Framework:	**Collaborative Delivery Framework**
Supplier:	**Ove Arup & Partners Ltd**
Company Number:	**01312453**
Geographical Area:	**Midlands**
Project Name:	**River Ryton Modelling**
Project Number:	**ENV0002885C**
Contract Type:	**Professional Service Contract**
Option:	**Option E**
Contract Number:	**29648**

Revision	Status		Originator		Reviewer		Date

PROFESSIONAL SERVICE CONTRACT under the Collaborative Delivery Framework
CONTRACT DATA

Project Name River Ryton Modelling

Project Number ENV0002885C

This contract is made on 13 April 2020
between the *Client* and the *Consultant*

- This contract is made pursuant to the Framework Agreement (the "Agreement") dated 01st day of April 2019 between the *Client* and the *Consultant* in relation to the Collaborative Delivery Framework. The entire agreement and the following Schedules are incorporated into this Contract by reference

- Schedules 1 to 22 inclusive of the Framework schedules are relied upon within this contract.

- The following documents are incorporated into this contract by reference
CDF PSC Technical Scope Ryton v2, NEC4 Minimum Technical Requirements for Modelling_v1, Ryton PSC Management Scope v2

Part One - Data provided by the *Client*

Statements given in all Contracts

1 General

The *conditions of contract* are the core clauses and the clauses for the following main Option, the Option for resolving and avoiding disputes and secondary Options of the NEC4 Professional Service Contract June 2017.

Main Option	Option E	Option for resolving and avoiding disputes	W2

Secondary Options

X2: Changes in the law

X9: Transfer of rights

X10: Information modelling

X11: Termination by the *Client*

X18: Limitation of liability

X20: Key Performance Indicators

Y(UK)2: The Housing Grants, Construction and Regeneration Act 1996

Y(UK)3: The Contracts (Rights of Third Parties) Act 1999

Z: *Additional conditions of contract*

The *service* is To produce a flood model to gain a better understanding of the flood risk from the River Ryton in North Nottinghamshire

The *Client* is Environment Agency

Address for communications [redacted]

Address for electronic communications [redacted]

The *Service Manager* is [redacted]
Address for communications

Address for electronic communications [redacted]

The Scope is in
CDF PSC Technical Scope Ryton v2' and 'Ryton PSC Management Scope v2'

The *partner contract* is

The *language of the contract* is English

The *law of the contract* is
the law of England and Wales, subject to the jurisdiction of the courts of England and Wales

The period for reply is 2 weeks

The *period for retention* is
6 years following Completion or earlier termination

The following matters will be included in the Early Warning Register
Covid19 restrictions

Early warning meetings are to be held at intervals no 2 weeks

longer than

2 The *Consultant's* main responsibilities

The *key dates* and *conditions* to be met are

conditions to be met	*key date*
'none set'	'none set'
'none set'	'none set'
'none set'	'none set'

The *Consultant* prepares forecasts of the total Defined Cost plus Fee and *expenses* at intervals no longer than 4 weeks

3 Time

The *starting date* is 13 April 2020

The *Client* provides access to the following persons, places and things

access	*access date*

The *Consultant* submits revised programmes at intervals no longer than 4 weeks

The *completion date* for the whole of the *service* is 30 September 2021

The period after the Contract Date within which the *Consultant* is to submit a first programme for acceptance is 4 weeks

4 Quality management

The period after the Contract Date within which the *Consultant* is to submit a quality policy statement and quality plan is 4 weeks

The period between Completion of the whole of the *service* and the *defects date* is 26 weeks

5 Payment

The *currency of the contract* is the £ sterling

The *assessment interval* is Monthly

The *expenses* stated by the *Client* are as stated in Schedule 9

The *interest rate* is 2.00% per annum (not less than 2) above the Base rate of the Bank of England

The locations for which the *Consultant* provides a charge for the cost of support people and office overhead are All UK Offices

6 Compensation events

These are additional compensation events

1. Managing and mitigating the impact of Covid 19 and working in accordance with Publ
2. 'not used'
3. 'not used'
4. 'not used'
5. 'not used'

8 Liabilities and insurance

These are additional *Client's* liabilities

1. 'not used'
2. 'not used'
3. 'not used'

The minimum amount of cover and the periods for which the *Consultant* maintains insurance are

EVENT	MINIMUM AMOUNT OF COVER	PERIOD FOLLOWING COMPLETION OF THE WHOLE OF THE *SERVICE* OR TERMINATION
The *Consultant's* failure to use the skill and care normally used by professionals providing services similar to the *service*	**£5,000,000** in respect of each claim, without limit to the number of claims	12 years after Completion

Loss of or damage to property and liability for bodily injury to or death of a person (not an employee of the *Consultant)* arising from or in connection with the *Consultant* Providing the Service	**£15,000,000** in respect of each claim, without limit to the number of claims	12 years after Completion
Death of or bodily injury to the employees of the *Consultant* arising out of and in the course of their employment in connection with the contract	*Legal minimum* in respect of each claim, without limit to the number of claims	*For the period required by law*
The *Consultant's* total liability to the *Client* for all matters arising under or in connection with the contract, other than the excluded matters is limited to	**£5,000,000**	

Resolving and avoiding disputes

The *tribunal* is litigation in the courts	
The *Adjudicator* is	'to be confirmed'
Address for communications	'to be confirmed'
Address for electronic communications	'to be confirmed'
The *Adjudicator nominating body* is	The Institution of Civil Engineers

Z Clauses

Z1 Disputes
Delete existing clause W2.1

Z2 Prevention
The text of clause 18 Prevention is deleted.
Delete the text of clause 60.1(12) and replaced by:
The *service* is affected by any of the following events
• War, civil war, rebellion, revolution, insurrection, military or usurped power;
• Strikes, riots and civil commotion not confined to the employees of the *Consultant* and sub consultants,
• Ionising radiation or radioactive contamination from nuclear fuel or nuclear waste resulting from the combustion of nuclear fuel,
• Radioactive, toxic, explosive or other hazardous properties of an explosive nuclear device,
• Natural disaster,
• Fire and explosion,
• Impact by aircraft or other aerial device or thing dropped from them.

Z3 Disallowed Costs

Add the following in second bullet of 11.2 (18) add:
(including compensation events with the Subcontractor, i.e. payment for work that should not have been undertaken).
Add the following additional bullets after 'and the cost of ' :

- Mistakes or delays caused by the *Consultant's* failure to follow standards in Scopes/quality plans
- Reorganisation of the *Consultant's* project team
- Additional costs or delays incurred due to *Consultant's* failure to comply with published and known guidance or document formats
- Exceeding the Scope without prior instruction that leads to abortive cost
- Re-working of documents due to inadequate QA prior to submission, i.e. grammatical, factual arithmetical or design errors
- Production or preparation of self-promotional material
- Excessive charges for project management time on a commission for secondments or full time appointments (greater than 5% of commission value)
- Any hours exceeding 8 per day unless with prior written agreement of the *Service Manager*
- Any hours for travel beyond the location of the nearest consultant office to the project unless previously agreed with the *Service Manager*
- Attendance of additional individuals to meetings/ workshops etc who have not been previously invited by the *Service Manager*
- Costs associated with the attendance at additional meetings after programmed Completion, if delay is due to *Consultant* performance
- Costs associated with rectifications that are due to *Consultant* error or omission
- Costs associated with the identification of opportunities to improve our processes and procedures for project delivery through the *Consultant's* involvement
- Was incurred due to a breach of safety requirements, or due additional work to comply with safety requirements
- Was incurred as a result of the *Client* issuing a Yellow or Red Card to prepare a Performance Improvement Plan
- Was incurred as a resulting of rectifying a non-compliance with the Framework Agreement and/or any call off contracts following an audit

Z6 The Schedule of Cost Components

The Schedule of Cost Components are as detailed in the Framework Schedule 9.

Z23 Linked contracts

Issues requiring redesign or rework on this contract due to a fault or error of the *Consultant* will neither be an allowable cost under this contract or any subsequent contract, nor will it be a Compensation event under this contract or any subsequent contract under this project or programme.

Z24 Requirement for Invoice

Add the following sentence to the end of clause 51.1:
The Party to which payment is due submits an invoice to the other Party for the amount to be paid within one week of the *Service Manager's* certificate.
Delete existing clause 51.2 and replace with:
51.2 Each certified payment is made by the later of

- one week after the paying Party receives an invoice from the other Party and
- three weeks after the assessment date, or, if a different period is stated in the Contract Data, within the period stated.

If a certified payment is late, or if a payment is late because the *Service Manager* has not issued a certificate which should be issued, interest is paid on the late payment. Interest is assessed from the date by which the late payment should have been made until the date when the late payment is made, and is included in the first assessment after the late payment is made

Z25 Risks and insurance

The *Consultant* is required to submit insurances annually as Clause Z4 of the Framework Agreement

Secondary Options

OPTION X2: Changes in the law

The *law of the project* is the law of England and Wales, subject to the jurisdiction of the courts of England and Wales

OPTION X10: Information modelling

The period after the Contract Date within which the *Consultant* is to submit a first Information Execution Plan for acceptance is 6 weeks

OPTION X18: Limitation of liability

The *Consultant's* liability to the *Client* for indirect or consequential loss is limited to

£1,000,000

The *Consultant's* liability to the *Client* for Defects that are not found until after the *defects date* is limited to

£5,000,000

The *end of liability date is* 6 years after the Completion of the whole of the *service*

OPTION X20: Key Performance Indicators (not used with Option X12)

The *incentive schedule* for Key Performance Indicators is in Schedule 17

A report of performance against each Key Performance Indicator is provided at intervals of

3 months

Y(UK)2: The Housing Grants, Construction and Regeneration Act 1996

The period for payment is 14 days after the date on which payment becomes due

Y(UK)3: The Contracts (Rights of Third Parties Act) 1999

term *beneficiary*

Part Two - Data provided by the *Consultant*

Completion of the data in full, according to the Options chosen, is essential to create a complete contract.

1 General

The *Consultant* is

Name: Ove Arup & Partners Ltd

Address for communications: [redacted]

Address for electronic communications: [redacted]

The *fee percentage* is: [redacted]

The *key persons* are

Name (1): [redacted]
Job: [redacted]
Responsibilities: [redacted]
Qualifications: [redacted]
Experience: [redacted]

Name (2): [redacted]
Job: [redacted]
Responsibilities: [redacted]
Qualifications: [redacted]
Experience: [redacted]

Name (3)
Job
Responsibilities
Qualifications
Experience

Name (4): [redacted]
Job
Responsibilities
Qualifications
Experience

Name (5)
Job
Responsibilities
Qualifications
Experience

Name (6)
Job
Responsibilities
Qualifications
Experience

Name (7)
Job
Responsibilities
Qualifications
Experience

The following matters will be included in the Early Warning Register

[redacted]

3 Time

The programme identified in the Contract Data is

To be provided within 4 weeks

Resolving and avoiding disputes

The *Senior Representatives* of the *Consultant* are

Name (1) [redacted]
Address for communications

[redacted]

Address for electronic communications

[redacted]

Name (2)
Address for communications

Address for electronic communications

X10: Information Modelling

The *information execution plan* identified in the Contract Data is

To be provided within 6 weeks

Contract Execution

Client **execution**

Signed under hand by [redacted] for and on behalf of the Environment Agency

Signature Role [redacted]

Consultant **execution**

Consultant **execution**

Signed under hand by [redacted] for and on behalf of Ove Arup & Partners Ltd

Signature Role [redacted]

Environment Agency
NEC3 Professional Services Contract (PSC) Scope

Project / contract information – Management scope

Project name	River Ryton modelling
SOP reference	ENV0002885C
Contract reference	29648
Date	06/05/20
Version number	2.0
Author	[redacted]

Revision history

Revision date	Summary of changes	Version number
30/04/20	First issue	1
06/05/20	Following Defra Commercial Lead review	2

This Scope should be read in conjunction with the version of the Minimum Technical Requirements current at the Contract Date. In the event of conflict, this Scope shall prevail. The *services* are to be compliant with the version of the Minimum Technical Requirements.

1 Overview

This contract is for a single modelling project in the IDT operational areas of the Midlands hub. This Scope details the overarching management arrangements that are to be applied to the individual project Scope listed in 1.2.

1.1 Objectives

The objective of the project is to improve the *Client's* understanding of flood risk by delivering a range of modelling outputs. These outputs are listed in the individual project Scope and may include, but are not limited to:

- Hydrological and Hydraulic model reviews;
- Flood history reviews;
- Hydrological assessments;
- New hydraulic models;
- Flood mapping.
- Climate change updates.

1.2 Project Details

The project details are listed in the table below:

Scope number	Task	Key PSO Contact	Area
01	River Ryton	[redacted]	EMD

The *Client* has provided an individual project Scope, detailing the technical services required.

2 *Services* required

2.1 *Consultant* project management

The overall management of the *services* shall include the following:

2.1.1. Attendance at:

a) Project Start-up meeting
b) monthly progress meetings, alternating monthly between telephone and face-to-face meetings at one of the *Client's* [redacted] venues with attendance at the minimum by the *Consultant's* Service Manager (either [redacted] or a [redacted])

The *Consultant* ensures the management of actions arising from these meetings.

2.1.2. Monthly project progress reports to be provided to the *Client*, including: a financial update and forecast; an updated programme; and a summary of work completed in month, an overview of upcoming stages and milestones, and key issues and risks using the *Client's* Modelling and Forecasting Monthly Reporting Tool template. These must be provided by the 8th of every month unless stated otherwise by the *Client.*

2.1.3. Monthly risk register review, update (including *Consultant* risk budget) and implementation of resulting actions.

2.1.4. Fortnightly progress updates via phone and/or email to the *Client* throughout the duration of the project. Any key decisions agreed with the *Client* must be documented by the *Consultant* and issued within a week to the *Client*.

2.1.5. All meetings (including progress and consultations) shall be recorded by the *Consultant* with actions identified (responsible party, date required). Minutes shall be provided within 1 working week of meeting date for review by the *Client*.

2.1.6. Recording and updating a list of data required to provide the services, which must be provided to the *Client* at the project start-up meeting and weekly intervals thereafter.

2.1.7. Quarterly input into the project efficiency register (CERT Tool).

2.1.8. Obtaining data from *Others* in order to provide the *services* and ensuring it is correctly licensed for use by the *Client*.

2.1.9. Following completion of a project, provide responses to *Client* queries about the completed project until the Services are completed. The *Consultant* provisions no more than 1% of the total contract value for delivering this task.

2.1.10. Highlights any slippage on the timescales identified in Section 3 immediately to the *Client's* Service Manager.

2.1.11. Model handover meetings – face to face anticipated at the *Client's* office, location as identified previously

3 Requirements of the programme

3.1 Programme

3.1.1. The *Consultant* shall provide a detailed programme in Microsoft Project 2013 meeting all requirements of the *conditions of contract*. The programme must show critical path activities, gateway, risk buffers and activities requiring *Client* input, for example review periods, and allowances for stakeholder/third party engagement.

3.1.2. Allow 10 working days for the *Client* review of standard draft deliverables and provide 2 weeks' notice of submission for review. The exception to this will be for *Client* review of all the draft baseline models, for which 20 working days will be allowed.

3.1.3. Allow 25 working days for the initial data collection by the *Client* following the data review by the *Consultant.*

3.1.4. Allow 20 working days for the *Client* to arrange site visits if specified in the project Scopes.

4 Data

4.1 Previous studies and data sources

See the individual project Scopes for previous studies and data sources.

4.1.1. The *Client* is responsible for the accuracy & sufficiency of existing data owned by the *Client*. The *Client* will only cover costs of sourcing new data, if existing data is proven to be incomplete or to contain mistakes or errors.

4.1.2. The *Consultant* is responsible for any new data requirements and third party data. The *Consultant* is to scope, procure and manage the acquisition of any new surveys or data requirements and third party data. The *Consultant* will ensure any Intellectual Property Rights remain with the *Client* after final delivery.

4.1.3. The *Consultant* completes a data review to analyse the completeness, accuracy, content and size of previous studies and data and identifies any risks or issues associated with these within 6 weeks of the Project Start-up Meeting. The *Consultant* produces a data review report to identify any major concerns within 6 weeks of the project start up meeting and attends a call to discuss the content of the report to allow appropriate action to be taken.

5 Specifications and guidance

Where applicable, the *Consultant* shall use the following specifications and guidance:

5.1.1. Operational Instruction 379_05 ‘Computational modelling to assess flood and coastal risk’.

5.1.2. Operational Instruction 197_08 Flood Estimation Guidelines

5.1.3. NEC4 Minimum Technical Requirements for Modelling_v1.xlsm

5.1.4. Fluvial Design Guide (online): http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide.aspx

5.1.5. Operational Instruction 466_15 Guidelines on high flow rating curve development using hydraulic models.

5.1.6. Development of flood warning thresholds must comply with Operation Instruction 137_05, Flood Warning Levels of Services (06/01/2014) and Operational Instruction 55_07 Threshold Setting in Flood Incident Management (26/10/10) where the 0.1% AEP flood outline exists.

5.1.7. PDM Model Calibration Principles 20151109.docx

5.1.8. Operational Instruction 57_07 Assessment of flood risk – topographic and hydrographic surveys.

5.1.9. Carry out any required surveys in accordance with the National Standard Contract and Specification for Survey Services version 4.1.

6 Services and other things provided by the *Client*

The *Client* will provide the following services:

6.1.1. Access to land to carry out surveys and site visits.

6.1.2. Arrangement of progress meetings, meetings with landowners and site visits with the *Client* in attendance.

6.1.3. Any other data owned by the *Client* which is requested by the *Consultant* will be provided along with a data licence.

Environment Agency
NEC4 professional services contract (PSC)
Scope

Project / contract Information

Project name	River Ryton
Project SOP reference	ENV0002885C
Contract reference	29648
Date	06/05/2020
Version number	2
Author	[redacted]

Revision history

Revision date	Summary of changes	Version number
30/04/20	First issue	1
06/05/20	Following review by Defra Commercial Lead	2

This Scope should be read in conjunction with the version of the Minimum Technical Requirements current at the Contract Date. In the event of conflict, this Scope shall prevail. The *services* are to be compliant with the version of the Minimum Technical Requirements.

Document	Document Title	Version No	Issue date
n/a	NEC4 Minimum Technical Requirements for Modelling	v1	03/12/19

Details of the Scope

Details of the Scope are as follows.

1. Description of the work:

1.1. Objective

The aim of this project is to gain a better understanding of the flood risk from the River Ryton in North Nottinghamshire, with particular focus on the communities of Shireoaks, Worksop and Blyth. There is a history of flood events affecting Worksop, with a large event occurring in June 2007 and more recently in November 2019. The June 2007 event resulted in internal flooding to an estimated 200 properties and the November 2019 event over 300 properties.

1.2. Outcome Specification

The River Ryton is the primary source of flood risk in this area though as with all urban areas surface water is known to cause flooding issues.

This study shall identify the source(s) and key mechanisms of fluvial flooding in the communities highlighted above with particular focus on Worksop being the community with by far the most properties at risk. The results of this study will be used to identify potential flood risk management options, inform incident response, justify asset investment and maintenance as well as inform spatial planning.

A 1D ISIS model was constructed for the River Ryton in 2008. Since then new modelling techniques and methodologies have become available which will enable us to create an improved understanding of the flood risk and flooding mechanisms within the catchment.

A significant amount of hydrometric data has been collected since the last study, including a very significant event which will aid in the development, calibration and validation of the model. In addition new channel cross section survey was collected in 2019 for the whole study reach and 1m resolution LiDAR has been collected in this area as part of the national programme. A review of the new survey is required in order to capture any key information (cross sections, structures) that may be missing. Where gaps are identified they should be highlighted to the local team.

The River Ryton is a tributary of the River Idle and flows through a predominantly rural catchment covering around 245km2. The main area of flood risk being the communities of Shireoaks, Worksop and Blyth. The catchment is gauged at Worksop and Blyth with a flood warning service provided to the local communities.

The extents of the study are:

River Ryton from SK 53837 82778 (HOMR) to SK 65749 92138 (River Idle Confluence) Approx 40 km.

2. Outcomes required

a) The *Consultant* shall

- The *Consultant* shall produce a written commentary in the Interim Hydrology Report or Hydrology Review Report to document local flood history analysis. The commentary shall consider the following:
    - Ranking and severity / probability of events where possible.
    - Likely causal mechanism of flooding (including combined sources).
    - The *Consultant* shall collect and evaluate data from the *Client*.
    - The *Consultant* shall collect and evaluate data from social media / other potential sources of information.

Site Visit and Topographic Survey

- Visit the site to understand the local flood flow pathways and flood history. The *Client* will facilitate this visit(s) and arrange for appropriate staff to accompany the *Consultant* to provide local knowledge. The *Consultant* shall give the *Client* at least 20 working days' notice prior to any required visits.

Hydrological Assessment & Hydrometric Review

The *Consultant* shall undertake the following activities to provide a hydrological assessment and / or hydrometric review in accordance with the Environment Agency's Flood Estimation Guidelines.

Reporting

- Submit a Hydrology Method statement for acceptance by the *Client* before commencing the hydrological assessment and/or hydrometric review. This shall set out the proposed approach, review of hydrometric data, catchment schematisation, and set out the methods and outputs.
- Submit a Draft Hydrology Report to the *Client* for acceptance prior to the commencement of design simulations.
- Submit a Final Hydrology Report to the *Client* for acceptance prior to commencement of design event simulations.

Review Data Availability

- Undertake a review of the hydrometric data (rainfall, levels, flow, flood extent) that are available for use for in the study (including donor catchments, model calibration and verification of models).
- Assess data availability, and the uncertainties in the accuracy of the data and what effect this could have on the reliability and accuracy of model outputs.
- Review the performance of all rating relationships that will be used in this study during high flow conditions. The rating throughout the full range of flows shall also be assessed, albeit in a less rigorous manner. The review shall include commentary on the extrapolation above validated range, modular limits, likely hydraulic control in drowned mode and inter-site comparison.

- Clear conclusions on the suitability of ratings for rainfall-runoff model development and calibration of hydraulic models must be provided. Conclusions must include an estimate of likely gauge accuracy (% error in flow) for flows up to and including AMAX1. An indication of gauge accuracy at high and extreme flows (0.1% AEP or similar) shall be provided where possible.

- Use model constructed to improve the rating relationship at required gauging stations. State the extent of model required, any new survey requirements, and the most appropriate modelling approach. Consider whether simpler methods (e.g. velocity/area) can produce the required results.

- Recommend any improvements to hydrometric networks and data collection in floods.

High-Flow Rating Development.

- Use model constructed to derive high-flow rating curves at required gauging stations at Blyth and Worksop

- Document new high flow ratings and their derivation.

- Report the updated AMAX and POT series (where appropriate) for use in the flood estimation methods (e.g. within the FEH Calculation record).

Catchment Understanding

- Schematise the catchment. Sub catchment schematisation shall represent key hydrological features (e.g. changes in catchment response, key tributaries/confluences and flood storage reservoirs). Catchment delineation must be verified including use of surface water sewer data in urbanised catchments. A GIS shape file of sub catchment boundaries must be provided for acceptance by the *Client* as part of the Draft Hydrology Report. Boundary unit type (ReFH, FEH, pumped catchment, etc.) and inflow locations (point, distributed lateral) shall be described and justified.

- Update sub catchment schematisation to improve delineation of (urbanised areas, improve resolution of inflows, changes on the ground).

Design flow estimation – general

- Tabulate the hydraulic model node labels corresponding to the locations of all level and flow recorders and other points of interest within the modelled area.

Design flow estimation - statistical method

- Agree peak flow data to be used for the analyses with the *Client*. The data will be based on available data as modified during the study (e.g. by the modelled rating curves).

- Undertake flood frequency analysis at all gauging stations using the agreed peak flow data. By default, FEH statistical methods (using the latest updates) will be applied - changes to these methods shall be agreed with the *Client*. Compare with any relevant previous estimates. The degree of uncertainty in the estimates shall be assessed. The effect of these uncertainties on the modelled levels and flood extents shall be assessed and documented.

- Where available use historical information to inform flood frequency analyses and choice of design values.

Design flow estimation - rainfall-runoff methods

- Assess the applicability of rainfall-runoff methods such as ReFH1 and ReFH2.

- Determine the critical design storm(s), including storm duration, DDF and ARF parameters. If the modelled area has a large variation in catchment size and response at different points of interest, the selection of design storms shall take this into account.

- Derive design flood hydrographs (e.g. ReFH, factor ReFH to fit statistical \ accepted design peaks, Archer method).

- Improve estimated rainfall-runoff parameters in accordance with the FEH Guidelines.

Reconcile Results and Produce Final Design Values.

- Reconcile the results from different approaches (e.g. rainfall-runoff and statistical). If peak flows are significantly changed, the effect on runoff volumes shall be investigated and hydrograph shapes amended if necessary.

- Compare flood estimates with previous studies at all gauging stations and other points of interest. Justify the final selection of methodology to be taken forward to design runs.

Fluvial – New Hydraulic Model Build

- The *Consultant* shall construct and deliver a new hydrodynamic hydraulic model extending over all. Main River. For fluvial models a single model is required and the *Consultant* must advise and obtain the *Client's* acceptance should multiple models be needed to achieve acceptable simulation times. Acceptable run-times are considered 72 hours for 7-day 0.1% AEP simulation on the *Client's* CMP computer. The model must be able to simulate flood events for: Fluvial undefended: 1%, 0.1%; Fluvial defended: 50%, 20%, 10%, 5%, 3.3%, 2%, 1.33%, 1%, 0.5%, 0.1% AEPs.

- Climate change scenarios are required as part of this project. Please refer to Minimum Technical Requirements for Modelling for details of climate change requirements.

Model Proving Calibration, Verification & Sensitivity.

- The *Consultant* shall provide written interpretation of results, including impact on model calibration/proving, design configuration, onset of flooding, standard of protection and recommendations for prioritisation of maintenance.

- Calibrate the River Ryton through simulation of up to 3 events and verify performance through simulation of up to a further 2 events. Suggested events include: November 2019, June 2007. Inflows shall be generated using observed rainfall and flow data and the *Consultant* is expected to select events to maximise available information. Variation in antecedent conditions between events must be explicitly computed.

- The *Consultant* shall achieve peak level fit at all gauged locations of ± 150 mm, with replication of overall hydrograph shape. Variance between the observed and modelled hydrographs shall be presented to the *Client* at a face to face calibration review meeting along with draft flood outlines for any out of bank calibration events.

The *Client's* acceptance of the calibration is required before progression to design event simulation.

Fluvial Models:

- ±20% flows
- ±20% roughness
- ± 20% slope change in downstream boundary

The following project specific sensitivity tests are required:

- Addition and removal of 300mm silt (depth to be confirmed and submitted for acceptance by the *Client*) through modification to the in-channel cross-section geometry.
- Simulations to determine sensitivity to blockage of culverts up to a maximum of 5. Specifics TBC
- Simulations to determine sensitivity to operation of structures up to a maximum of 5. Specifics TBC.

Design Simulations & Results

- All scenarios listed below must be delivered for defended scenarios. Fluvial scenarios are modelled with the flood defence system scenario of defended, no failure by breaching.
- Scenarios: Fluvial undefended: 1%, 0.1%. Fluvial defended: 50%, 20%, 10%, 5%, 3.3%, 2%, 1.33%, 1%, 0.5%, and 0.1% AEPs. Climate change scenarios are required as part of this project. Please refer to Minimum Technical Requirements for Modelling for details of climate change requirements.
- The *Consultant* shall provide written commentary on the %AEP of onset of flooding, standard of protection (including freeboard, in accordance with the Client's Updated Fluvial Freeboard Guidance Note, 2017) and suitability of fit with the anecdotal historic evidence of flooding. Limitations with historical evidence results shall be clearly identified in the conclusions and further recommendations shall be given if appropriate (e.g. state where new telemetry gauges shall be installed, where new survey / LiDAR would improve model accuracy etc). This commentary is to be included within the draft and final Model Report.

In addition the *Client* requires:

- Identify the design event probabilities for which the defence provides benefit – this shall include all events where retained water level is above local ground levels. The assessment shall include identification of receptors protected. The analysis must be sufficiently detailed to distinguish between individual communities and include strategic infrastructure (trunk road, railways, power sub-stations). Provide this commentary as part of the Model Report.
- Animations of flow and velocity vectors for the 2D model domain for:
  - Location - Worksop
  - Design Event – 5%AEP, 1%AEP

- Simulate removal/addition of sediment for:
    - Locations – Worksop
    - Scenarios – 100mm, 300mm
    - Design Event - 5%AEP, 1%AEP

- Produce a table of the number of residential, critical infrastructure and other non-residential properties within all defended, undefended and blockage %AEP outlines referring to the flood level at the nearest relevant river gauge(s) - if applicable).

- Assess the performance of up to 5 structures: locations TBC

Flood Warning Improvements

The *Consultant* shall deliver the following services in accordance with Operational Instruction 137_05 Flood Warning Levels of Services and OI 55_07 Threshold Setting in Flood Incident Management. The following services are anticipated following receipt of the improved flood outlines but allowance shall be made by the *Consultant* for liaising with the Flood Resilience team for specific guidance on the process and at key points:

- Review the existing Flood Alert Areas and / or Flood Warning Areas extents in comparison with the updated modelled outputs and advise whether modifications are required to the extents. Review the first impacts (out of bank), first property to flood and trigger thresholds using the updated and accepted flood maps / levels. There are 2 existing Flood Alert Areas and 7 existing Flood Warning Areas.

- Update the existing Flood Alert Areas and / or Flood Warning Areas extents based on the updated modelled outputs (without defences 0.1% AEP plus historic flood extents, where appropriate) following the *Client's* acceptance of recommended modifications from 11.1 and provide revised extents.

- Deliver an Excel spreadsheet which includes %AEP, land use type, risk category assigned and number of commercial / residential properties for each FWFRA. Information on suggested FWAs shall include names of FWFRAs aggregated to make the FWA, highest AEP, total number of properties, breakdown of commercial and residential properties, vulnerable receptors (utilities, hospitals, care homes etc) and overall assigned risk category.

- Produce flood extent shapefiles with associated level at Flood Warning gauge for each of the existing Flood Warning Areas. Outlines are required for each simulated (with defences) %AEP between onset of flooding and the Extreme Flood Outline. Submit the proposal for the *Client's* acceptance whether onset of flooding is first property to flood, first impacts or overtopping of defences.

- Review the data quality of the gauge sites in the study area and provide a detailed recommendation for the gauges to be used in level-level correlation for each FWA.

- Produce level-level correlation between the onset of flooding location and Flood Warning Gauge Site for each Flood Warning Area. Determine the frequency the trigger level will be exceeded. Make recommendations for improvements, explaining the benefits.

- Produce travel time between the onset of flooding location and Flood Warning Gauge Site based on model results and verify these results through comparison with the available hydrometric data.

3. Constraints on how the *Consultant* provides the *services*

    a) The *Consultant* shall ensure that appropriate use is made of existing data, to avoid duplicating work already undertaken.

4. Exclusions

    a) TBC

    b) TBC

5. Specifications or standards to be used

    a) NEC4 Minimum Technical Requirements for Modelling_v1

    b) TBC

6. Specific Project Requirements

    a) TBC

    b) TBC

7. Services and other things provided by the *Client*

    a) Fastdraft for Contract Mgt.
    b) Facilitate site visits this visit(s) and arrange for appropriate staff to accompany the *Consultant* to provide local knowledge

Appendix A Existing Information

Title	Format	Available from
TBC	TBC	[redacted] [redacted] Service Manager

Appendix 1 BIM Protocol – Production and Delivery Table

All *Client* issued information referenced within the Information Delivery Plan requires verifying by the *Consultant* unless it is referenced elsewhere within the *Scope.*

The IDP is now accessed and created through Asite. The extent of BIM compliance is expected to extend only to final reports associated with the services as mapping and modelling data cannot be stored within the CDE due to size constraints.

~~**www.Pow.bim4.info**~~

~~**You need google chrome for this link to work. Once the table is completed it should be printed for issue in the tender document, so that the correct baseline position can be seen by tenderers and price**~~