

# Kenilworth Sewerage Strategy

## to remove flooding from different sources

**T**he town of Kenilworth is located in Warwickshire. The area is predominantly residential with a population of 25,000 covering a catchment of 750 Ha which consists of the tributary watercourses the Tanyard Stream and Cattle Brook to the south and the main river the Finham Brook. The town had experienced flooding from a variety of different sources; i.e. sewerage system, watercourses and overland flow. Flooding from the existing public sewerage system had resulted in the internal flooding of 65 properties and 38 external locations (mainly residential gardens).



Flooding from public sewers in Kenilworth Courtesy of Severn Trent Water Ltd

The main causes of the flooding from the sewerage system were:

- Sewers undersized for current flows that had increased due to growth in the area.
- Restrictions in the system (shallow railway and watercourse crossings)
- New housing, infill development, and paving over permeable surfaces (e.g. block paving of front gardens) increasing intensity of run-off.
- Existing Combined Sewer Overflows (CSO's) closed to prevent pollution of watercourses (pre 1990)

### Existing Sewerage System

The existing sewerage system is partially separate and very complex with duplicated and triplicated carrier sewers, multiple bifurcations and siphons. Both surface water and combined systems are generally flat and shallow. The town stands on Sandstone with inter layers of red-brown mudstone from depths of 2m which has determined the development of the system. The whole foul/combined sewer catchment drains to a terminal pumping station that pumps at a consented rate of 240 l/s to Finham Sewage Treatment Works some 6km North East of Kenilworth.

### Development of the Strategic Solution

A project team, consisting of Severn Trent Water (STW) In-house Asset Delivery Sewatering Engineers with North Midland Construction and Barhale Construction, appointed as contractors, was set up once the outline of the strategy had been established. Each phase was procured using a Target Price Contract in accordance with STW's Contract Strategy.

Due to the complex sources of flooding and the number of bodies responsible STW took the lead to try to understand the drainage interactions in detail, setting-up a "Flood Forum" of key stakeholders. The group met quarterly, quickly establishing the flooding mechanism in each area, and the interaction between each contributory element through a sharing of information.

Hydraulic analysis of the catchment and development of the strategy was achieved by building a verified Infoworks model containing 2500 nodes with verification against 63 flow monitors from a 3 month flow survey. Two HEC-RAS river models were also constructed for the Finham Brook and Cattle Brook for flood risk assessment and interaction with the surface water system.

Initially thought to involve several separate solutions, it became apparent during the feasibility stage a strategic approach was required for the whole catchment due to the interaction and scheme dependency of options. Smaller stand alone solutions on the outskirts of the town were undertaken in advance and following the main strategy.

The key features of the Strategy are:

#### Phase 1

- New Combined Sewer Overflow (CSO) with 900mm diameter outfall discharge to the Finham Brook in times of high intensity storm events; on average, 7 spills per year.
- 200m<sup>3</sup> of screened storage at CSO complying with Water Quality requirements under Urban Pollution Management (UPM) Study approved by the Environment Agency.
- Upsize of nearly 2km of large diameter sewers.

This phase allowed increased flow to be passed forward from the hydraulically deficient sub catchments, while at the same time protecting of the downstream Dale House Lane trunk system to the Terminal Pumping Station from increased surcharge.



CSO screens installed

Courtesy of Severn Trent Water Ltd



New CSO Outfall at Finham Brook Courtesy of Severn Trent Water Ltd

**Phase 2**

- Construction of a new 1200mm diameter surface water sewer (850m in length, through pipejack construction, at up to 12m deep with associated railway crossing.)
- 1.8km of large diameter sewers.
- New 900mm diameter outfall discharge to Cattle Brook.

This phase allowed a 3Ha contributing area, to the already overloaded Tanyard Stream, to be diverted to the Cattle Brook and prevented flooding directly from the hydraulically deficient surface water system.

**Phase 3**

- New CSO to spill to Cattle Brook watercourse via new surface water tunnel constructed on phase 2; on average, 14 spills per year.
- On line storage tanks to alleviate foul flooding risk (total of 750m of 1350mm diameter storage pipework with associated hydroslide flow control device).
- Local sewer enlargements (830m) through open cut excavation to alleviate internal foul flooding by increasing pass forward flow.

This "catchment transfer" phase allowed the abandonment of a siphon railway crossing and alleviated flooding risk to property in the Farmer Ward Road area of the town. This was achieved by providing a new CSO in Warwick Road which diverted the pass forward flow through the town centre (110 l/s Formula "A").

**Example stand alone scheme**

A dual cell, foul and surface water, storage shaft tank (8.5m diameter,

12m deep) was constructed at Whitemoor Road to alleviate flooding from 6 properties. This innovative tank design provides surcharge relief from both foul and surface water systems. Increased capacity was not possible as both systems shared a culverted crossing of the railway; its enlargement could not be undertaken due to level constraint. A dual cell was used due to limitations of available space.

**New CSO Approval**

New CSO's were pivotal to the success of the strategy. UPM modelling of both the Finham Brook and Cattle Brook were undertaken using a Simgol3 model and 10 years rainfall records.

The Mill End CSO required 200m<sup>3</sup> of storage to ensure <10% deterioration in river quality. Water quality storage is provided by a 1400mm diameter "blind" pipe. Screened flow spills via a side weir through a 6mm screen into the storage facility. During greater flow rates a second weir spills to a siphon outfall pipe to the Finham Brook. Gravity discharge to the Finham Brook cannot be achieved because the outfall point is below bed level. The levels provide enough driving head to produce a discharge without assistance until the tail end of the spill when the outfall pipe is emptied by its own pump station into the Finham Brook to complete the discharge of the consented spill. The first spill within the blind storage pipe is then emptied by pumps within the CSO chamber to return the effluent to the trunk sewer once the storm has abated.

**Construction and Programme**

The strategic projects have improved the capacity of the sewerage network through the enlargement of over 6 km of large diameter sewers and construction of two new CSO's. The town now has a sewerage system to cope with all but the most extreme forms of weather.

Phase 3 was successfully commissioned in October 2008 completing a three and a half year construction period, involving twenty road closures. The three phases were achieved for a project cost of £14.5m and without a lost time incident (over 100,000 man hours of construction).

This strategic approach resulted in efficiencies in the design, construction and future operation of the sewerage system clearly delivering best investment choice for the company and customers.

The Kenilworth Sewerage Strategy effectively demonstrates how STW's investment is meeting the objectives set out under the companies Key Strategic Intention of improving the capacity of the sewerage network to alleviate internal sewer flooding.

**Note: The publishers and editor thank Severn Trent Water Ltd for providing the above the article. ■**



TBM Launch (left) and TBM Jacking (right)



Courtesy of Severn Trent Water Ltd