Ash Lane Detention Tank: KHW Phase 2B (HAL0037)

modular construction of largest tank of its kind in the UK - underground storm detention tank with associated CSO and pumping station

by Rob Sharpe BEng (Hons) CEng CWEM MCIWEM

The HAL0037 - Ash Lane Unsatisfactory Intermittent Discharge (UID) scheme is one of a number of outputs associated with the overall United Utilities AMP5 Change Protocol C (CPC) Knowsley, Huyton and Widnes (KHW) programme of works. The AMP5 KHW CPC Catchment UID programme consists of a total of seven outputs, six of which KHW Phase 1 and Phase 2A are now complete. The remaining scheme HAL0037 (Ash Lane) is currently under construction. The completion of this project will provide an integrated solution for the problems associated with storm discharges.

Detention tank: May 2015 - Courtesy of KMI+

Background

The existing HAL0037 CSO is located in a field adjacent to New Farm Bungalows, Ash Lane, Widnes. The CSO is a stilling pond type. The inlet pipe is 1,750mm diameter and the throttle continuation pipe is 400mm. Spill flows discharge through a 1,750mm diameter pipe to Ditton Brook, approximately 680m from the chamber.

There is no storm storage at the site and flows currently pass through the CSO chamber and on through the continuation pipe or over the spill weir and out to Ditton Brook.

Initial scope

The initial project scope comprised the construction of a new detention tank with a new CSO chamber and storm return pumps. The new CSO chamber was to have two CSO screens capable of screening circa 2,800l/s each to 6mm in two dimensions. The new detention tank would have 17,000m^3 of storage and an integral flushing system to provide cleansing of the tank on emptying. The tank was envisaged as a 35m diameter tank with a tank floor approximately 20m deep.

A set of duty/standby storm return pumps installed in the new detention tank would return flows downstream of the new CSO chamber once storm flows subsided. A smaller scavenger pump was to be provided within the detention tank to enable the tank to be fully drained. A twin vacuum flushing system combined with the scavenger pump was to ensure the tank base was cleaned after a storm event subsided.


NOW OPEN
FOR BUSINESS
www.kijlstra.co.uk
MULTI MILLION £
MAKEOVER
TO BOOST BRITISH
MANUFACTURING
Our first UK factory facility is bringing innovative products and new jobs to the home market to satisfy increasing demand.
Setting new standards in precast drainage solutions
A Kijlstra manhole installation video can be viewed on YouTube on www.youtube.com/watch?v=YyJhGG1fQ30.
Kijlstra
Precast

Scope development

KMI+ started out in mid-2013 developing the solution as set out in the original scoping document, but quickly became aware of difficulties in designing out the risk of flotation in the main construction item; the detention tank. Working with specialist contractors, a number of options were considered for the diaphragm wall tank proposal including thickened walls, thickened base and anchor piles. None of these options, singly or in combination, provided a workable cost effective solution.

KMI+ began to look at provision of storage in a large footprint but shallow tank as there was an adjacent area of farmland that could be used for this purpose. A large diameter pipe option was considered and rejected. A modular tank system was considered and developed in conjunction with Kijlstra Ltd. The proposed solution was also cheaper and had a shorter construction period than the original design.

Modular concrete construction

KMI+ worked up a new site layout incorporating a new CSO chamber, a new return pumping station and a new detention tank. Using modelling software provided by United Utilities, it was proven that the required storage could be provided within the main structures and the connecting pipework.

CSO chamber: The CSO chamber (15.5m x 13.3m x 5.6m high) is being built with the chamber roof at ground level. It has an in situ base with the external walls constructed from generally 2.5m wide and 400mm thick PCC panels. The roof is made up of mostly 8m x 2m panels, 300mm thick which support a 200mm thick layer of in situ concrete.

Return pumping station: The return pumping station is buried with 2m cover and will have internal dimensions of 10m x 5m x 6.8m high. It has an in situ base with external walls and roof constructed of PCC panels of a range of sizes and thickness 300/400mm depending on their location.

Detention tank: The detention tank is buried with 3m cover, has internal dimensions of 135m x 42.1m x 3m high. It has an in situ base set at a fall of 1 in 200, and split into 8 (No.) 5m wide channels which will be cleaned using a flushing mechanism. The external tank walls are built from 300mm thick PCC panels which are mostly 6m wide. The 300mm thick PCC tank roof is made up of mostly 5m x 3m panels which support a 200mm thick layer of in situ concrete.

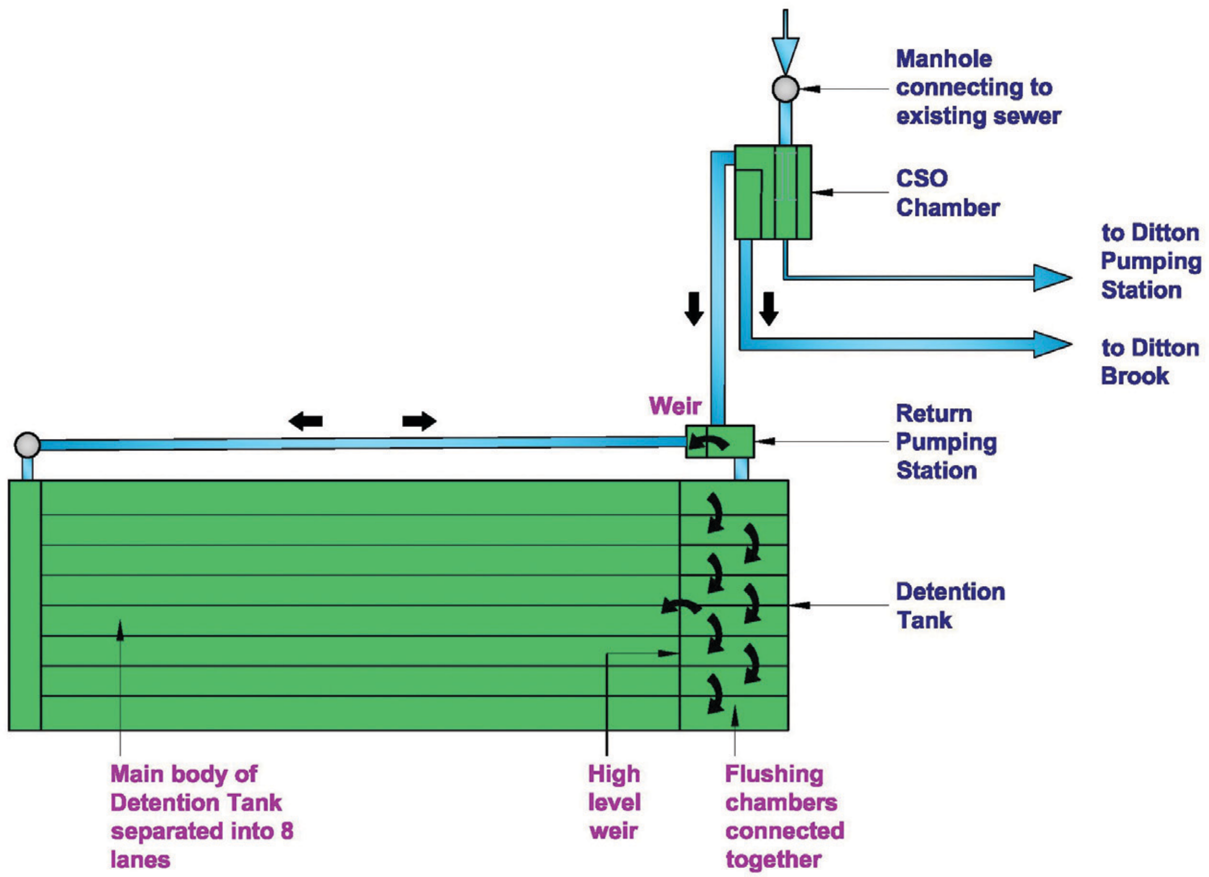
Detention tank operation

Filling Sequence: When the pass forward flow (274 l/s) in the sewer network is reached, the excess flow is screened up to the 1 in 5 year event and spills into the pumping station. From there it spills in sequence into the flushing chambers at the top of the detention tank.

When the flushing chambers are full, the flow spills over the weir in the pumping station and down to the bottom end of the detention tank from where the tank is filled until the storage volume is reached. At this point the spill weir level in the CSO chamber is reached and the flows discharge to the existing overflow pipe into Ditton Brook.

The modelling shows that there will be spill at the CSO Chamber into the pumping station about 150 times per year.

Emptying Sequence: When the storm has passed and there is capacity in the sewer network, the return pumping station operates to empty the pumping station, the main body of the detention tank and the connecting pipework. When the main body is empty, the flushing gates open in sequence each releasing 78m^3 down the channels which are then cleaned.



Works schematic: October 2014 - Courtesy of KMI+

After the last flushing chamber is emptied then the detention tank is ready for the next spill event.

Design responsibilities

Normally on these type of schemes Mouchel would undertake the detail design of the pipework, structures and mechanical and electrical and overall site works. As the main structural elements were to be precast concrete units it was decided that Mouchel would prepare the outline general arrangements and key design parameters for Kijlstra to detail the structure. Mouchel would then review the construction calculations and drawings. Mouchel Geotechnical Engineers carried out an assessment of the ground investigation (GI) across the site and advised the KMI+ site team and Kijlstra on base slab requirements.

The detention tank is founded on firm to stiff clay (Glacial Till) and it was determined the tank would not induce any additional loads onto the ground. Mouchel advised Kijlstra to ensure enough reinforcement was included in the base to account for greatest moments generated for combined case of full uplift from groundwater when the tank was empty and ground heave.

All the design was managed through the KMI+ design coordinator with monthly design review meetings on site. The United Utilities business collaborator web based platform was used to review and approve all submitted drawing and calculations.

Current status

At the time of writing (June 2015) the construction is well underway:

- ***Detention tank***: The detention tank is approximately 85% complete; the in situ base has been laid with the majority of the walls erected. The in situ pressure layer on the roof has been placed over the flushing chamber end of the tank and compaction has begun around the structure. The mechanical engineers are installing the hydraulic pipework to the flushing chambers.
- ***CSO chamber***: The CSO chamber is about 70% complete; the in situ base has been laid with the majority of the walls erected.
- ***Pumping station***: The pumping station base is being excavated.
- ***Pipework, manholes and culverts***: Sections of the connecting pipework and manholes have been constructed, where they can be built without affecting the structures. The need for this work to be undertaken at the same time as the structures has led to some issues which have had to be designed out with individual pipe/structure connection details. The in situ culvert between the pumping station and the detention tank has been designed and is awaiting the construction of the structures.

Conclusion

The use of the precast units on the in situ bases has gone smoothly with deliveries keeping up with the erection sequence. The quality of the PCC units is good and it is often remarked, by the many visitors to site, that the finish on the PCC units is noticeably better than that on the more usual concrete site items such as manholes and pipes.

As the water industry is embracing the use of precast concrete construction it is pleasing to report that this scheme appears to have all the benefits associated with it. The benefits are only realised however when the solution is appropriate, the materials are of the correct quality and delivered in a timely manner, the review process is sufficiently robust and the construction team fully engaged.

The editor and publishers would like to thank Rob Sharpe, Principal Engineer with Mouchel (Part of KMI+), for providing the above article for publication.

Detention tank excavation: February 2015 - Courtesy of KMI+

Flushing chambers 1 of 2 connecting orifices: May 2015 Courtesy of KMI+

Detention tank connection to/from pumping ptation: June 2015 Courtesy of KMI+

CSO chamber downstream outlet orifices: June 2015 - Courtesy of KMI+