

# Freshney Bog Flood Storage Reservoir Improvements - Flood Risk Statement

ARUP

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## 1. Introduction (Purpose of Statement)

Arup has been commissioned on behalf of the Environment Agency (EA) to produce a Flood Risk Statement in support of the planning application for proposed improvement works to the Freshney Bog flood storage reservoir on the River Freshney and New Cut Drain in Grimsby, North East Lincolnshire.

This statement summarises existing fluvial flood risk at the site, the drivers and objectives of the proposed works, and the implications for flood risk. This document should be read in conjunction with the planning application and supporting documents. Additional site and scheme details are also provided in the Grimsby (fluvial) Environmental Assessment Report<sup>[1]</sup>.

## 2. Site

The Freshney Bog is an EA owned and operated flood storage reservoir, located between the left bank of the River Freshney and the right bank of the New Cut Drain, adjacent to The Willows housing estate, Grimsby (NGR TA239 092). Flood waters are retained within raised embankments extending along the left bank of the River Freshney and the right bank on the New Cut Drain. Inflows to the reservoir from the River Freshney occur via a spillway in the river embankment, immediately downstream of the Great Coates Road Bridge. Drainage of the reservoir is controlled by an outfall with flap valve discharging back into the river and a penstock structure discharging into the New Cut Drain.

## 3. Existing Flood Risk

There are two components to the proposed works at the Freshney Bog site:

1. There is a legal requirement to undertake spillway works to the reservoir in order to satisfy inspection recommendations required for reservoir safety in compliance with The Reservoirs Act (1975);
2. It has been identified that The Willows housing estate remains at relatively high risk of flooding. In order to fully sustain the original flood alleviation function of this asset, the EA proposes to address this issue as part of the scheme.

These two components are described below in the context of the historical flooding record and previous studies undertaken to assess the reservoir condition and the existing flood mechanism.

### 3.1. Flood History

Flooding has been a major problem on the River Freshney through Grimsby in the past, but flood risk has been substantially reduced by the construction of Freshney Bog.

In June 2007, approximately 90 properties flooded in The Willows and Wybers Wood Housing Estates, including the Willows Primary School and The Willows Resource Centre (NHS).

The flooding mechanism which led to flooding in 2007 was associated with the New Cut Drain which was not part of the 2001 scheme on the River Freshney.

### 3.2. Reservoir Safety

The Reservoirs Act (1975) places an obligation on the owners of reservoirs with a capacity of more than 25,000m<sup>3</sup> to provide for their inspection in the interest of public safety. The Act requires owners to provide for regular inspections of the retaining structure by a suitably qualified engineer from a panel prescribed within the legislation.

In 2007 a review<sup>[2]</sup> of all reservoirs in the Anglian region owned or operated by the EA concluded that the Freshney Bog flood storage reservoir falls under the scope of the Act. It is defined under the Act as a 'large raised reservoir' based on its capacity to hold more than 25,000m<sup>3</sup> of water above the natural level of the

<sup>1</sup> Environment Agency, Freshney Washland Reservoir and Flood Alleviation Scheme, Environmental Report (Arup, Nov 2011)

<sup>2</sup> Environment Agency, Review of Unregistered Reservoirs: Reservoirs Act 1975 Anglian Region (Mott MacDonald, April 2007)

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adjacent land. The subsequent Section 8 Inspection Report (2009)<sup>[3]</sup> designated the Freshney Bog as a ‘Category C’ reservoir (where a breach could have a negligible risk to human life) whereby the retaining structure therefore requires a spillway with capacity to safely pass the 1 in 1,000 year flood event. As such the report outlined the following recommendations:

1. The capability of the reservoir to pass the 1 in 1,000 year return period flood event should be checked;
2. If the reservoir is not able to pass the 1 in 1,000 year return period flood then such remedial works that are necessary shall be carried out;
3. A crest level survey should be carried out to determine the extent of any settlement that has taken place since construction in 2001 and any low spots should be topped up.

A Reservoir Flood Study<sup>[4]</sup> was undertaken in 2010 in order to address recommendations 1 and 3 above. The results of the hydraulic modelling work undertaken as part of this study to verify the existing flood mechanisms and Standard of Protection at the site are described in Section 3.3.

### 3.3. Flood Mechanisms

Since the construction of the Freshney Bog in 2001, the River Freshney hydraulic model has been updated to bring the model into line with the latest hydrological methodology, and incorporate results from recent topographical surveys.

The flood study<sup>[5]</sup>, and subsequent modelling and improvements in understanding of flood pathways, has confirmed that the mechanism for the 2007 flooding was overtopping of the left bank of the New Cut Drain. Upstream along the River Freshney, high flows can by-pass the reservoir and enter the New Cut.

## 4. Proposed Works

The Grimsby (fluvial) Project Appraisal Report produced for the Environment Agency and approved in January 2012 has developed outline design options for addressing recommendation 2 of the Section 8 Inspection Report and management of the existing fluvial flood risk issues identified at the site, as described in Section 3.

Key components of the proposed works include:

- 340m long section of sheet piles located to the rear of residential properties on Grasby Crescent and Anderby Drive, to form the new northern boundary of the flood storage reservoir;
- Construction of a new embankment on the left floodplain of the New Cut Drain to form new northern boundary of the flood storage reservoir. The embankment will be 530m in length and up to 1.7m high;
- Construction of a new reservoir spillway at the downstream end of the new embankment forming the new boundary of the flood storage reservoir. The spillway will be 160m long with a crest level of 3.62mAOD;
- Installation of a new 1200mm diameter culvert on the New Cut Drain underneath the new embankment. This will form the drain outlet from the reservoir. The culvert will be approximately 13m in length with a 575mm diameter orifice plate at the upstream face to restrict the maximum discharge downstream to a controlled amount;
- Removal of two approximately 20m lengths of the existing embankment along the right bank of the New Cut Drain (which presently forms the northern boundary of the reservoir); and,
- Localised topping up of ground levels along the top of the left bank of the New Cut Drain. Topping up will be to a depth of up to approximately 0.4m over a length of approximately 60m.

<sup>3</sup> Environment Agency, Freshney Washlands Flood Detention Reservoir: Report of a Section 8 Inspection by TJF Hill on 27 August 2008 (Mott MacDonald, July 2009)

<sup>4</sup> Freshney Washland Preliminary Reservoir Flood Study (Arup, July 2010)

<sup>5</sup> River Freshney & Washland: Summary of the baseline model and flood mechanisms (Arup, January 2011)

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## 5. Implications for Flood Risk

The proposed works will reduce flood risk in Grimsby. They will improve the Standard of Protection against fluvial flooding for the surrounding properties relative to the existing condition. The works will also improve reservoir safety and reduce the risk of reservoir breach and the associated flood consequences in accordance with latest legislation.

### 5.1. Standard of Protection

#### On Site

The proposed works will reduce the level of flood risk to the residential properties adjacent to the site within The Willows housing estate relative to the existing condition. The new flood defence structures along the left bank of the New Cut Drain will be set at a level at which all flows up to and including the 1 in 100 year return period (1% AEP) event will be contained within the new extent of the flood storage reservoir (south of the new defence line), with no flooding occurring to the surrounding properties:

- The new flood defence sheet piles crest level will be set at the 1 in 100 year return period (1% AEP) plus climate change allowance event level, plus freeboard;
- The new flood defence embankment crest level will be set at the 1 in 100 year return period (1% AEP) event level, plus freeboard. An 'adaptive sustainable management' solution has been applied whereby the level of the embankment may be increased in future as necessary, in accordance with increases to flow due to climate change.

#### Downstream

Downstream flood risk will be alleviated by the proposed works, because the risk of a breach ever occurring in the reservoir embankments will be reduced. Discharge from the River Freshney downstream of the reservoir will be negligibly altered relative to the existing condition. Discharge from the New Cut Drain downstream of the reservoir will be restricted by the new culvert and orifice control structure so that flows downstream of the reservoir remain in bank during all events up to and including the 1 in 100 year return period (1% AEP). Flood risk from the New Cut Drain downstream of the reservoir will therefore be reduced over the existing condition up to and during events of this magnitude.

### 5.2. Development Vulnerability

The proposed works will comprise water-compatible flood control infrastructure only. No new development components will be created at the site that are classified as being vulnerable to flood risk under the Technical Guidance to the National Planning Policy Framework<sup>[6]</sup>.

	Prepared by	Checked by	Approved by
Name	Daniel Newton / Laura Mayo <i>PAUL DICKENS</i>	Nicole Rabier	Will McBain
Signature	<i>P. Dickens</i>	<i>[Signature]</i>	<i>[Signature]</i>

<sup>6</sup> Technical Guidance to the National Planning Policy Framework (Department for Communities and Local Government, 2012)