Environment Agency

NEC4 Professional Service Contract (PSC)

Project / Contract Information

Project Name: Lower Colne Baseline Improvements
Expected Completion date: 30/05/2022
Version Number: **1.1**
Environment Agency Area: Hertfordshire and North London
Area Lead: [redacted]
Modelling Technical Lead: TBC

This scope should be read in conjunction with LIT 56326 Fluvial Modelling Standards current at the Contract Date. In the event of conflict, this Scope shall prevail. The service is compliant with the minimum technical requirements set out in LIT 56326 Fluvial Modelling Standards and LIT 18686 NEC4 Minimum Technical Requirements for Modelling current at the Contract Date.

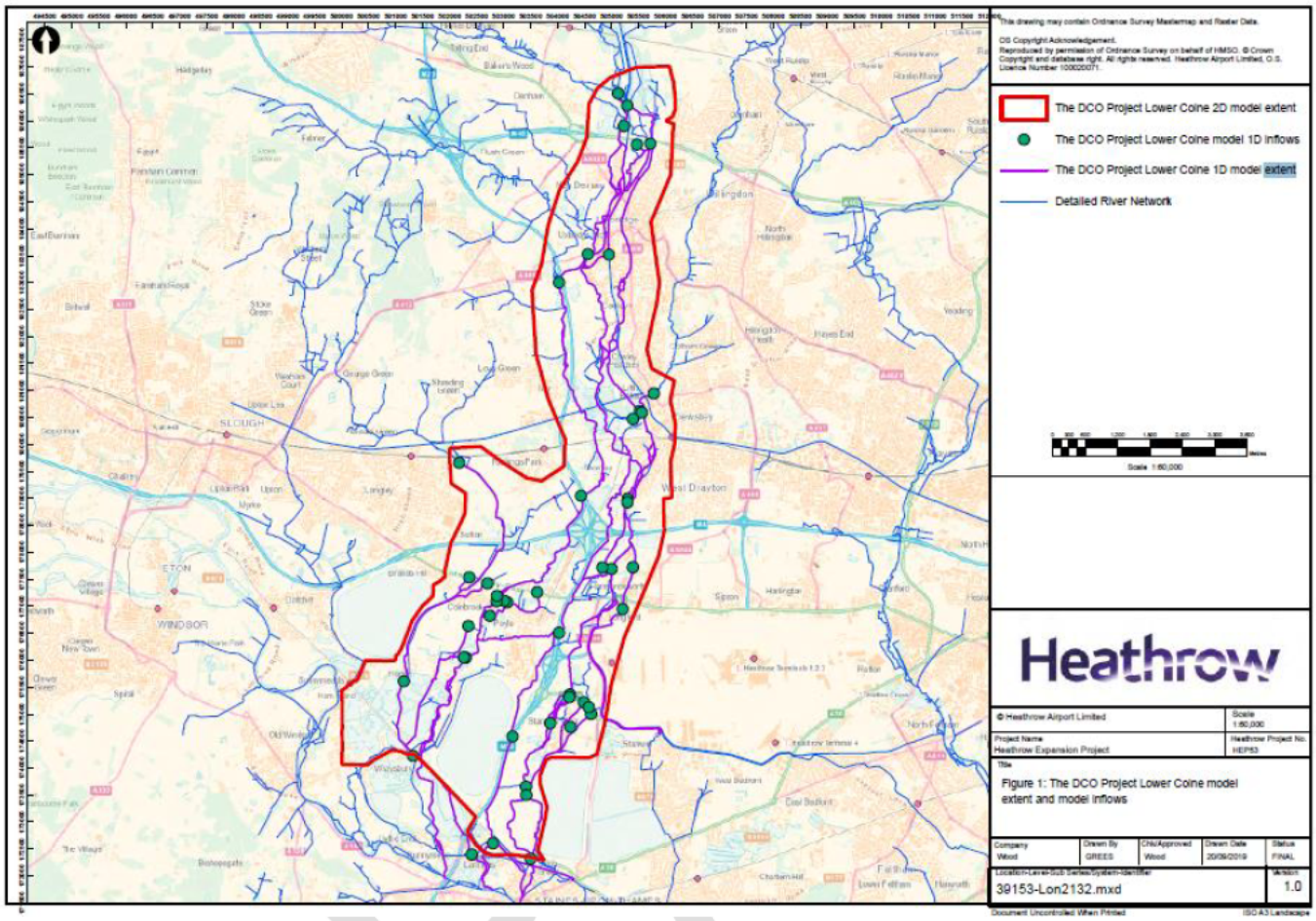
Project Overview

Update and improvements as required to the Lower Colne catchment model; Heathrow DCO Project Model' (2019) based upon (i) recommendations arising from the JBA review completed in 2019 and (ii) identification of further revision/refinement required for future improvements to the model, outside of scoped arrangements in this document.

Background: The Heathrow DCO Project Model' (2019) was developed from the Lower Colne Modelling and Mapping Study in 2012. This model was subsequently revised and updated to support preparation of the flood risk evidence base supporting proposals for construction of a third runway at Heathrow airport (the Heathrow DCO Project Model). This work was completed in 2019 and the updated model was reviewed by JBA Consulting, on behalf of the EA, in November 2019. The JBA review set out a number of recommendations relating to revision/refinement of the model that was required before it could be used for flood mapping purposes. However, due to a change in the status of the Heathrow expansion plans, the model was not updated to reflect the recommendations arising from the JBA review.

The Heathrow DCO Project Model is currently the 'best available' model for the Lower Colne and is to be used to support flood risk management and asset performance related projects in the Lower Colne catchment. As noted above, a wider, 'whole-model' review/audit was completed by JBA Consulting in November 2019. It is not therefore anticipated that this exercise should be repeated, but an assessment of the recommendations go ahead before model improvements applied. The Agency requires that a general comparison also be taken into account when reviewing the recommendations and the difference between what has been carried out by Heathrow for the DCO model and the 2012 model. This should: (i) take account of the findings/observations and recommendations set out in the JBA and EA recommendations review and (ii) identify to what extent further revision/refinement is needed to support future improvements for this model, outside of scoped arrangements in this document.

Map of Heathrow DCO Project Model' (2019)



*Taken from Lower Colne Hydraulic Modelling report, Heathrow, Appendix A

1. Hydraulic and Hydrological Model

1.1 The *Consultant* shall submit a method statement for acceptance by the *Client* prior to implementing model improvements/updates, This is to be prepared following (i) review of the documents associated with and arising from the previous 2019 review (referenced in Appendix B) and (ii) completion of the review of the DCO model against the 2012 EA Lower Colne Model. This method statement will provide a clear approach to the activities requested and agreed as part of this scope. Please see Appendix A for the detailed recommendations of model improvements identified following the 2019 review and Section 1.3 for overview of themes for recommended improvements for future consideration. *Consultant* to follow Environment Agency Hydrology and Modelling guidance.

1.2 The *Consultant* shall focus on the following themes when comparing updates from the 2012 Lower Colne Model to the 2019 Heathrow DCO Model:

Survey update locations and gaps going forward
- Updated and new structure information included and identify where there are gaps

1.3 Consultant is required to review the documents associated with and arising from the previous 2019 review (referenced in Appendix B) and complete an overview of comparison between the 2012 EA Lower Colne model and the 2019 Heathrow DCO model to provide recommendations for future update and visual gap analysis. Consultant is to take into account that update to the 2019 Heathrow DCO model will not be including further survey updates, but completing with current data.

1.4 The *Consultant* is to assess whether the Lower Colne Improvement Scheme (a range of assets across the Lower Colne catchment area) has been adequately represented in the Heathrow DCO Project Model (2019) and consider whether revision/update of the model is required to fully represent the Lower Colne Improvement Scheme, as referenced in Appendix B.

2. Local Flood History for Calibration

2.1 The *Consultant* shall review local flood history post 2018 to support flood events taken forward for calibration of the model, in addition to what has already been completed by Heathrow consultants for the model being updated. The approach to model calibration should form part of the written commentary and proposed way forward set out in the Method Statement. The commentary shall consider the following:

2.2 The *Consultant* shall collect and evaluate data from the *Client*, and existing information from modelling reports and reviews, please see Appendix B for these listed.

2.3 The *Consultant* shall collect and evaluate data from recent EA flood reports and social media.

3. Site Visit and Topographic survey

3.1 Consultant to (i) review study area of Heathrow model to identify where new or additional survey was obtained as part of the Heathrow study and where EA survey data derived from the original 2012 study has been applied.

The C*onsultant* will include this within the recommendations for model improvements within the method statement to be agreed with the *Client*.

The *Client* will liaise with the *Consultant* to provide local knowledge.

The *Consultant* shall give the *Client* 10 working days' notice prior to any required virtual or on the ground site visits if needed.

4. Hydrological Assessment and Hydrometric Review

4.1 Consultant to review all the current recommendations and technical requirements as listed in Appendix A using linked material as referenced in Appendix B to support this. *Consultant* to then produce a method statement of approach for model improvements to be approved by the *Client.*

Consultant to include in their review, prior to preparing the method statement, the Lower Colne and Heathrow comparison (as set out in Section 1.3) and the areas of the Heathrow DCO Project Model that have not undergone update to 2D.

The method statement should address:

- Areas of the Heathrow DCO Project Model that have not undergone update to 2D
- Areas of the Heathrow DCO Project Model that have not had updates to structure or survey information.

Key assessment areas to be taken into account

4.2 The *Consultant* to take into account the following areas when reviewing the recommendations provided by the *Client* and JBA in Appendix A and include their recommendations in the method statement:

- Catchment understanding and practices used to represent in the model
- Design flow estimations, general, statistical method, rainfall runoff measures
- non-stationary flood frequency analysis
- Flood plain representation – LiDAR and survey
- Model proving
- Model Calibration
- Model Verification
- Sensitivity testing
- Design simulations and results

As per EA modelling standards.

5. Additional elements

5.1 1D/2D representation

Consultant to update area of 1D Heathrow DCO Project Model to 2D if this allows with data available; existing survey, LiDAR and relevant data referred to in the information in Appendix B.

5.2 Design simulations and results

5.2.1 All scenarios listed below to be delivered by Consultant:

Scenarios:
Fluvial defences removed: 0.1%, 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 NEC4 Minimum Technical Requirements for Modelling V5 for details of climate change requirements and the format of all deliverables.

Client requires that the 2080s Climate Change allowance, Central, Higher and Upper is applied to the 1% defended model run and the 2020s climate change 'Upper' scenario applied to the 1% defended model run. Please see these highlighted below taken from gov.uk.

Colne Management Catchment peak river flow allowances:

Period	Central	Higher	Upper
2020s	10%	16%	30%
2050s	8%	16%	38%
2080s	21%	35%	72%

5.3 Calibration and Validation

Model calibration to be undertaken with events to be confirmed by the client following consultant review of flood history (Section 2 of this scope).
Consultant to advise if previous calibration carried out will require repetition once improvements have been applied to the Heathrow DCO Project Model.

5.4 Flood warning review

5.4.1 The *Consultant* shall deliver the following services in accordance with Operational Instruction 381_03 Defining Flood Alert and Flood Warning Areas 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:

5.4.2 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 4 existing Flood Alert Areas and 7 existing Flood Warning Areas.

5.4.3 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).

5.4.4 Produce flood extent shapefiles with associated flood level at the Flood Warning gauge for each of 7 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.

5.4.5 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.

5.4.6 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.

5.4.7 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.

5.5 Blockage Modelling

5.5.1 Simulate structure blockage scenarios for 3 locations:

The locations for these are as follows:

- Albany Park barrage non return valve, fully blocked, half blocked for 3x AEPs
  [Grid Ref: TQ0302077091]
- Wraysbury Mill fully blocked, half blocked for 2x AEPs
  [Grid ref: TQ01477439]
- Ash Offtake fully blocked for 2x AEPs
  [Grid Ref: TQ 03507 72321]
  Old Mill House for 2x AEPs
  [Grid Ref: TQ0496681889]
  Braybourne close for 2x AEPs
  [Grid Ref: TQ0549784938]

The specific AEPs for each structure to be discussed and agreed with the Client.

5.6 Structure Removal Scenarios

5.6.1 Simulate structure removal(s) for 5 locations x3 AEPs, using updated baseline to compare flood extent outlines and hydrographs.

The locations for these are as follows:

- Hythe End Weir
  [Grid ref: TQ0187872464]
- Horton Mill
  [Grid ref: TQ 02108 75777]
- Huntsmoor
  [Grid ref: TQ 04870 81574]
  Stanwell Lake offtake
  [grid ref: TQ 04217 75321]
- Wraysbury Mill
  [Grid ref: TQ01477439]

The specific AEPs for each structure to be discussed and agreed with the Client.

Appendix A – Technical requirements for update of the model

Taken from JBA Heathrow expansion Lower Colne Baseline Review and EA review (red and amber flagged recommendations).

Add Water Level Lines to the modelled 1D sections

- Add network lines to the model to enable mapping of 1D outputs before re-running for Flood Map purposes
  Update model to use latest Thames model as downstream boundary condition. Client can provide this.
- Remove flood defences for undefended model runs and Flood Map
- Check all cross sections and update panel markers for entire model.
- Run check and update model to rationalise cross section spacing in locations where nodes with erratic node spacing and have extremely small intervals (2-5m)
- Run check and update model to rationalise Mannings longitudinally in reaches where there are erratic changes
- Add inlet and outlet losses if photos or survey exists for the 11 structures that do not show this in the model.
- Review the representation of these two structures that are mis-represented as defined in the JBA review document referenced in Appendix B.
- Update modular limits to variable or default (to be determined) as a sensitivity test before running the model for Flood Mapping purposes.
- An initial high level review, to determine if the use of sluices is reasonable, as it was deemed suitable in 2012 and now updated as so in the Heathrow model. Depending on the results of this review, a decision would then need to be made as to whether to proceed with updates to the structures - This would depend on survey availability, the number of structures that were deemed requiring an update and resource availability for this work, and the criticality of the structure (is it in a high risk location)
- Review and update 1D/2D links in locations set out in the JBA review document
- Recommend improvements required to update area of 1D downstream boundary of the model to 2D with data available.
  Model calibration to be undertaken with events to be confirmed by the client following supplier review of flood history (Section 2 of this scope).

Full matrix of recommendations from JBA and EA review

Taken from document: Lower_Colne_Model_Heathrow_Review_For_EA_Use_August_2020
Please note those referenced as ‘considered’ are EA reference only and have been included for improvements required by consultant for this scope (as referenced above).

Issue	Possible Action	Context	Recommendation	Priority
There are no panel markers in 33 cross sections, which is quite a large number. An inspection of a sample of the cross sections reveals that a single Manning's n is specified in each of the cross section, notwithstanding geometrical transitions that would warrant change in roughness, hence a panel marker.	Check all cross sections and update panel markers for entire model.	This update was carried out by HAL following the review, but we never received the updated model files and so this would need to be carried out by the EA if the issue is to be resolved. As its only 33 cross sections, it is a relatively straight forward process to update where required (poor conveyance plots in the model)	Consider updating these sections prior to re-running the model for Flood Map purposes.	Consider
Nodes with erratic node spacing and extremely small intervals (2 5m)	Run check and update model to rationalise cross section spacing in these locations	This update was carried out by HAL following the review, but we never received the updated model files and so this would need to be carried out by the EA if the issue is to be resolved. This is a fairly limited issue and is unlikely to have a significant impact on model results (minor issue in JBA review). It would be relatively straight forward to update the model in these locations if required.	Consider updating these sections prior to re-running the model for Flood Map purposes.	Consider

Erratic changes in Mannings in some reaches	Run check and update model to rationalise Mannings longitudinally in these reaches.	This update was carried out by HAL following the review, but we never received the updated model files and so this would need to be carried out by the EA if the issue is to be resolved. This is a fairly limited issue and is unlikely to have a significant impact on model results (minor issue in JBA review). It would be relatively straight forward to update the model in these locations if required.	Consider updating these sections prior to re-running the model for Flood Map purposes.	Consider
Bernoulli losses used to represent bridges, which is an outdated method		HAL have updated units to use detailed bridge units where new survey was captured. In the absence of the original survey used in the original modelling, it is not possible to update the remaining units.	Without the original survey for these structures it would be quite an undertaking to update these units. It is recommended that the remaining Bernoulli units are left in place, as they would have been calculated and been representative (and signed off) in 2012. They should remain a limitation of the modelling, for future updates of the model, when new survey data is available.	Consider
No inlet or outlet losses in 11 culverts.	Add inlet and outlet losses if photos or survey exists for the structures.	This update was carried out by HAL following the review, but we never received the updated model files and so this would need to be carried out by the EA if the issue is to be resolved. It would be relatively straight forward to update the model in these locations if required and if photos/survey exist. Potential for stability issues to arise	Consider updating these sections prior to re-running the model for Flood Map purposes, but only if survey data/photos exist of the inlets/outlets.	Consider

According to notes in the geometry file, the single notional weir in the model is a dummy weir representing a very low footbridge at Pound Mill in Staines. Similarly, one of the round-nosed broad-crested appears to be used to model a road bridge. In the absence of the original survey drawings it is not feasible to judge whether representation of the structures in this manner is appropriate.	Representation of these structures could be reviewed is survey is available.	HAL were going to review the representation of these structures to determine if an update was required and possible.	Consider reviewing the representation of these two structures if survey data is available.	Consider
Modular limits in all the sluices are fixed (as opposed to variable and calculated by the software) and assigned the default value of 0.7 in 51 of the sluices, 0.8 in five and 0.9 in seven.	Modular limits could be reviewed and updated to be variable.	HAL were going to review Modular limits and update to be variable for sluices in their site boundary, but we didn't receive those model files to assess the sensitivity to these changes. For EA purposes, this update could be done for all sluices.	Consider updating modular limits to variable or default (to be determined) as a sensitivity test before running the model for Flood Mapping purposes.	Consider
It would appear that, not only are actual sluices are modelled as "sluices" but also road bridges, culverts, inverted syphons, flumes etc are modelled as "sluices". In the absence of the original survey drawings it is not feasible to judge whether representation of the structures as sluices is appropriate.	Use of sluices in the model could be reviewed if survey data of structures exists.	HAL reviewed those within their site boundary, but did not look at the whole model. It would be a fairly considerable undertaking to review and update these representations.	An initial high level review, using survey data if it exists, to determine if the use of sluices is reasonable, as it was deemed suitable in 2012. Depending on the results of this review, a decision would then need to be made as to whether to proceed with updates to the structures - This would depend on survey availability, the number of structures that were deemed requiring an update and resource availability for this work, and the criticality of the structure (is it in a high risk location)	Consider

It would appear that potential bypassing / overflow is not modelled at 19 weirs, 2 orifices, 41 sluices, 49 Bernoulli losses, 37 bridges and 27 culverts, i.e., a large number of the structures in the model. This would seem to suggest that bypassing / overtopping is unlikely. However, this is not stated either in the model or accompanying report.	Review structures with no bypassing/overtopping allowed to check if this is a reasonable assumption.	HAL reviewed those in their site boundary but we did not receive the updated modelling. It would be relatively straight forward to review whether spills are required at these structures, any identified as requiring a spill could be updated if survey data exists for the overtopping/bypassing route.	An initial review of the structures identified to determine how many require a spill. Depending on the results of this review, a decision would then need to be made as to whether to proceed with updates to the structures - This would depend on survey availability, the number of structures that were deemed requiring an update and resource availability for this work, and the criticality of the structure (is it in a high risk location)	Consider
No Water level lines in the 1D domain - Does not affect results but means that the 1D channel cannot be mapped.	Add WLL to the modelled 1D sections.	This will be required if the mapping needs to have the channel coloured "blue".	Add WLL to the model to enable mapping of 1D outputs before re running for Flood Map purposes.	Must do
there are no network lines. As water level lines, network lines are purely cosmetic and do not affect model results. However, they are useful in model visualisation and navigation.	Add network lines to the 1D model.	Useful for visualisation	Add network lines to the model to enable mapping of 1D outputs before re-running for Flood Map purposes.	Must do
At river cross section locations within the north and south west areas of 2D domain, the differences between 1D cross section and 2D CN line widths are small (within two cell widths). The differences in the south east area of the 2D (south of the M4 and east of Colne Brook) are much larger.	Review and update 1D/2D links in locations specified in review	HAL were going to review the locations highlighted in the review, but we did not receive an updated version of the model or report. Checks could be carried out by the EA before re-running the model.	Initial checks of problem areas to determine if improvements can be made. A decision would then need to be made whether updates are required and whether resource allows for this, perhaps based on whether they are in critical areas.	Consider
Model uses 2009 Thames model as downstream boundary conditions	Update model to use latest Thames model as downstream boundary condition.		Update model to use latest Thames model as downstream boundary condition.	Must do

Calibration is stated to be "good" in the HAL report, however shapes and peaks are not deemed "good" by the reviewer and +/- 500mm is not a usual EA standard.		The complexities of this catchment and system of watercourses makes calibration very complex and tricky and so this is the context that the mixed calibration results should be measured against. There is not much we can do to improve this without carrying out further monitoring and a new, detailed study and so this is just an issue that needs to be noted as a limitation of the modelling.	Note limitation of modelling.	Note/No Action
The model represents the present day baseline, including flood defences.	Remove flood defences for undefended model runs and Flood Map	Schedule for defences to be removed for Flood Mapping undefended purposes would need to be provided for this model version to be updated.	Remove flood defences for undefended model runs and Flood Map	Must do
Not all model results were provided and only limited runs carried out. 2, 20, 100, 1000 along with climate change runs were provided. Other input files were provided, but without results (50, 200yr)		Which runs are required for the area update will need to be determined.	Area to confirm which runs (return periods and scenarios) are required. E&R to confirm which files were delivered and can be used.	Must do

Appendix B – Relevant technical reports and information

Please see embedded information below to assist in request of this scope.

- Lower Colne Baseline Model 2012 Technical Report
- Heathrow Lower Colne Hydrology Report 2019
- Heathrow Lower Colne Hydraulic Modelling Report 2019
- JBA Heathrow expansion Lower Colne Baseline Review
- Heathrow Comments response
- Environment Agency recommendations
- LCIS report and shapefile (various structures and assets that make up scheme.
- NEC4 Minimum Technical Requirements for Modelling V5

Client to package these and send with this scope.