near Faversham.

MEASS encompasses the large urban areas of the Medway Towns including Rochester, Strood, Chatham and Gillingham; major industrial and commercial areas along the estuaries; and large swathes of rural farmland and extensive salt marsh and mudflats. Many of the rural areas are highly designated and protected for their heritage, landscape and environmental value.

1.2.1 Benefit Areas

As the Strategy frontage is approximately 120km in length, and there are complex interactions between the different land uses, the MEASS area has been broken down into a series of Benefit Areas (BAs) based on the extent of discrete flood cells. These BAs have been broken down further into 35 sub-Benefit Areas based on the SMP Policy Units (Figure 1).

Figure 1: The division of the frontage into 11 BAs and 35 sub BAs based on discrete flood cells (determined from modelling) and land use. Please note that BA1.1 is now included in the Thames Estuary 2100 Strategy. BA8.1 and 8.2 were merged to form BA8.2 to reflect the interconnectivity between these areas.



Source: Mott MacDonald, 2017. Contains Ordnance Survey Data © Crown copyright and database right 2015

1.3 Aims of the strategy

MEASS will assess and consider a variety of economic, environmental, and technical approaches to manage the coastal flood and erosion risk, in order to balance the wide range of features and interests within the area.

The vision statement of MEASS is to "*work with the community to plan how we will sustainably reduce flood risk to 17,226 homes in the Medway Estuary, Swale and Sheppey over the next 100 years (under a 0.1%AEP event), whilst also protecting and enhancing the local environment*."

Building on from this vision statement a series of primary and secondary objectives for MEASS have been developed (Table 1) to drive the delivery of an effective FCRM strategy which supports as many local plans and aspirations as possible.

Table 1: MEASS Primary and Secondary Objectives

Primary Objectives		Secondary Objectives	
1)	Reduce flood and erosion risk to properties and infrastructure at significant or very significant risk in light of coastal change over the next 100 years.	3)	Favour options that reduce the whole life costs of current defences.
2)	Maintain the integrity of Natura 2000 sites (protected under the Habitats and Birds Directives) assuming the loss due to coastal squeeze of 113ha of saltmarsh habitat between years 0-20 and a further 140ha of saltmarsh habitat between years 20-50.	4)	Favour options that support delivery of the Thames River Basin Management Plan.
		5)	Help enable local plan objectives to be realised where possible.

1.4 Aims of this Report

This Report forms an appendix to MEASS. The aim of this Report is to outline the Strategy risks, the proposed mitigation for these and the residual risk level. These risks have also been fed into the Monte Carlo risks assessment to determine the potential risk value profiles. The Report is split into the following Sections:

- **Section 2: Risk Register** – this Section outlines the method used to calculate the risks and how thee have been used in the economic assessment.
- **Section 3: Project Risk Register –** the detailed risk register that was developed as part of the Strategy.
- **Section 4:** presents the results of the Monte Carlo Risk Register.

2 Risk Register

The Project Risk Register compiles the key project risks identified for the Project. It is intended that the Risk Register is a live document that all parties involved in the Project use and update throughout the life of the Project.

2.1 Calculation of Risk

Risks have been identified within the Risk Register as:

'the potential occurrence of a threat or opportunity, which could affect (positively or negatively) the achievement of the Project Objectives'.

RISK = CONSEQUENCE X LIKELIHOOD

The consequence is defined as the effect of the risk event on one or more objectives if it occurs.

The likelihood is defined as the chance the risk event occurring within the project time frame.

The objectives of this Project cover a range of technical, social, economic, environmental and safety objectives and therefore our risk assessment has defined risks under the following sections:

- Strategic Risks
- Environmental Risks
- Project Budget Risks
- Design Risks
- Construction Risks

2.2 Project Risk Register

The Project Risk Register is presented in Section 3 which defines:

- Key risks
- Likely consequences of the risks
- The impact, likelihood, and overall risks
- Risk type - split into health and safety, time, cost, reputation, and environment
- Mitigation and control measures which have been or will be implemented throughout the project
- The residual impact, likelihood, and risk.

The overall risk has been calculated using a matrix approach; combining the impact of the risk and the likelihood of the risk (Figure 2).

Figure 2: Risk matrix used to define overall risk of Scheme

			Likelihood				
			Very Low	Low	Medium	High	Very High
		Score	1	2	3	4	5
Negative Consequence	Very Low	1	n	n	n	n	t
	Low	2	n	n	t	t	s
	Medium	3	n	t	t	s	s
	High	4	n	t	s	s	i
	Very High	5	t	s	s	i	i

Risk Key

intolerable	RED	i	20 to 25
significant	AMBER	s	10 to 16
tolerable	YELLOW	t	5 to 9
negligible / trivial	GREEN	n	1 to 4

2.3 Monte Carlo Risk Register

The Project Risk Register has been used to define the residual risks to be included in the Monte Carlo Analysis (Section 4). The analysis uses the best estimate cost for the works to then define maximum and minimum risks on the various potential impacts that have been identified. The results are then input into a Monte Carlo simulation providing distributions of overall potential risk value profiles.

2.4 Risk used within Strategy economics

The 60% optimism bias has been included within the economic assessment for the Strategy.

The 95th%ile from the Monte Carlo risk distribution has been used to assess a worst likely case scenario and compare it to the risk allowance in the project to ensure the risk allowance is sufficient. Through value engineering and careful management of the key risks, the total risk allowance is unlikely to be used. The results of the Monte Carlo propose a 59% risk budget which is comparable to the 60% optimism bias used and which justifies and supports the risk allowance used within the economics for the Strategy.

2.5 Risk used within Strategy Approval Costs

Within the economic analysis a 60% baseline optimism bias risk allowance was added to the costs (including future costs) to account for potential risks that may arise during the OBC, detailed design and construction phases. This risk allowance is based on guidance within the FCERM-AG (2010) and the HM Treasury Green Book (2011).

The optimism bias is incorporated within the economic assessment to ensure a robust cost is presented. This allows confidence that the scheme is economically justifiable. The 60% optimism bias risk allowance has been used within the economic assessment, cost effectiveness analysis, and partnership funding calculations as it allows consideration of risks within the costs associated with not just the capital works, but also future maintenance works over the 100 years of the scheme. Table 2 presents the breakdown of the optimism bias.

The optimism bias is applied to all of the options, although each option has specific risks associated, the general risks associated with the project are considered to be applicable to all of the options.

Table 2: Optimism Bias for the economic assessment

Risk components contributing to above factors (%, summing to 100)	Average % of total project risk	Strategy 60% baseline
Environmental impact	20	12
Inadequacy of the business case	10	6
Funding availability	10	6
Project management team	5	3
Stakeholder support for the scheme	10	6
Design complexity	5	3
Degree of innovation	5	3
Site characteristics	10	6
Economic	10	6
Legislation/regulations	10	6
Other	5	3
Total	100%	60%

3 Project Risk Register

RISK REGISTER

Date: 29/03/2018 **Project Phase: Strategy** **Project: Medway Estuary and Swale Strategy (MEASS)**

NOTE: RISK TYPES; HS = Health & Safety, T = Time, C = Cost, R = Reputation, E = Environment
Risk: I = Intolerable, S = Significant, T = Tolerable, N = Negligible

Risk Assessment carried out by: Project Team

Risks	Consequences	IMPACT	LIKELIHOOD	RISK	RISK TYPE	Potential Risk Control Measures / Actions	IMPACT	LIKELIHOOD	RESIDUAL RISK	OWNER	Action (by whom and when)
Strategic Level Risks											
Lack of public support for the scheme.	The Strategy will need to prove public support for the scheme. Risk of loss of reputation.	VH	H	I	T, C, R	Ensure early stakeholder engagement and consultation to ensure no objections arise, show clear options development process and detailed reasoning for the scheme. Review lessons learnt on other schemes. Setup a SEG to represent their local community/ organisation.	H	M	S	MM/EA	Engage relevant stakeholders early on and keep them informed of progress and developments addressing their concerns. Ensure that affected landowners are informed, and that the SEP is followed to ensure engagement with the community
Lack of support for scheme from stakeholders.	Lack of alignment of aims and objectives of all key stakeholders, especially Historic England who have not been an active member of the SEG. Stakeholders not signing up to the outcomes of the strategy.	VH	H	I	T, C, R	Early consultation undertaken and the EA in-house communications team involved. Consultation through SEG meetings; Environment group meetings; NE part of project Board.	H	M	S	MM/EA	Statutory consultation with Historic England on the SEA. NEAS archaeologist and landscape experts to attend the internal draft preferred option workshop
Perception that comments from stakeholders have not been incorporated into the Strategy.	Potential lack of buy in from stakeholders, resulting in the Strategy not being approved	VH	L	S	T, C, R	Clear audit trail of how decisions made and how comments have been addressed.	M	L	T	MM	Ensure accurate records of consultation are kept and recorded in the final reporting.
LPRG require significantly more information prior to Strategy approval.	Programme delay and additional costs incurred.	VH	H	I	T, C	Fully detailed business case presented with clear explanation of any residual issues and accompanying mitigation. Follow the FCERM-AG methodology. Also discuss requirements with LPRG throughout the development of the project, and try to get draft documents reviewed prior to submission.	VH	L	S	MM/EA	Fully detailed business case and clearly identified within the report. EA to set-up early meetings with LPRG to discuss how to present the StAR and supporting reports especially around moderation funding etc.
Project programme is not of an adequate length for both the Strategy and subsequent OBC and design stages.	Cost of programme over-running.	M	H	S	T, C	Regular progress updates between the project team during the development of the Strategy, and also in the subsequent business case development and design process. Issues to be identified early on, deliverables and deadlines clearly identified and fed back to team.	M	M	T	MM	MM staff to identify potential problems early on and plan work appropriately.
Completion of environmental assessments.	Programme delay should full IROPI be required.	VH	H	I	T, C	Early involvement with Natural England to account for their concerns and provide detailed explanations of the decision made during the optioneering stages of the project. DEFRA early review of draft IROPI case.	VH	M	S	MM/ EA	NE invited to regular meetings and involved in decisions around the method used to decide the preferred options. Comments from NE on the preferred options taken into account and options updated accordingly. Statement of case to be reviewed by DEFRA representative before LPRG process.
Changes in the Project Team.	Loss of knowledge/motivation.	M	M	T	T, C	Detailed records of correspondence and project developments to be maintained for ease of transition. Where possible a hand-over should be undertaken to reduce the risk of loss of information.	L	M	T	MM/EA	Maintain communication / information trail. The use of Asite to store issued documents and accurate records of meetings kept.
Change in EA processes in funding.	Change in potential funding amounts, which may affect the future viability of some of the projects.	H	M	S	T, C	Secure confirmation from EA on route to proceed to funding and keep informed on guidance revisions and enforcement dates.	L	L	N	MM	Liaise with EA representative.
Data inaccuracies.	Inaccuracies in the NRD dataset, the AIMS dataset, classification and valuation of agricultural land etc may results in an inaccurate business case being developed.	H	M	S	T, C	When the project is taken through to scheme level ground truth the datasets and undertake condition surveys of the defences.	H	L	T	MM/EA	Note the potential limitations of the datasets used and put appropriate recommendations for the review of the data at the project level.
Inaccuracies in the cost data.	Outline costs and typical outline designs used to cost the options, but this may be inaccurate and could result in an inaccurate business case being developed.	M	M	T	T, C	At Strategy level use a variety of cost sources to calculate the costs, and outline all the assumptions used in the costings. At project level undertake Early Contractor Involvement and undertake a more detailed assessment of the costing, based on a more detailed design to help validate costs further.	M	L	T	MM	Ensure that all costing assumptions are recorded in the reporting.
Uncertainties in climate change predictions.	Changing predictions and updates to guidance may result in uncertainties over the future impacts and the design requirements.	H	M	S	T, C	Ensure that the current UKCP09 guidance is followed for a medium emissions scenario.	H	L	T	MM	Note the climate change scenarios used in the assessment in the technical reporting.
Impact of major flood event over the next 5-10 years.	Potential change in the preferred options and impacts on designated sites of the preferred options.	VH	H	I	C, T, E	Monitor the condition of the defences and ensure that maintenance of the current defences is undertaken until the business case is approved.	VH	M	S	EA	Allow sufficient maintenance until the business case for the new schemes is approved.
Moderation funding availability.	Moderation funding to pay for the compensation of the designated habitat is not available. Potential for the StAR to not be approved.	VH	VH	I	C	EA to have discussions with internal funding groups and ensure the process for obtaining the funding is documented in the StAR and implementation plan.	H	H	S	EA	Undertake discussions with EA funding groups.
LPRG don't approve business case.	Programme delay and additional costs incurred.	VH	M	S	T, C, R	Liaise with LPRG throughout development and use current guidance, ensure clear concise preferred option development.	VH	L	S	MM/ EA	Involve statutory bodies at an early stage in the project.
Environmental Risks											

WFD objectives are not met - poor water quality.	Preferred options impact negatively on the water quality of the estuaries. May lead to increased environmental impacts and potential time and cost delay at construction stage.	H	M	S	E, T, C	Ensure designs meet relevant WFD Objectives. Monitor and liaise with relevant organisations, ensure biodegradable fluids used in plant (fuel, hydraulics etc.) during construction.	H	L	T	OBC Consultant / Contractor	Ensure a WFD assessment is undertaken on the preferred options at strategy level and at further scheme stages. During option design ensure WFD objectives are considered. During constructions ensure drip trays used where required and biodegradable fluids in all plant accessing /working near the estuary.
Preferred option causes detrimental impact to the environment.	Business case unlikely to be approved at LPRG due to environmental impacts.	VH	L	S	T, C, R	Ensure designs meet environmental requirements. Optioneering process to include impacts on the environment. Ongoing discussions with environmental stakeholders	H	L	T	MM/ OBC Consultant/ EA	Engagement with Natural England and NEAS early on to identify potential issues. SEA and HRA to feed into the optioneering stage.
Uncertainty around the species that need protecting, especially in the RAMSAR sites.	Potentially the compensatory habitats developed are not suitable and the functionality of the SPA is not maintained. Could result in a change in options.	VH	H	I	T, C	HRA and SEA completed on available information at the strategy level. It will be recommended that the habitat surveys are undertaken as soon as possible in the implementation plan to ensure that this information can be fed into the OBC stage.	H	H	S	OBC Consultant/ EA	EA to undertake environmental surveys early to fully understand if there are any impacts on the preferred options.
Reliance on third parties for funding contributions.	Funding not available to provide compensation and mitigation to impacts from increased overtopping which causes adverse effects on the functionality of the SPA freshwater and intertidal habitat and the Ramsar habitat.	VH	H	I	E, R	During the Strategy ensure that the potential adverse impacts are assessed and mitigated/ compensated for. This needs to be recorded in the HRA, and developed at the OBC and DD stage. During the construction phase timing of the works would need to be carefully considered in terms of impact on both the bathing water season and overwintering bird season.	VH	M	S	MM/ OBC Consultant/ EA	Ensure that the adverse impacts and mitigation are accurately recorded in the strategy HRA, to allow it to be reviewed and built upon at the OBC/ DD stage. Contractor to ensure the construction programme is appropriate.
Problems identifying freshwater habitat sites.	Unable to determine suitable sites for freshwater habitat compensation, which deliver the hectares required, and to the required quality	VH	M	S	E, C, R	Get early involvement from NE, RSPB, KWT and others to identify unsustainable compensation sites. Evidence the decision making for clear audit trail.	H	M	S	MM	Review the potential sites with NE prior to submission to ensure are suitable. Review at OBC stage.
Suitability of Great Bells Farm as a freshwater compensation site.	The project team are aware of potential concerns raised by RSPB around the suitability of Great Bells Farm as a freshwater compensation site. This could impact upon the approval of the Strategy as the environmental impacts of the works may not be fully mitigated.	VH	H	I	E, R	The EA to work with RSPB to improve the condition of the freshwater habitat at Great Bells Farm.	VH	M	S	EA	Undertake regular reviews of the condition of Great Bells Farm to ensure that the condition of the site is improving.
Change in environmental designations.	Environmental designations changed which may cause the preferred options to be reviewed, resulting in rework.	VH	M	S	E, C, T	Early and ongoing consultation with Natural England.	VH	L	S	EA/MM	Ensure that NE are consulted with.
MR sites are challenged due to stakeholder consultation, impacts on infrastructure, heritage risk or landscape risks.	If the MR sites cannot be delivered the requirements for intertidal habitat compensation will not be met. This could cause the Strategy to be rejected by NE, and require significant re-work.	VH	M	S	E, C, R, T	Early and ongoing consultation with landowners and NE. Clear auditable trail of decision process and explanation of why MR sites taken forwards. Implementation plan to highlight key early studies and surveys which are required to manage the MR site risks.	H	M	S	MM	Ensure the assessment process is clearly documented. Undertake open and transparent consultation with landowners. Include clear priority of surveys for MR sites in the Implementation Plan.
Loss of recreational areas with the development of MR sites.	Loss of recreational areas for local residents, could have wider health and well-being consequences.	H	M	S	E, R	Agree through stakeholder engagement and statutory consultation.	H	L	T	MM/ EA	Early Stakeholder Engagement.
Project level Budget Risks											
Reliance on third parties for funding contributions.	Potential delay in programme if third parties are not willing to contribute. Potential that OBC schemes are not approved.	VH	H	I	T, C	Ensure early statutory stakeholder engagement and consultation to ensure no objections arise, show clear options development process and detailed reasoning for the scheme.	VH	M	S	OBC Consultant/ EA	Engage relevant statutory stakeholders early on at the start of the project level studies and keep them informed of progress and developments addressing their concerns.
Estimated costs for the Scheme increase.	Benefits are not high enough and therefore FDGiA funding is less than initially considered.	H	H	S	T, C	Review the economic assessment at OBC stage. Continual communication with EA regarding previous assessments and data available to help with assessment.	H	M	S	OBC Consultant	OBC consultant to undertake economic assessment - building on previous studies and modelling outputs.
Ground Investigation at project level shows unforeseen ground conditions.	Change to design required - time deal and potential to increase cost of the scheme.	VH	H	I	T, C	Undertake Ground Investigation prior to FBC. Any changes to design required - use value engineering approaches to limit the significance of the change on the cost of the scheme.	H	H	S	OBC Consultant/ EA	OBC consultant to review Ground Investigations early on in project.
Cost of ground investigations higher than anticipated due to change in investigation approach.	Scope of investigations has to be reduced. Extra funding has to be found to cover investigation work.	H	H	S	C	Investigations procured on a menu based system allowing them to be tailored to the budget. Investigation done in stages to allow areas to be targeted to give the greatest value	H	M	S	OBC Consultant/ Designer	OBC consultant to undertake initial Ground Investigation phase. Designer to review and undertake further Ground Investigation during detailed design
Design Risks (at project level and beyond)											
Design basis changes during design period.	Changes to design cost and programme impact.	H	H	S	T, C	Ongoing communication and clarity of Client expectations.	H	M	T	Designer	Designer to regular meet with the EA throughout the design to understand outputs and requirements.
The preferred design causes disruption to utility services.	Damage to utility services, which could have potential impacts on the wider area e.g. Power Outages.	H	H	S	HS, T, C	Further surveys required to outline location of utilities, ongoing communication with utility companies.	H	M	T	Designer/ EA	Designer to review the location of utility services.
Interaction with roads and railways.	Potential delay to programme and increased costs.	M	M	S	T, C, R	Ensure early and ongoing consultation with National Rail, Highways England and the local councils so any requirements/ limitations can be worked into the design at the start of the OBC.	M	L	T	Designer	Designer to engage with road and railways and infrastructure providers at an early stage.
Interaction with infrastructure.	Potential delay to programme and increased costs.	M	M	S	T, C, R	Ensure early and ongoing consultation with infrastructure owners so any requirements/ limitations can be worked into the design at the start of the OBC. Also will provide third party contributions to the projects	M	L	T	Designer	Designer to engage with infrastructure owners at an early stage.
Risk of adverse impacts on electricity pylons at Chetney and Cleve Hill.	Potential delay to programme and increased costs.	M	H		T, C, R	Undertake early consultation with landowner and electricity suppliers to ensure that the correct mitigation/ compensation is included in the cost of the project.	M	M	T	EA / Designer	Organise early consultation with landowner and electricity suppliers.
Tender prices do not meet engineers estimates.	Additional costs and delay to programme and appointment of works.	VH	H	S	T, C	Clear design specification with minimal uncertainties and early contractor involvement and liaison with suppliers.	VH	L	T	Designer	Tender design to be informed and detailed with minimal uncertainties.
Construction and material risk											
Failure to prevent public access to the construction site.	Accidents.	VH	M	S	R, HS	Ensure best practice method of working is observed. Public information to be provided. Site security to be implemented.	VH	L	S	EA/ Contractor	Contractor to implement best practice method of working, provide public information and implement site security.

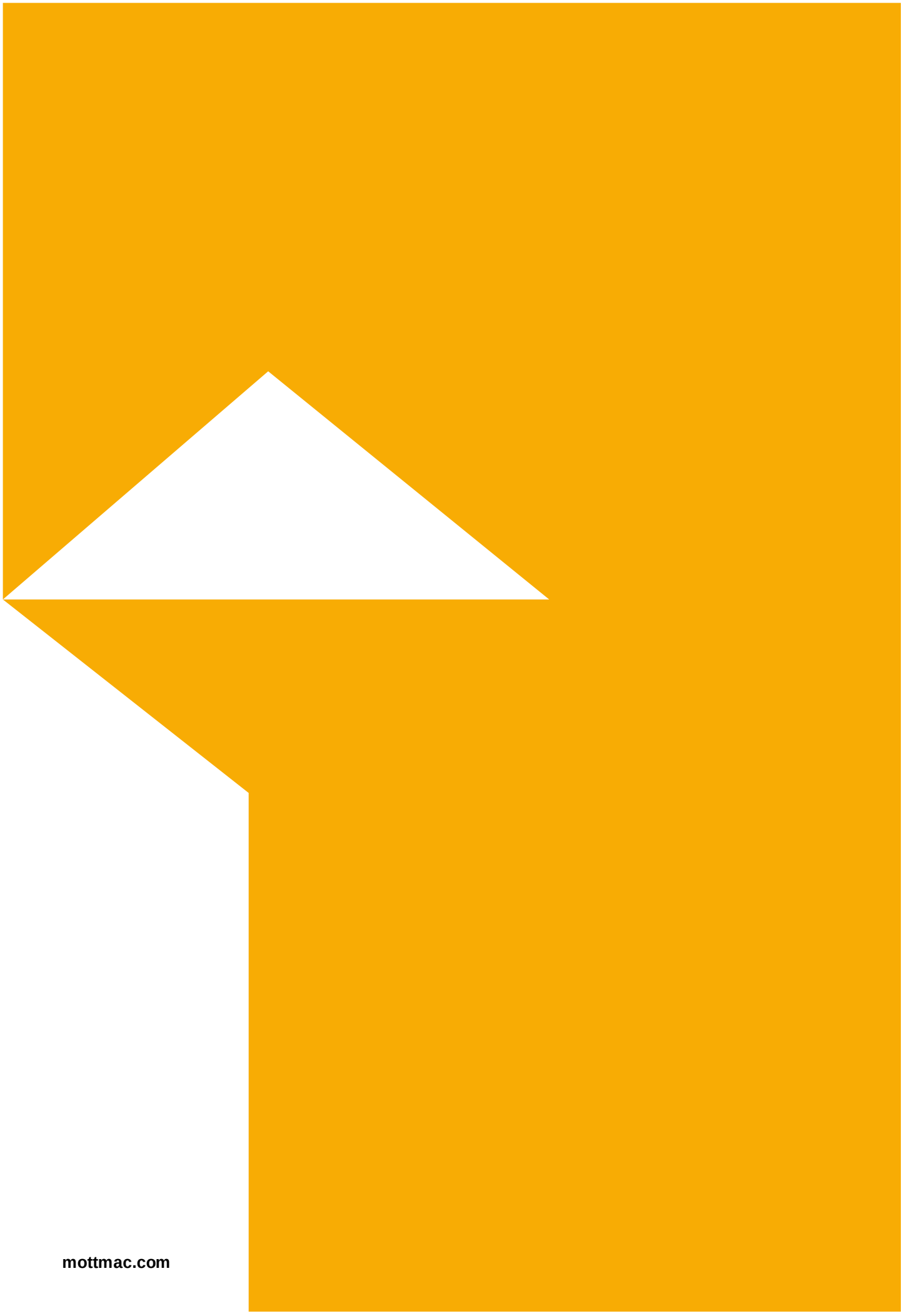
Adverse weather conditions.	adverse weather conditions including storms and high tide levels leading to increased flood risk, delays in programme and possible damage to plant.	VH	H	I	T, HS	Use suitable methods of working. Careful planning and timing of works. Emergency action plan and contract provision. Works to stop if there is a flood risk.	H	M	S	EA/ Contractor	Use suitable method of working. Careful planning and timing of works. Emergency action plan and contract provision.
Problem with material supply.	Delay to programme.	H	M	S	T, C	Upon funding approved confirm with supplier quantities and tine scales.	H	L	T	Contractor	Determine local suppliers and contact prior to commencing construction.
Change in exchange rates.	Increase in material prices.	H	M	S	C	Where possible source material locally.	M	M	T	Contractor	Contractor to determine supplier for construction materials.
Complaints or objections to works by local residents.	Delay to programme.	VH	H	I	T, C, R	Provide good local engagement during construction process to maintain public image and concern.	VH	M	S	Contractor	Ensure local councillors are aware of the scheme and can provide information where required.
Noise and vibration issues - changes to agreed working practices.	Complaints from members of the public, additional costs and potential delay to programme.	VH	H	I	T, C, R	Leaflet drop to immediate residences, measures to reduce noise adopted outside acceptable working hours (where measures inadequate to resolve issues restrict working hours).	H	M	S	Contractor	Inform and keep members of the public engaged, liaise with client representative prior to adoption of mitigation measures.
Lack of access for contractor/ emergency services.	Altered working methodology, additional temporary access required, complaints from local stakeholders.	M	H	S	T, C, HS, R	ESE to discuss requirements and working methods and stakeholder engagement to confirm emergency access requirements to mitigate impacts early on.	M	M	T	Designer	Consider aspects during detailed design stage to provide mitigation measures and minimise impacts.
Contractor going bankrupt.	Severe delays and additional costs to procure new contractor.	VH	M	S	T, C	Ensure contractor has necessary insurances and meets requirements of quality and experience during tender assessment.	VH	L	S	EA	Ensure tender assessment conducted thoroughly. FRAMEWORK CONTRACTOR
Services affected during works.	Additional costs and delay to the programme.	VH	M	S	T, C, R	Ensure statutory bodies contacted confirm plant in vicinity, care taken when works undertaken near potential services.	VH	L	S	Designer/ Contractor	Include services search plans within tender documents. Contractor to take care when working in areas of potential services.
Loss of parking, public rights of way etc. during the construction phase.	Objections from the public, poor PR.	H	M	S	R	Utilised section working, ensure there is ongoing consultation and PR, find alternative parking.	M	M	T	EA/ Contractor	EA to provide ongoing PR and consultation. Contractor to follow best method of working.
Item of UXO or archaeological significance found during excavations.	Health and safety risks. Delay to works and cost of archaeologist during excavation works.	VH	H	I	T, C, HS	English heritage and MOD contacted to determine significance of the area, excavations minimised to reduce risk. UXO desk study.	VH	M	S	EA/ Contractor	Contractor to adopt best working proactive. NEAS archaeologist involved throughout the detailed design stage. UXO desk study to be undertaken during detailed design.

4 Monte Carlo Risk Register

Project Budget £250,386,690

Threat	Residual Impact	Residual Likelihood	Impact (%)		Likelihood (%)		Quantitative Risk Envelope					
							Min		Most Likely		Max	
			Min	Max	Min	Max	(%)	£	(%)	£	(%)	£
Strategic Level Risks												
Lack of public support for the scheme.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
Lack of support for scheme from stakeholders.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
Perception that comments from stakeholders have not been	M	L	1%	10%	0%	1%	0.00%	£25.44	0.05%	£127,227.10	0.10%	£254,428.76
LPRG require significantly more information prior to Strategy	VH	L	20%	50%	0%	1%	0.00%	£508.86	0.25%	£636,326.32	0.50%	£1,272,143.79
Project programme is not of an adequate length for both the	M	M	1%	10%	1%	10%	0.01%	£25,442.88	0.51%	£1,284,865.22	1.00%	£2,544,287.57
Completion of environmental assessments.	VH	M	20%	50%	1%	10%	0.20%	£508,857.51	2.60%	£6,615,147.68	5.00%	£12,721,437.85
Changes in the Project Team.	L	M	0%	1%	1%	10%	0.00%	£25.44	0.05%	£127,227.10	0.10%	£254,428.76
Change in EA processes in funding.	L	L	0%	1%	0%	1%	0.00%	£0.03	0.01%	£12,721.45	0.01%	£25,442.88
Data inaccuracies.	H	L	10%	20%	0%	1%	0.00%	£254.43	0.10%	£254,555.97	0.20%	£508,857.51
Inaccuracies in the cost data.	M	L	1%	10%	0%	1%	0.00%	£25.44	0.05%	£127,227.10	0.10%	£254,428.76
Uncertainties in climate change predictions.	H	L	10%	20%	0%	1%	0.00%	£254.43	0.10%	£254,555.97	0.20%	£508,857.51
Impact of major flood event over the next 5-10 years.	VH	M	20%	50%	1%	10%	0.20%	£508,857.51	2.60%	£6,615,147.68	5.00%	£12,721,437.85
Moderation funding availability.	H	H	10%	20%	10%	50%	1.00%	£2,544,287.57	5.50%	£13,993,581.64	10.00%	£25,442,875.70
LPRG don't approve business case.	VH	L	20%	50%	0%	1%	0.00%	£508.86	0.25%	£636,326.32	0.50%	£1,272,143.79
Environmental Risks												
WFD objectives are not met - poor water quality.	H	L	10%	20%	0%	1%	0.00%	£254.43	0.10%	£254,555.97	0.20%	£508,857.51
Preferred option causes detrimental impact to the environment.	H	L	10%	20%	0%	1%	0.00%	£254.43	0.10%	£254,555.97	0.20%	£508,857.51
Uncertainty around the species that need protecting, especially in the RAMSAR sites.	H	H	10%	20%	10%	50%	1.00%	£2,544,287.57	5.50%	£13,993,581.64	10.00%	£25,442,875.70
Reliance on third parties for funding contributions.	VH	M	20%	50%	1%	10%	0.20%	£508,857.51	2.60%	£6,615,147.68	5.00%	£12,721,437.85
Problems identifying freshwater habitat sites.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
Suitability of Great Bells Farm as a freshwater compensation site.	VH	M	20%	50%	1%	10%	0.20%	£508,857.51	2.60%	£6,615,147.68	5.00%	£12,721,437.85
Change in environmental designations.	VH	L	20%	50%	0%	1%	0.00%	£508.86	0.25%	£636,326.32	0.50%	£1,272,143.79
MR sites are challenged.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
Loss of recreational areas with the development of MR sites.	H	L	10%	20%	0%	1%	0.00%	£254.43	0.10%	£254,555.97	0.20%	£508,857.51
Project level Budget Risks												
Reliance on third parties for funding contributions.	VH	M	20%	50%	1%	10%	0.20%	£508,857.51	2.60%	£6,615,147.68	5.00%	£12,721,437.85
Estimated costs for the Scheme increase.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
Ground Investigation at project level shows unforeseen ground conditions.	H	H	10%	20%	10%	50%	1.00%	£2,544,287.57	5.50%	£13,993,581.64	10.00%	£25,442,875.70
Cost of ground investigations higher than anticipated due to change in investigation approach.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
Design Risks (at project level and beyond)												
Design basis changes during design period.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
The preferred design causes disruption to utility services.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
Interaction with roads and railways.	M	L										
Interaction with infrastructure.	M	L	1%	10%	0%	1%	0.00%	£25.44	0.05%	£127,227.10	0.10%	£254,428.76
Risk of adverse impacts on electricity pylons at Chetney and Cleve Hill.	M	M										
Tender prices do not meet engineers estimates.	VH	L	20%	50%	0%	1%	0.00%	£508.86	0.25%	£636,326.32	0.50%	£1,272,143.79
Construction and material risk												
Failure to prevent public access to the construction site.	VH	L	20%	50%	0%	1%	0.00%	£508.86	0.25%	£636,326.32	0.50%	£1,272,143.79
Adverse weather conditions.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
Problem with material supply.	H	L	10%	20%	0%	1%	0.00%	£254.43	0.10%	£254,555.97	0.20%	£508,857.51
Change in exchange rates.	M	M	1%	10%	1%	10%	0.01%	£25,442.88	0.51%	£1,284,865.22	1.00%	£2,544,287.57
Complaints or objections to works by local residents.	VH	M	20%	50%	1%	10%	0.20%	£508,857.51	2.60%	£6,615,147.68	5.00%	£12,721,437.85
Noise and vibration issues - changes to agreed working practices.	H	M	10%	20%	1%	10%	0.10%	£254,428.76	1.05%	£2,671,501.95	2.00%	£5,088,575.14
Lack of access for contractor/ emergency services.	M	M	1%	10%	1%	10%	0.01%	£25,442.88	0.51%	£1,284,865.22	1.00%	£2,544,287.57
Contractor going bankrupt.	VH	L	20%	50%	0%	1%	0.00%	£508.86	0.25%	£636,326.32	0.50%	£1,272,143.79
Services affected during works.	VH	L	20%	50%	0%	1%	0.00%	£508.86	0.25%	£636,326.32	0.50%	£1,272,143.79
Loss of parking, public rights of way etc. during the construction phase.	M	M	1%	10%	1%	10%	0.01%	£25,442.88	0.51%	£1,284,865.22	1.00%	£2,544,287.57
UXO/archaeological artefact found during excavations.	VH	M	20%	50%	1%	10%	0.20%	£508,857.51	2.60%	£6,615,147.68	5.00%	£12,721,437.85

95% Confidence £149,148,278



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