Highways England

A63 Castle Street Improvement Scheme

Flood Emergency and Evacuation Plan Report

P02 | June 2019

Job number 237912-00

Ove Arup & Partners Ltd
Admiral House Rose Wharf
78 East Street
Leeds LS9 8EE
United Kingdom
www.arup.com

ARUP

Document Verification

ARUP

Job title		A63 Castle Street Improvement Scheme			**Job number** 237912-00
Document title		Flood Emergency and Evacuation Plan Report			**File reference**
Document ref					
Revision	**Date**	**Filename**	Flood Emergency Evacuation Plan Report.docx		
Draft 1	May 2018	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Adriaan van den Berg	Andrew Drake	Sonam Norbu
		Signature			
P01	June 2018	**Filename**	HE514508-ARP-EGN-S0-RP-CD-000001		
		Description	First Issue		
			Prepared by	Checked by	Approved by
		Name	Tom Haller	Adriaan van den Berg	Sonam Norbu
		Signature			
P02	June 2019	**Filename**	HE514508-ARP-EGN-S0-RP-CD-000001		
		Description	Updated to respond to EA queries		
			Prepared by	Checked by	Approved by
		Name	Adriaan van den Berg	Andrew Drake	Andrew Drake
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
			Issue Document Verification with Document		ü

Contents

Appendices

Appendix E

Minutes of Meetings

Appendix F

Environment Agency Relevant Representation Response: Pumping Station Flood Resilience

1 Introduction

The A63 Castle Street Improvements scheme involves grade-separation of the currently at-grade Mytongate junction of the A63 with Ferensway. The grade separation of the junction will feature east and westbound entry and exit slip roads, enabling all movements. The scheme also features the provision of a number of pedestrian footbridges which will replace at-grade pedestrian crossing points along the A63 Castle Street.

1.1 Purpose of the Document

This document aims to identify and assess the potential risk of flooding within the area of the scheme. The document describes the emergency and evacuation procedures to respond to such a flood event.

1.2 Scheme Description

The A63 Castle Street comprises approximately 1.5km of dual carriageway which runs through the centre of Hull. The current layout is dual-2 lane all-purpose trunk road with no hard shoulder which runs in an east-west direction to the south of Hull city centre, from Rawlings Way Junction to Market Place. The route is an important link between the M62, Humber Bridge and Port of Hull. The current speed limit is 40mph.

As the primary access to the Port of Hull on the strategic road network, Castle Street handles large volumes of traffic, and congestion is exacerbated by two at-grade junctions at Mytongate and Market Place. Difficulties with the current A63 Castle Street route through Hull city centre is characterised in two ways: it acts as a substantial barrier, creating severance between the city centre to the north and the area targeted by Hull City Council (HCC) for development and regeneration to the marina and market area on the south side of the A63. Secondly, sited through the middle of Hull city, capacity problems and signalised junctions severely hinder free flowing traffic.

The proposed scheme includes the following highways interventions:

- Lowering the level of the road into a cutting by approximately 7 metres at Mytongate Junction;
- Raising Ferensway and Commercial Road by approximately 1 metre creating a grade-separated junction;
- Widening the eastbound carriageway to three lanes between Princes Dock Street and Market Place, with the nearside lane being marked for local weaving traffic;
- Provision of bridges for pedestrians, cyclists and disabled users at Porter Street;

- Provision of an enhanced / iconic crossing structure for pedestrians, cyclists and disabled users in front of Princes Quay;
- Upgrading an existing route that runs underneath the A63 at Market Place to allow people to cross underneath the A63; and
- Restricting access to the A63 by closing some junctions and restricting movements on some side roads to improve safety.

The scheme objectives are as follows:

- Improve access to the Port of Hull;
- Reduce congestion;
- Improve safety; and
- Reduce severance between the city centre and the waterfront area.

2 Flood Risk Assessment

The Flood Risk Assessment produced by Mott MacDonald Sweco JV identified the following sources of flooding that pose a potential risk to the Scheme:

- Tidal
- Fluvial
- Pluvial
- Sewer and Drainage
- Groundwater

2.1 Conclusions from Flood Risk Assessment

The Flood Risk Assessment concluded the following:

1. Currently the greatest risk of flooding to the Project area is from wave overtopping of existing flood defences on the north bank of the Humber.

2. Flooding from the River Hull requires the failure of the Hull Tidal Surge Barrier to close. This is unlikely as it incorporates a system to automatically close the barrier in the event of a power failure. However, under the 1 in 200-year event the underpass structure is completely flooded but this prevents flood flows reaching the area north and west of Mytongate junction, particularly around the junction of Ferensway and Anlaby Road reducing flood risk in this location. For this scenario, there is a minor increase in flood risk in the area between the Docks and the River Hull north and south of the Project from the slight change in the elevation of the road. This results in the diversion of flood flows into Princes Quay.

3. Widespread and significant flooding is predicted for the Humber 1 in 1000-year wave overtopping event and the Humber undefended tidal

flooding scenarios. The impact of a flood of this magnitude would be significant, not just for the Project but for the whole of Hull. During such an event, the A63 would be completely closed west of Mytongate junction regardless of whether or not the Project goes ahead.

4. Probability of flooding from combined sources (high sea levels in the River Hull and Humber during high fluvial baseflow conditions in the River Hull) was also considered in the study. However, the analysis indicates that the dependence between the different sources of flooding within the area is very low.

5. The underpass drainage is designed for a 1 in 100-year critical duration rainfall event including a 30% allowance for climate change. The model predicts negligible increases in surface water flooding from such a rainfall event as a result of the Project.

6. The risk of groundwater flooding to the Project and from the Project is considered to be slight. The walls of the underpass structure are estimated to discharge an average of 1.4 m^3 per day into the underpass drainage system. This is equivalent to less than 1 l/s which would be drained by the underpass drainage network.

7. Analysis of flood routes and flow velocities during the extreme tidal events shows the greatest impact of the Project results from the proposed underpass structure. Predicted maximum velocities of water (combined with the depth) flowing into the underpass are classified as ‘danger for all’ under Defra’s Hazard to People Classification.

8. The resilience of the Project to climate change is considered for tidal, fluvial, pluvial and groundwater flooding sources. The underpass drainage is designed to accommodate flows generated from a 1 in 100-year event with a 30% increase in rainfall intensity for climate change impacts. Consequently, the pluvial events with consideration of climate change result in only negligible increases in flooding to areas outside the Project outline.

9. Climate change impacts on tidal flooding scenarios from the Humber are more significant, flooding not only the Project area but significant parts of Hull city centre. This is a result of tidal water levels exceeding the level of the existing Humber defences.
10. For extreme tidal flooding events such as those witnessed on 5 December 2013, there is an existing procedure in place whereby flood alerts from the Environment Agency (EA) are issued to the Highways England Emergency Planning team who consider an appropriate response, for example, the closure of the underpass. This report is a review of this process and makes recommendations to accommodate future technology introduced by the Project.

2.2 Flood Defence Structures

This section addresses current and future flood defence structures in the vicinity of the project.

2.2.1 River Hull Flood Defences

The SFRA (Arup, 2016) states that the flood defence infrastructure on the River Hull is in variable condition with some parts being in poor condition. Defences in poor condition may not necessarily have a low standard of protection (based on probability of over topping and vice versa. Figure 1 of the SFRA (Arup, 2016) indicates that the flood defences along the banks of River Hull have a standard of protection, excluding freeboard, of greater than 1 in 200 (0.5% annual probability) assuming the Hull tidal barrier operates as intended. Defences are maintained at a level as defined within the Kingston upon Hull Act 1984.

The SFRA (2016) reports there are isolated low points in the flood defences where the standard of protection is between 1 in 75 and 1 in 100 (1.33% and 1% annual probability). The locations of these low points are identified in the area between Ferry Lane Bridge and the railway line bridge.

The River Hull is further protected by the Hull Tidal Surge Barrier. The Hull Tidal Surge Barrier protects the City of Hull along the lower reaches of the River Hull by providing a 1 in 200-year standard of protection from tidal flooding. The barrier provides protection from a tidal flooding event with a return period of up to 1 in 1000 years, although it is not designed to protect the area from a 1 in 200-year event with consideration of climate change.

It is understood from consultation with Environment Agency staff that the Hull Tidal Surge Barrier is lowered between 1 to 3 hours in advance of high water when the tide level is predicted to exceed 4.4mAOD. If there is a power failure the barrier will automatically close to ensure flood protection is provided.

2.2.2 River Humber Flood Defences

As stated in the SFRA (Arup, 2016), the current standard of protection, excluding freeboard allowance, of the Humber defences adjacent to the City of Hull varies from 1 in 200 or greater in the west to less than 1 in 5 adjacent to Victoria Pier and the western part of Victoria Dock village (which is outside of the boundary of the study area). No inspection location plans have been provided, but records show that defects in the defences are typically of a relatively minor nature. Further details of the Humber defences can be found in Volume 3, Appendix 11.3 Flood risk modelling technical report of the A63 Castle Street Improvement, Hull – Environmental Statement.

New flood defences were constructed in 2015 at Albert Dock following the December 2013 tidal surge. These defences provide a standard level of protection of between 1 in 100 and 1 in 200 years (Arup, 2016) with an approximate top of defence level at 6.05mAOD.

2.2.3 Future Flood Defences

In May 2019, construction began on the upgrades to 19km of tidal flood defences on the north bank of the Humber Estuary; this scheme is known as the Humber Hull Frontages. The upgraded defences will protect Hull from the effects of flooding from the Humber Estuary from a 1 in 200-year event with an allowance for the effects of climate change up to 2040. Beyond 2040, the effects of climate change will be considered through a 'managed adaptive' approach. The proposed completion data for the Humber Hull Frontages is 2021. As such, the scheme will be in place and provide additional protection to the A63 Castle Street Improvement Scheme.

However, at the time of the preparation of the Flood Risk Assessment, no details on residual flood risk from the Humber Hull Frontages scheme were available and as such, the proposals have not been included as part of this assessment.

3 Flood Emergency and Evacuation Plan

3.1 Existing Flood Emergency and Evacuation Plan

This Flood Emergency and Evacuation Plan needs to link into and build on existing plans in place for the specific network.

The Humber Local Resilience Forum has already produced a detailed plan that proposed the required procedures to follow during a flooding incident. The Humber LRF Multi Agency Flood Plan (Version 3.0 June 2017), has been attached as Appendix A.

In addition to this plan, Highways England requires their Asset Maintenance and Operational Service Provider needs to respond to incidents on the network. These plans are listed below:

- Area 12 Incident Response Plan:

  http://assets.highways.gov.uk/freedom-of-information/disclosure-log/Area-maintenance-plans-693546/Area12-REDACTED-IRP-Update-Nov2012.pdf

- Area 12 Service Provider Contingency Plan:

  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/395837/Redacted-Area-12-Contingency-Plan-April-2013.pdf

- Area 12 Severe Weather Plan:

  http://assets.highways.gov.uk/freedom-of-information/disclosure-log/Area-maintenance-plans-693546/Area12-REDACTED-Severe-Weather-Plan201213-Rev0(2).pdf

3.2 Environment Agency Flood Warning Service

The Scheme is located within the following Environment Agency Flood Warning Areas:

- 122FWF112 Hull City Centre, and;
- 122FWT024 North Bank of the Humber Estuary in the West of Hull.

In addition, the following Flood Warning Areas border the Scheme to the west:

- 122FWF118 River Hull at Old Town, Dry Pool and Sutton Fields, and;
- 122FWT041 River Hull and Humber Estuary at Hull City Centre.

Records from the Environment Agency show the following warnings have been issued:

- 05/12/13 122FWT024 Flood Warning issued at 18:13;
- 05/12/13 122FWT024 Severe Flood Warning issued at 18:53;
- 02/03/14 122FWT024 Flood Warning issued at 10:48, and;

- 12/01/17 122FWT024 Flood Warning issued at 14:46.

The 2013 Severe Flood Warning was issued during the December 2013 tidal surge flooding event.

3.3 Flooding History

The Environment Agency Recorded Flood Outlines dataset confirms the Scheme area has been flooded previously:

- The area east of Princes Quay was flooded in September 1969 due to a tidal flood overtopping the River Hull defences. This occurred prior to the construction of the Hull Tidal Surge Barrier, and;
- The Scheme area throughout and north to the A1105 were flooded during the December 2013 tidal surge flood event.

3.4 Proposed Flood Emergency and Evacuation Plan

As highlighted from 2.1.12 above, it is essential to develop an integrated flood emergency and evacuation plan that mitigates the risks of these potential flooding scenarios.

For any flood emergency and evacuation plan to be effective, it will have to be responsive and closely linked with the Environment Agency Flood Warnings (EAFW) systems and the Humber LRF Multi Agency Flood Plan. The Environment Agency Flood Warnings are broken into a hierarchy of severity. They are as follows;

- Flood Alert: Flooding is possible; therefore, the affected parties need to be alert. Flood alert issued between two hours to two days in advance of flooding;
- Flood Warning: Flooding is expected. Immediate action is required by affected parties. Flood warnings are issued one hour to one day in advance of flooding, however sometimes they are issued moments before or during if not forecast in advance;
- Severe Flood Warning: Severe flooding, which poses a danger to life.
- Warnings no longer in force: No further flooding is currently expected in the affected area. This is issued when the river or sea conditions being to return to normal.

In addition to the EAFW, there are several additional warning services which can be used to provide a robust warning system. These include the Met Office Weather Warnings, Flood Forecasting Centre Hazard Manager notifications and bespoke Operational Instructions agreed with the EA on pre-defined trigger levels from telemetry. These will need to be agreed as part of the further development of the Humber LRF Multi Agency Flood Plan.

The Underpass Flood Detection Technology Options Report (See Appendix B), outlines two main options for the use of technology in the event of flooding of the underpass. Both of these options propose to transmit information to the North East Regional Control Centre (NERCC) for further action. The following elements have been identified as required from the preliminary technology design:

- Above lane mounted Light-Emitting Diode (LED) signals at the underpass entrance to indicate lane status and show underpass as closed;
- Motorway Signal Mark 4 (MS4) or Variable Message Sign (VMS) message signs (depending on approved option) on approaches to the underpass to advise road users of flooding and redirect them via alternative routes;
- Closed-Circuit Television (CCTV) cameras within the junction to monitor traffic flow and conditions, giving full visibility of the underpass with no blind spots; and
- An alarm output from the pumping station within the underpass, indicating pump failure and a high-water level warning, which will be connected to the NERCC.

Option 2 of the technology report builds on this basic concept with additional functionality which includes additional VMS on the A63 network that indicates emergency diversion routes, dedicated precipitation and water level sensors installed in the underpass, and the potential to interface outputs from the tunnel management subsystem with message updates sent using the Traffic Message Channel.

For this report it is assumed that at a minimum Option 1 proposed in the technology report will be implemented.

Technology Flood Resilience

The scheme takes cognisance of the potential impact different flood scenarios will have on the scheme. With this in mind, it is the intention of the scheme to look at different ways the proposed technology and mechanical equipment can be designed and built to be as flood resilient as reasonably possible. The technology resilience is broken up into three parts:

1. Flood detection technology;
2. Variable Message Signs; and
3. Pumping Station M&E.

Flood detection technology

The proposed flood detectors are designed to work in wet conditions and maintenance performance requirements shall be as per maintenance access arrangements, including remote access.

In terms of the designing technology, the detection equipment shall be designed to provide continuous operation for a minimum service life of 15 years and the detection equipment will have a minimum of 5 years maintenance, based on the reliability data handbook of Highways England. This information will have to be confirmed by the supplier.

Variable Message Signs

During the design development, different information signage systems were reviewed to support the objectives of the scheme. The option to deploy Fixed Text Message Signs, that could be rotated to display three different messages to advise closures was considered, however as an alternative the suggestion to install reduced size MS4 type message signs was thought a more practical solution. Both require electrical connections, which could potentially be interrupted in a flood scenario, however the MS4s would offer greater flexibility in terms of the tactical and strategic network. Additionally, these will be able to tie into the Hull City Council's wider VMS aspirations.

An alternative signage strategy that is being considered is the prism signage system. These signs can display multiple messages and claim to be robust enough to withstand adverse weather conditions and require little maintenance. However, these signs still require power, especially when rotating messages.

It is not yet clear which of these solutions is best suited for Highways England and Hull City Council's needs. The exact signage solution will be confirmed at detailed design.

Pumping Station M&E

The pumping station AIP, which was produced as part of the preliminary design, provides protection for a 1-in-200-year flood event. However, it is deemed necessary to provide some additional resilience for the pumping station building.

1. If the water level during the flood is less than 1m above the finished floor level: -
    a. It will be worthwhile investigating if the building can be protected from flooding (i.e. flood defences) to prevent water ingress. The flood defences would need to protect the substation, the generator and the MCC.
    b. If the entire building cannot be protected, it would be worth investigating whether the MCC could be raised and include an additional temporary generator connection point on the MCC to allow temporary generators to be hired in and then utilise the existing pumps. Providing the MCC was not submerged.
2. If the water level during the flood is greater than 1m above the finished floor level
    a. Construct a two-story building to allow all the plant within the building to be housed on the second story to protect against any first story flooding. This option is probably not feasible in terms of planning permission but would be an option for flood protection in the future.

b. Traditional type of flood recovery by hiring temporary pumps and temporary generators and use those to pump until the fixed plant has been replaced.

Based on the FRA models, Figure 14.35 shows a 1-in-200-year plus climate change Humber undefended tidal flooding maximum flood depth for existing layout. The figure shows that the flood depth at the pumping station area is less than 1.0m. Therefore, it seems plausible that scenario 1.a above would provide sufficient resilience for such a flood event. Additionally, the building can be future proofed, to design the foundations of the building in such a way, that it will accommodate a scenario 2.a or 2.b, if Hull City Council or the Environment Agency require additional flood protection in the future. See Appendix F for further details. Such 'future proofing' would be in line with the 'managed adaptive' approach adopted by the Environment Agency for the Humber flood defences.

Flood Warning Scenarios

It should be noted that the CCTV and pump alarm will only notify the NERCC if no prior warning occurred. They therefore are not preventative measures, but reactionary measures in the unlikely event all other warning measures did not happen.

The table below shows the Evacuation and Emergency plan for each of the Environment Agency Flood Warning scenarios:

Flood Risk Level	

Flood Risk Level	
Flood Alert (Level 1)	· EAFW, Local Authority or another partner identifies a potential flood scenario and convenes a Humber LRF Flood Advisory Cell (FAC) teleconference. Highways England (and the Area Maintenance Team) invited to participate; · The FAC teleconference makes a decision whether to escalate to a Tactical Co-ordinating Group (TCG) or to keep monitoring; · EAFW issues Flood Alert to NERCC; · NERCC records Flood Alert on system; · NERCC monitors risk identified by Flood Alert and logs the potential risk of flood; · Area Maintenance Team moves into position to be ready to respond to Flood Warnings; · HE High volume pump stood up by the NERCC ready to deploy; · If Flood Alert escalates to Flood Warning, see Flood Warning action below; and · In the event that Flood Alert subsides wait for ***Warnings no longer in force*** notification.

Flood Risk Level	
Flood Warning (Level 2)	· EAFW, Local Authority or another partner identifies a potential flood scenario and convenes a Humber LRF Flood Advisory Cell (FAC) teleconference. Highways England (and the Area Maintenance Team) invited to participate; · A Tactical Co-ordinating Group (TCG) will be arranged whilst monitoring the situation; · EAFW issues Flood Warning to NERCC; · NERCC activates VMS on network and redirects traffic away from A63 underpass, or any other areas in danger; · Area Maintenance Team to physically close underpass with appropriate Traffic Management. The closure of the underpass will be done in accordance with the AMT's Incident Response Plan and Severe Weather Plan; · HE High Volume Pump is deployed to Hull; · NERCC and EAFW monitor flood and coordinate with Partner Agencies; · Monitor route via CCTV and communications from Emergency Services; and · Monitor situation until ***Warnings no longer in force*** notification is issued.

Flood Risk Level	
Severe Flood Warning (Level 3)	· EAFW, Local Authority or another partner identifies a potential flood scenario and convenes a Humber LRF Flood Advisory Cell (FAC) teleconference. Highways England (and the Area Maintenance Team) invited to participate; · EAFW issues Severe Flood Warning to NERCC; · NERCC triggers closure of A63 underpass, activates VMS on network and redirects traffic away from A63 underpass; · The Area Maintenance Team to physically close underpass with appropriate Traffic Management. The closure of the underpass will be done in accordance with the AMT's Incident Response Plan and Severe Weather Plan; · A Tactical Co-ordinating Group (TCG) will be arranged. The TCG/SCG and FAC will relate as much information on the Severe Flood Warning as possible, e.g. potential flood type, direction of flood and determine potential areas of immediate impact.; · NERCC informs Humberside Police, · NERCC and EAFW monitor flood and coordinate with Partner Agencies; · HE High Volume Pump is located in Hull ready to operate as required · Monitor route via CCTV and communications from Emergency Services; and · Monitor situation until ***Warnings no long in force*** notification is issued.

Flood Risk Level	
Warnings no longer in force	· EAFW issues ***Warnings no longer in force*** notification; · NERCC records ***Warnings no longer in force*** notification on system; · Coordinate with Partner Agencies and assess safety of flooding situation; · If it is agreed with Partner Agencies that flooding risk is safe, the SCG will trigger the Recovery Scenario (See Humber LRF Multi Agency Flood Plan – Section 9); · The High-Volume Pump, in coordination with the Underpass Pumping Station will be used to drain the underpass from flood water; · Area Maintenance Team to assess condition of route and identify any damage or risk to public; · Area Maintenance Team to record all potential issues and risks and inform NERCC; · Area Maintenance Team, with assistance of NERCC, Traffic Officer Service and Emergency Services to clear route and make it safe for traffic; and · Once AMT, NERCC, Traffic Officer Service and Emergency Services are in agreement about safety of route the road can be opened for traffic again. This includes changing VMS signage to remove diversion routes. · HE High Volume Pump recovers to its depot

All three evacuation plans rely heavily on the Environment Agency Flood Warning system. To ensure that the evacuation and emergency plan is robust and allows for a contingency in the event that communication between the EAFW and NERCC doesn't work, it is proposed that the following measures are taken:

- High-water level warning in the pumping station;
- CCTV in the underpass and on network;
- Area Maintenance Team notice potential flood risk and informs NERCC;
- Emergency Services become aware of flood risk and informs NERCC; and
- The potential of adding in the dedicated precipitation and water level sensors installed in the underpass.

All of these measures would provide notification to the NERCC to put into action the appropriate Flood Risk Level Scenario.

Flood Event with No Warning

Despite best efforts to have a robust and proactive warning system in place, there is a potential for flood events to occur with little or no warning. It is therefore important to understand the evacuation procedures in such an event, especially if the underpass and the rest of network is completely congested.

Flood models indicate that during a wave overtopping event, it will approximately take 2.5 to 3.0 hours for the flood water to reach the underpass from Albert Dock wall. Modelling of defence breach scenarios suggest a time to inundation of the underpass following such a breach would be approximately 1 hour. Therefore, the plan needs to be address this concern and allow for closure of the underpass with minimal warning. It must be noted that either a wave overtopping event, or a breach event would be precipitated by substantially raised water levels within the Humber Estuary. As such, it may be possible in such situations to enact the Level 1 Flood Alert procedures to enable a more rapid response in the event of a breach or no warning flood event.

Flood Risk Level	

Flood Risk Level	
No Warning	· Overtopping wave or breach event occurs without any warning; · EAFW, Local Authority or another partner identifies flood event and convenes a Humber LRF Flood Advisory Cell (FAC) teleconference. Highways England (and the Area Maintenance Team) invited to participate; · EAFW issues Severe Flood Warning to NERCC; · NERCC triggers closure of A63 underpass, activates VMS on network and redirects traffic away from A63 underpass; · The Area Maintenance Team to physically close underpass with appropriate Traffic Management. The closure of the underpass will be done in accordance with the AMT's Incident Response Plan and Severe Weather Plan; · A Tactical Co-ordinating Group (TCG) will be arranged. The TCG/SCG and FAC will relate as much information on the Severe Flood Warning as possible, e.g. potential flood type, direction of flood and determine potential areas of immediate impact.; · NERCC informs Humberside Police, · NERCC and EAFW monitor flood and coordinate with Partner Agencies; · HE High Volume Pump is located in Hull ready to operate as required · Monitor route via CCTV and communications from Emergency Services; and · Monitor situation until ***Warnings no long in force*** notification is issued.

Refer to Highways England Crisis Management Manual (Version 2.1) – "has been developed to provide the guidance and instructions for responding to significant disruption within any part of the company across all levels of the business, including Strategic Road Network related issues such as Major traffic incidents and Severe weather impacts.

The possibility of producing a Traffic Management Outline (TMO) for the scheme would be considered. This TMO could look at the maximum length of queueing on the network before VMS should be turned on, therefore diverting traffic away from the A63 underpass and relieving congestion in the underpass. This will hopefully mitigate the risk in the event of a flood event with no warning.

Closure of underpass

The closure of the underpass is done by a combination of measures. These measures are as follows:

- Above lane mounted Light-Emitting Diode (LED) signals at the underpass entrance to indicate lane status and show underpass as closed;
- Motorway Signal Mark 4 (MS4) or Variable Message Sign (VMS) message signs (depending on approved option) on approaches to the underpass to advise road users of flooding and redirect them via alternative routes; and
- Physical closure of the underpass by the Area Maintenance Contractor.

The review of providing a physical barrier was discounted at an early stage for the following reasons:

- It will be too complex to provide automated, or fixed closure barriers on the proposed Scheme due to the constraints imposed by the Scheme such as available space and the design implications on the underpass retaining walls and concrete base;
- The maintenance of such barriers will impose disproportionate obligations on the existing area maintenance contractor;
- The additional maintenance requirements will put the area maintenance contractor at risk on a more regular basis;
- Automated or fixed closure barriers will impose a safety risk for drivers if the barriers are activated without adequate warning systems in place. The complexity of the hazard it introduces exceeds the value that it could have;
- Due to the urban location of the scheme, providing physical barriers will be exposed to vandalism and anti-social behaviour, which in turn could pose a significant risk to drivers; and
- The cost of incorporating such technology would make the scheme unaffordable.

Ultimately it was agreed by Highways England, their Area Maintenance Contractor and the Emergency Services, that the road will be closed in line with the Area Maintenance Contractors approved Incident Response Plan and Severe Weather Response Plan. This includes the appropriate Traffic Management depending on the level of closure required.

Recovery after flooding

In the event of a severe flood, the underpass and majority of Hull will be completely flooded. The pumping station solution will not be able to prevent flooding of the underpass but will be able to assist in the recovery of the underpass. The pumping station will only be able to pump water into the Yorkshire Water network at a maximum discharge rate of 200 l/s.

Therefore, it was recommended by the NERCC, that a high-volume pump could be sourced from Area 14 to further assist in the recovery process. Once requested, it would take approximately three to four hours for this pump to arrive in Hull. The high-volume pump has 3 km of discharge pipe available to relocate the flood water to a suitable location. The Humber Estuary at Albert Dock is less than 600m away from the underpass. Ideally, it would be preferable to agree with the Environment Agency to discharge directly into the Humber Estuary in the event of such an emergency. Additionally, it was recommended that an agreement be reached with the Humberside Fire and Rescue Service, which will be able to pump water to their preferred location.

Secondly, as part of the Combined Operations report, it will be necessary to provide details for traditional flood recovery procedures such as the hiring of temporary pumps and temporary generators until the fixed plant has been replaced.

All these details will be developed as part of the Detailed Design stage of the scheme.

4 Plan Ownership

4.1 Ownership

Highways England will be the designated owners of the Flood Emergency and Evacuation Plan. They will be responsible to ensure that the NERCC is adequately informed and enabled to implement the plan.

4.2 Plan Review

The plan will have to be reviewed and updated on a regular basis with consultation with the Environment Agency, NERCC, Emergency Services and Area Maintenance Teams.

The interval of review will have to be determined. A current recommendation would be that a formal review will have to be done every three years, and after each flood alert or warning.

4.3 Plan Testing

The plan needs to be tested annually to ensure that all the responsible individuals are well aware of their roles and responsibilities. The test can be done by recording the time of response for each step of the plan, including time of notification, recording of notification, informing emergency services and the time it takes for emergency services to respond.

5 Consultation

5.1 Parties Consulted

During the development of the Flood Emergency and Evacuation Plan, the following individuals were consulted:

Name	Organisation	Role	Email	Telephone No.
Alan Bravery	Humber Emergency Planning Services		heps@eastriding.gov.uk	0148 239 3058
Lizzie Griffiths	Environment Agency	Sustainable Place, Planning Advisor	lizzie.griffiths@environment-agency.gov.uk	0203 025 8439
Dave Bristow	Humberside Fire and Rescue	Station Manager	mailto:dbristow@humbersidefire.gov.uk	0780 703 1737
Darren Storr	Humberside Police	Traffic Management Officer	darren.storr@humberside.pnn.police.uk	0148 222 0034
Sarah Atkinson	Yorkshire Ambulance Services	Admin Support Officer	Sarah.Atkinson7@nhs.net	0190 466 6110
Rachel Glossop	Hull City Council	Flood Risk Planning Manger	rachel.glossop@hullcc.gov.uk	0148 261 2129
Frances Oliver	Highways England	Assistant Project Manager	Frances.Oliver@highwaysengland.co.uk	0300 470 2527
Christopher Addy	Regional Control Centre (RCC)	Operations Manager - Deputising	Christopher.Addy@highwaysengland.co.uk	0300 470 6283
Andrew Charnick	North East RCC	Emergency Planning Manager	Andrew.Charnick@highwaysengland.co.uk	0300 470 6326
Mark Booth	A-one+	Area Maintenance Manager S.E.	Mark.Booth@aone.uk.com	0192 422 5795

[Page not used]

Minutes of the Consultation Meetings have been attached in Appendix E.

These minutes are only in Draft form, as they have not been approved by all parties present. However, all the comments received from the various parties after the meetings have been incorporated in the report.

5.2 Exceptions

During the consultation process, the following items were identified that needs further consultation and confirmation prior to the start of construction. It was agreed that these items will be recorded and prioritised during the Detailed Design Stage.

The exceptions are as follows:

- Diversion routes and physical signage for diversion routes;
- Extent of responsibility of Area Maintenance Team during emergency situations;
- Further consultation regarding high-volume pump used in emergencies;
- Further consultation and development of technology in underpass; and
- Positioning of Area Maintenance Team standby area in preparation of Emergency event.

5.3 DCO Hearings Requirements

During the DCO Issue Specific Hearing 2 on Wednesday, 5 June 2019, the following points were raised to be resolved prior to the start of the Detail Design. These items need to be resolved through collaborative coordination between Hull City Council, Environment Agency, Highways England and their Area Maintenance Contractor:

- Environment Agency and Hull City Council need to provide their preferred location where water will be discharged to during an emergency. These details will be incorporated into a Recovery Plan which will form part of, and will be provided in a future version ofthe FEEP;
- Hull City Council raised concerns about the design of the pumping station building and the visual impact this will have around the area. The building and pumping station compound landscaping design will be done in consultation with both the Environment Agency and Hull City Council, to ensure the design adheres to their requirements. These requirements will need to consider the potential flood risk, ensuring the building is flood resilient, whilst remaining in keeping with the area's aesthetic narrative. Hull City Council need to provide visual design requirements, that will inform the proposed design. Secondly, the building design levels need to be agreed with both parties to mitigate potential flooding. See Appendix F for further context; and

- Additional discussions need to be had regarding the signage for diversion routes across Hull. It was mentioned, that potentially an additional VMS sign could be provided near the Humber Bridge, to divert traffic onto the A164. Unfortunately, this area falls outside the current DCO redline boundary and can't be included in the scope of this scheme. However, Highways England have indicated that they are happy to look at potentially providing this sign through some other mechanism. Hull City Council to produce a plan to show the propose location, which will then be considered by Highways England.

6 Conclusion

The Flood Emergency and Evacuation plan needs to be a robust and adaptable plan that can respond adequately to emergency flooding situations including those with minimal or no prior warning. The plan should be clear enough for any team member to take action, but not too prescriptive as to hinder the effective and vast implementation of the plan. Safety of drivers, general public, Emergency Services and Area Maintenance Teams are of utmost importance.

Appendix A

Humber LRF Multi Agency Flood Plan

A1

Appendix B

Underpass Flood Detection Technology Options Report

B1

Appendix C

Hull Variable Message Signs and Emergency Diversion Routes

C1

Appendix D

Flooding Maps

D1

Flooding Maps were taken from the Humber Tidal Impact Maps, Edition 1.0 (20.03.14).

Only the maps showing the scheme have been included in this appendix.

For more detailed flood maps, please refer to the Appendix 11.2 Flood Risk Assessment in the A63 Castle Street Improvements, Hull Environmental Statement (Ref: 1168-10-215-RE-001-PD3)

Appendix E

Minutes of Meetings

E1

E2

Appendix F

Environment Agency Relevant Representation Response: Pumping Station Flood Resilience

F1