

Barrow DG5 Flood Relief Scheme

protecting a town from within

by
John March BEng(Hons), CEng, MICE, MCIWEM, RMaPS

KMI+ was tasked by United Utilities (UU) with delivering a programme of improvements in Barrow town centre in order to reduce the number of properties on the risk register with the potential to suffer cellar flooding.



Detention Tank Showing Vacuum Flushing Column Construction

Courtesy of KMI+

The Solution

By far the most significant elements of the solution involved the construction of a 25.6m diameter, 29.5m-deep detention tank capable of holding more than 10 million litres of storm flows as well as a 12m-deep intercepting sewer.

Due to the variable ground conditions and high water table, the detention tank is a diaphragm wall construction tying into the sandstone bedrock. The detention tank outer diaphragm walls are 1,000mm thick. The structural design of the diaphragm incorporated the use of skin friction, which, with a combination of tension anchors, resulted in a base slab 1,500mm thick to resist flotation. The tank is equipped with a central vacuum flushing column, which consists of 2,400mm internal diameter PCC manhole rings encased in 300mm thick re-inforced concrete. The column retains sewage to a height of approximately 10m before the vacuum is broken. This enables the base of the tank to be flushed clear of any settled solids.

Construction

In December 2008 a 720 tonne roof, composed of 48 super-size concrete slabs resting on 12 huge beams, was hoisted into place by a 250 tonne crane to seal the subterranean chamber.

Two further shafts were constructed utilising jacked Caisson and underpinning techniques according to depth and ground conditions.

A 500m length of sewer was constructed 12m below one of the busiest roads in Barrow using a Lovat Tunnel Boring machine to drive a 2.1m internal diameter pre-cast concrete segmental tunnel. This connects the existing sewer to the new detention tank. As the sites were located within a highly developed and busy town centre it was necessary to undertake structural surveys in advance of the tunnelling works and a settlement monitoring regime during the construction period.

The project had two main sites in the town centre, each with a high density of vehicular and pedestrian traffic passing site. Ramsden Square is located on a major through-route and had been newly developed as a bus stop area within pleasant landscaping. Coronation Gardens was the site of a former chapel and is now a communal garden, surrounded by a new office development, terraced housing and the Magistrates Court. A carefully controlled plan for material deliveries and spoil removal was implemented to avoid impact on residents, businesses and court users.



Construction of the Vacuum Flushing Column

Courtesy of KMI+

Key Challenges

The main construction sites were situated on land away from the public highway, however, the construction of two spill chambers had to take place close to the busy main road and required extensive highway traffic management schemes. In addition, it was necessary to divert and upgrade many of the existing sewers in the adjoining residential streets close to Barrow town centre.

Construction work had to contend with ground water that was subject to tidal variation in the Walney channel, approximately 600m distance from Ramsden Square. The team was therefore faced with working on and around a live sewer system with surcharges and spills known to occur in storm conditions.

Historical research undertaken about the construction area indicated that the bulk of the bombing during WW2 had occurred away from where work would take place, however, the possibility of discovering unexploded bombs could not be ruled out. Fortunately none were found.

The Solution Identification and Development (SID) stage of the project was undertaken by MWH on behalf of UU. The design and build contract was awarded to KMI+ (Keir, Murphy, Interserve and Mouchel) in 2006 with construction commencing in January 2007.

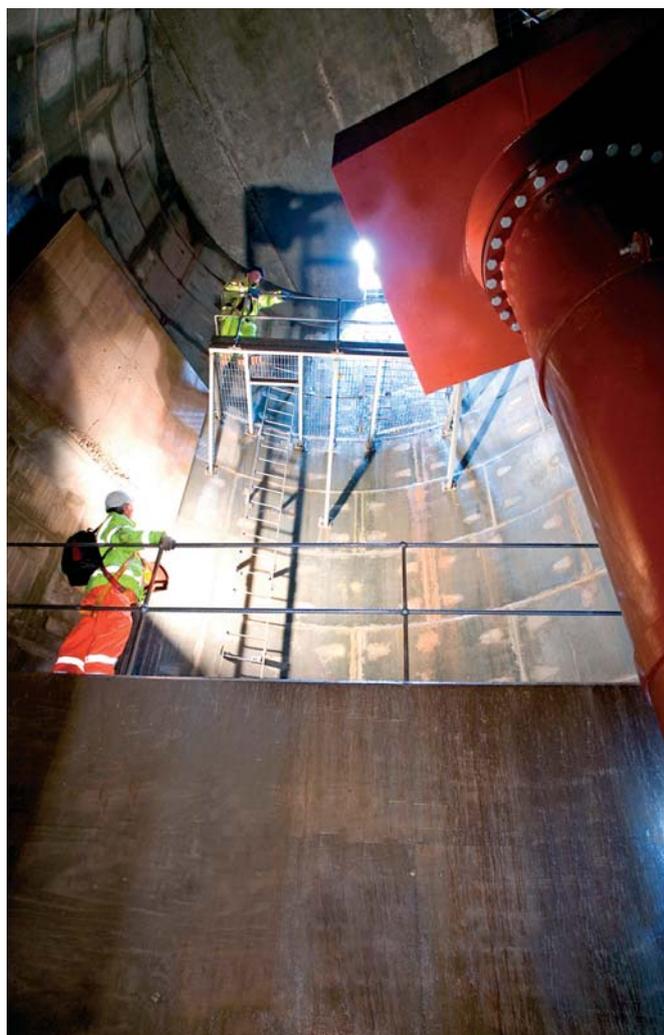
Coronation Gardens: New construction work comprised:

- Spill chamber, located on line of the existing 1080 x 870 brick egg sewer in Abbey Road.
- 6m diameter, 14m-deep reception shaft in Coronation Gardens.

- 1200mm diameter pipejack sewer between new spill chamber and driveshaft.

Ramsden Square: New construction work comprised:

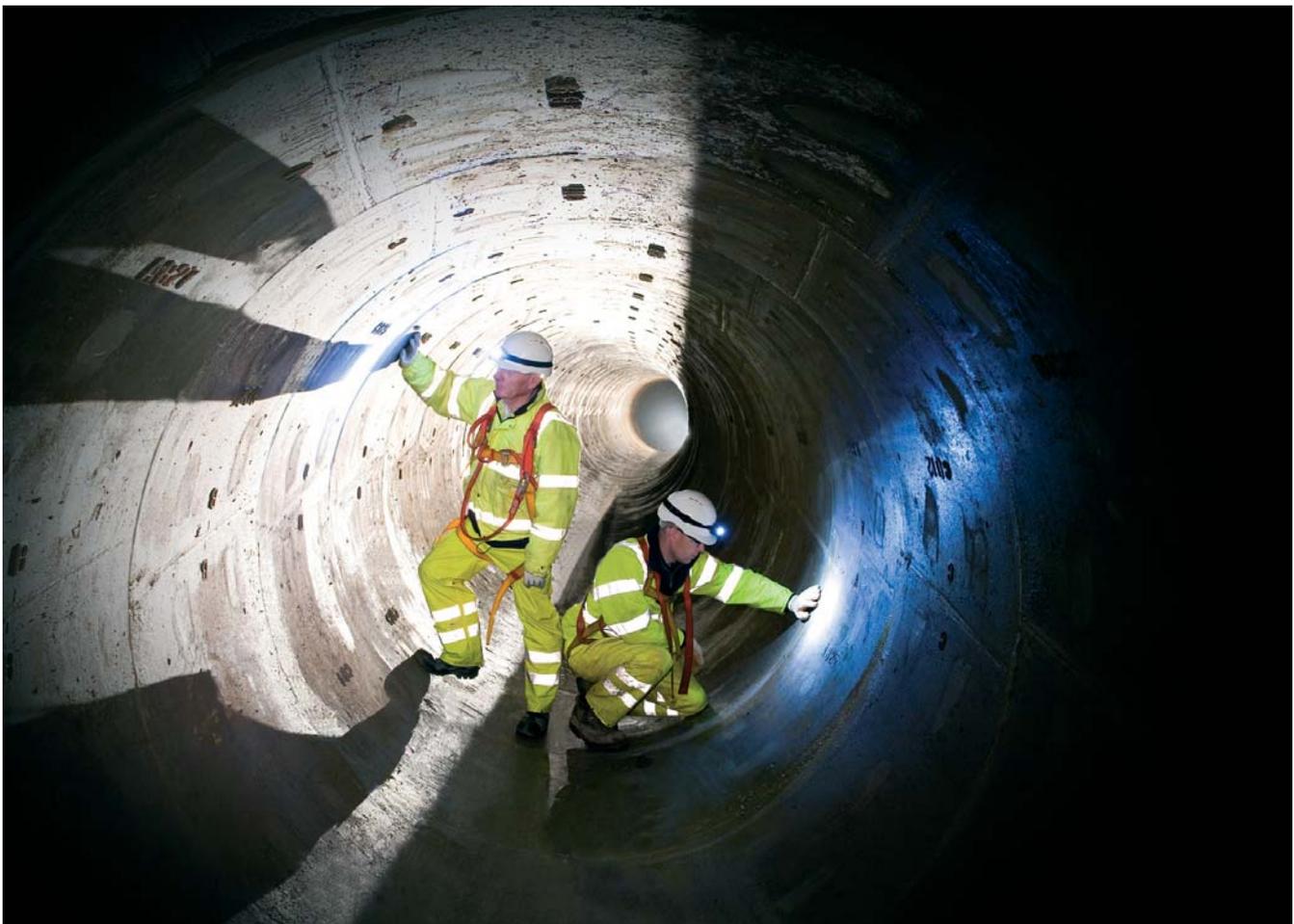
- Spill chamber No located on line of the existing 1080 x 870 brick egg sewer in Abbey Road.
- Penstock chamber.
- 900mm diameter plastic twin-wall pipe between spill chamber and penstock chamber.
- 23m diameter, off-line detention tank with vent pipes and pumped return to new discharge chamber.
- 2.070m internal diameter tunnel between detention tank at Ramsden Square and drive shaft at Coronation Gardens.
- 900mm twin-wall pipe connection between penstock chamber and detention tank
- Discharge/flowmeter chamber.
- 450mm diameter concrete sewer between discharge chamber and manhole C2.
- 600mm diameter concrete sewer between manhole 5401(C4) and new manhole chamber in Abbey Road.
- 4 No 2100mm diameter manholes (C1,C2, C3 and C4)
- 4 No 250mm diameter rising main pipelines between detention tank and discharge chamber.
- Abandonment of existing sewers.
- 4 No duty/standby variable speed storm pumps.
- Control building.
- Provision for Odour Control Unit within Control Building to be supplied and fitted as and when required or stipulated by the Local Authority - all ducting and pipework up to control building supplied and terminated.



Reception tank from below (left) and reception tank & drop shaft from below (right)



Courtesy of KMI+



Main Tunnel Lining & Joint Inspection

Courtesy of KMI+

- Vacuum flushing column equipment.
- Construction and installation of Motor Control Centre, Telemetry, PLC cabling and associated works.

Summary

This £14.5 million, complex project for United Utilities involved major construction activities within Barrow town centre. A significant traffic management plan was required to reduce the impact of the works on a major through-route. The use of skin friction for the design of the detention tank produced cost and time savings in the construction of the tank. As a result of limited site access, careful planning of material deliveries and spoil removal was required around the daily workings of the busy town centre. The project team comprised MWH as the SID phase designer, and KMI+ (Keir, Murphy, Interserve and Mouchel) as detailed designer and principal contractor. The main process plant suppliers were KSB Pumps, Blackburn Starling and CSO Technik with the principal sub-contractors being Amco and Bachy Soletanche. Construction work commenced in January 2007 and is due for completion and handover to UU in summer 2009.

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Glasgow -
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Dublin -
Tel: +353 1 458 6715 Fax: +353 1 458 6916

