Stormwater management in historic town centers

W. van der Toorn Vrijthoff

Associate Professor Real Estate Management
Delft University of Technology, Faculty of Architecture
Department of Real Estate and Project Management
P.O. Box 5043, 2600 GA Delft
The Netherlands
E mail W.vanderToornVrijthoff@tudelft.nl

ABSTRACT

Many cities in the Netherlands and abroad are developing plans to reopen and restore historic urban waterways. At the local level such decisions are based specifically on the following arguments:

- Historic waterways are an important element in the distinctive cultural and historical positioning of old town centres, which are often promoted as a 'trademark' for the town or city.
- Reopening filled-in canals and harbours will help to meet the need for more stormwater storage capacity.

Higher precipitation levels expected as a consequence of climate change will exceed the capacity of existing urban water management and drainage systems.

This paper examines the problems arising from the need to introduce more surface water in historic town and city centres, focusing on solving these problems by reopening old canals, rivers and harbours. This option is illustrated by explanations of the plans for restoring historic waterways in the Dutch cities of Utrecht and Breda. A different approach to resolving the water management problems in the historic centre of Delft is also described. Here, the strategy is not to expand the area of open water in the centre, but to prevent the flow of water into the town from the surrounding areas.

Key words: city centres, stormwater, surface water, historic waterways

1. INTRODUCTION

The urban fabric of city centres is fine grained, with narrow streets, dense building and usually little surface water. Access to the centre, where there are functions that have a large scale or serve a large area, is therefore an important urban design issue. This aspect may conflict with a desire to restore filled-in canals, with a view to making the city more liveable and creating more surface water, often at the expense of access roads and parking spaces. Nonetheless, more surface water will be appearing in many city centres, such as Utrecht and Breda, in the coming years.
Other water issues for the city centre are retaining storm water and disconnecting the sewer network. Disconnection is not always possible as such, but when combined with a transformation issue, both often become feasible. For example, new buildings can be designed to retain storm water for longer. City centres are often situated on higher ground, but being located on rivers or in the polder landscape means they can still be exposed to flooding. Additional investment in technical and spatial means of retaining storm water (which is known as the delay model) is called for where this problem exists, as in Delft city centre.

2. UTRECHT SINGEL PROJECT

Utrecht is a water management and wet infrastructure hub in the west of the Netherlands. Its location at the end of the river Kromme Rijn (or 'Crooked Rhine') area and its extensive paved surface make the city vulnerable to flooding, in theory. Flooding does occur incidentally in practice, but is not a major problem, perhaps unlike the downstream areas. Utrecht's freedom from the risk of flooding depends on several factors, including the elevation of the city, how sensitive the infrastructure and public life are to excess water, the surface water and groundwater levels, and future climate change. A

city is normally extremely vulnerable to a rise in precipitation levels or incoming surface water volumes.
The water issue in the Utrecht Station Zone project falls within the public space category. One of the aims of the Station Zone Structure Plan (February 2006) is to improve the connection with the city centre. The principal objective is to create a new centre for Utrecht by integrating the upgraded station zone with the city centre, to their mutual benefit. The link between the two zones must be made in the public space.
The restoration of the singel structure is an essential part of the plan. It is one of the drivers of large scale change within the station zone. The Catharijnesingel will act as the go-between for two now separate worlds, the old city centre and the Hoog Catharijne retail complex. New links are being created between Vredenburg square and the Catharijnesingel. Vredenburg, on the east side of the singel, will be a social, recreational and shopping area, with apartments above the shops. The Music Palace, the new Hoog Catharijne and the V&D department store will also be accessible from the singel side, thus ensuring effective interaction between the buildings and life on the street and the singel. The Vredenburg side will be a waterside route for cyclists and pedestrians. The main route for road vehicles and cyclists is to the west of the water, towards the station, where street-accessed non-retail commercial premises, service companies and possibly shops will be based.
The Utrecht municipal administration has decided to restore the part of the singel that is now filled in so as to strike a balance between roads and car parks on the one hand and the city centre with its restricted traffic access on the other. The main point is the restoration of the centuries-old water structure, and has little to do with nostalgic design.

Figure 1 Artist's impression showing the strategic position of the Catharijnesingel for both the station zone and the city centre.

Figure 2 Artist's impression of the public space on the Catharijnesingel.

Consultation has taken place with the Water Board Stichtse Rijnlanden within the framework of the Water Assessment that started on 1 November 2003, to draft a joint water clause for the Station Zone Structure Plan. The clause describes the existing situation (as at February 2006). The station zone has a considerable paved surface in the form of infrastructure, car parks and large contiguous roof areas. The existing water system in the station zone is based on rapid drainage. Storm water is discharged directly into the groundwater, sewer system and surface water. The waste water is transported under normal circumstances to a treatment plant. No additional storage capacity, with the exception of the mixed sewer system, is present in the station zone, which means that large precipitation peaks cannot be stored in the zone itself. The surface water quality in the station zone is mediocre because of sewer system overflows and various sources of pollution, such as road traffic, the bus station and the railway yard, and discharges from treatment plants. The biological and ecological water and bank quality in the station zone is minimal.
It has been decided that the station zone development will aim to intensify the use of space. A common incentive for a choice of this kind in restructuring city centres is the need to generate revenue. On the other hand, it is particularly difficult to increase the storage capacity in areas of this kind. Nonetheless, the structure plan is an improvement, because the amount of open water in the station zone will increase from 1% to 3%, and some 95% of the urban function expansion will be realised within the existing paved area.
It would seem obvious that the structure plan is unable to offer sufficient space to remove all possible obstacles within the station zone. The proportion of open water needed to achieve the drainage factor desired by the Water Board Stichtse Rijnlanden (which goes unmentioned) is estimated at 13%, which is not realistically feasible in a central urban area.
However, the economic damage caused by excessive rain in the station zone may be considerable, and therefore the parties directly involved within the framework of the Water Assessment have defined joint ambitions and explored possible measures. An assessment will be made of the necessity of actually implementing these measures in the production of the sub plans and definition of the subprojects. Factors to be taken into account will include the social feasibility of the measures and the trade-off between the costs of the measures and the costs of possible emergencies.

3. BREDA OLD HARBOUR

Throughout most of its history, the harbour in Breda has been functional, and one of the reasons for the city to exist. More than 700 years after Breda received a city charter (in 1252), a decision was made in 1964 to fill in this ‘monument’ to improve access to the city by car. The course of the river Mark originally formed the west city canal and the boundary of Breda. Breda harbour was the wide section of the river Mark. Plans were drawn up as far back as the early 1930s for a broad highway between the south and the north of the city. This 'corridor' was intended to improve access to the city and followed the course of the river Mark along the west side of the old city. What this meant for the harbour zone was the construction of a large multi-storey car park under the four-lane road, which was built after the harbour was filled in.
Plans for restoring Breda's filled-in inland harbour started sometime in the 1990s, prompted by a growing interest in cultural heritage and the policy of restricting traffic access to the city centre. A broad debate gathered momentum on a local level, culminating in firm plans for restoring the harbour.

Breda municipal council approved the ‘provisional outline design’ for restoring the old harbour in September 2000. An important idea underlying the decision to bring the water back was to boost the city's experiential value. The objective is a visual impact that appeals to residents' and visitors' sense of history. The municipality made a budget of 29.5 million euros available for bringing back the water to the harbour. This substantial investment in the public space creates favourable conditions for private investments in adjoining existing property and new building development on undeveloped areas in the immediate surroundings. The municipality's aim is to fulfil the plans completely by the end of 2008.

Figure 3 The harbour before, 2004 and 2008

The filled-in harbour was the subject of intense debate in Breda. The decision to satisfy the demands for accessibility in support of the economic interests in the historic city centre was in keeping with the spirit of the time. A powerful countermovement that came into being at the same time argued for preservation and restoration of the cultural heritage that is inextricably linked with Breda's origins. Soon after the idea for reconstruction was launched, the question changed from whether the water would return to what form it would take.(figure 3) A whole series of constraints came into play in the search for an answer. The most important objective, but not the only one, was the restoration and preservation of cultural heritage, in support of the attractiveness of the historic city centre.
On this basis, private developers were willing to waive part of the added land and property value to cover the costs of the intervention in the public space (equalisation). At the same time, discussion is still ongoing on the authenticity aspect. It is debatable whether the monument should be restored to its original state. A combination of technical and financial considerations has led to a decision that 'look alike authentic' is good enough for parts of the plan.

Figure 4 Activities for opening the harbour, 2006

The urban water issue had yet to become an item for discussion when the plans for restoring the harbour were made. The starting points for the provisional design therefore contained no objective for improving urban water management. The district water board was consequently scarcely involved in the planning. The first talks with the district water board were in 2003, and one of the objectives was to agree a financial contribution. The district water board assesses the main impact of the plans for urban water management to be a better through flow in the surface water network in the city centre, which is an improvement in the surface water quality. However, the district water board was unwilling to make a substantial contribution at that stage in the project development, bearing in mind that the decisions on funding the plans had already been made.

4. DELFT

Delft was built on a dug watercourse, the Delf, and its name is indeed derived from *delven*, which means to dig. A count's manor was situated on the elevated site where the Delf crossed the creek wall of the silted up river Gantel, probably since the eleventh century. This was one of the reasons why Delft was an important market centre, evidence of which is still visible in the size of the central market square. The river Gantel runs through Monster and Poeldijk in the Westland region. The Gantel was once a broad creek that was part of a complex system of tidal creeks running into the Maas estuary. Delft has a historic city centre with a fairly straightforward street plan. The Old Delft and New Delft canals run parallel to each other in a roughly north-south direction. The New Delft canal is better known as the sequence Koornmarkt-Wijnhaven-Hippolytusbuurt-Voorstraat.

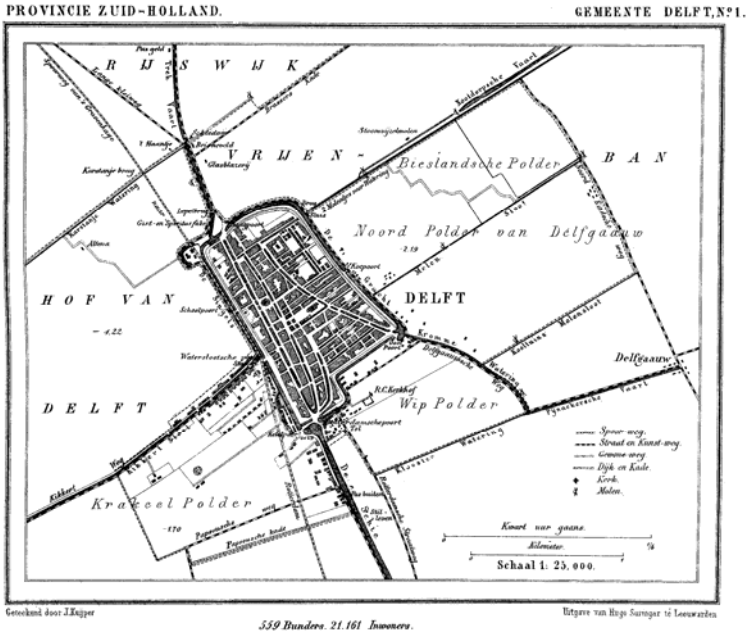

Figure 5 Delft around 1870.

With the levelling of the city walls in the nineteenth century and the arrival of the train in 1847, Delft again became an attractive site for new industries

The Delft Water Plan, entitled ‘A Blue Network’, was adopted on 27 April 2000. This plan outlines water management objectives for the coming years. The plan also includes some concrete measures, such as those for preventing flooding in Delft city centre. Delft suffered severe flooding in 1998 and 1999. The municipality of Delft together with the Water Board for Delfland commissioned the study 'Future survey of the water and soil levels of Delft city centre'. The conclusion was that the quays in the east of Delft city centre were at risk of more frequent overflowing because of more intense

precipitation, a higher discharge level of the river Schie and persistent subsidence. To prevent this from happening, it must be possible during heavy rainfall to separate the canals in the east of the city centre from the outlet waterway, the Rhine-Schie Canal. Most old city centres are connected to the outlet waterway water. They are usually situated on higher ground, which has better natural protection against water. The urban expansions, in particular in the twentieth century, were built in lower-lying polders. During heavy rainfall the water is discharged to the outlet waterway water, and sometimes the old centre is then confronted with flooding, despite being the highest part of the urban area.
A start was made in 2001 on emergency measures on the most critical canals, the Vlaminggracht and the Rietveldgracht. Temporary dams sufficed for the short term; it was estimated that a permanent impoldering of the city centre would be needed within 10 to 15 years, as a result of sustained subsidence together with an unchanged outlet water level.
The Water Plan Steering Group resolved on 14 April 2003 to design a semi-permanent enclosing variant, which involved the near-term installation of fixed closing structures where possible, and flexible gates where desirable. This alternative solution was elaborated to produce a water management requirements specification for Delft city centre. The specification observed the constraints from the viewpoints of water quantity, water quality, management and maintenance, and took into account the various users of the water system. It must be possible to isolate the east of the city centre at eight places (see the ground plan). for each of which the closure options were defined. The result is a plan for building six – at all locations – movable water retaining structures and a pumping station to remove excess water from the polder (i.e. the city centre). The two existing water retaining structures were integrated into the plan.

Figure 6 Rietveldgracht en Vlaminggracht (with semi-permanent enclosing).

5. WHO IS PAYING THE BILL?

The public funds available to municipalities fall under three categories:

1. own resources (municipal taxes and duties), amounting to approximately 17% of income, one third of which from property tax (OZB);
2. the general contribution from the Municipalities Fund, amounting to approximately 37% of income;
3. specific contributions, which are approximately 46% of income.

The first two are part of the autonomy of the municipalities, and the third comes under the heading of 'joint administration'. The first category includes property tax (OZB), which accounts for about one third, plus the betterment levy, second-home tax, tourist tax, parking taxes, dog licences, advertising tax and the tax on encroachments on or above public land.

The municipal contribution to the Breda project costs must be covered by the first two, above mentioned, categories. The assumption is that the municipal land agency budget forms part of the municipal budget.

The plan for bringing the water back to the Westflank district of the old town of Breda, popularly known as the 'New Mark' construction, consists of several components. Restoring the old watercourse, including the harbour, is a restructuring intervention on part of the urban public space, which will be accompanied by redeveloping or refurbishing adjacent existing buildings and implementing building plans for undeveloped areas. The 2002-2006 local political programme agreement set a normative investment budget of € 29.5 mln

The idea for restoring the singel structure within the framework of the Utrecht Centre Project (UCP) development was as a lever to generate support for the plans. The municipality used the concept as a showpiece for the UCP. As a result, the restoration of the singel would appear to have largely symbolic value. A concept that figured prominently through the years of political debate surrounding the UCP was liveability. More offices and car parks, in the context of the debate, made no positive contribution to liveability in the zone, unlike a restored singel structure, which therefore ensured balance in the UCP plans. This balance appeared essential for approval from the local politicians. Against this background, the contribution made by the restoration of the singel structure to solving the urban water issue was a relatively minor matter.

The Delft Water Plan makes firm proposals for implementing emergency measures at the Rietveld and the Vlamingstraat. At the time of adopting the Water Plan there was no insight into the long term solution. The Water Plan includes as a guide a figure of approximately 1.13 million euros to be charged to the Water Board for improving surface water management. This amount was embedded in the Water Board's ABC plan in September 2000. The municipality has earmarked 453,780 euros for the municipal part of enclosing the city centre from the EZH funds (which are the proceeds of the sale by the municipality of the shares in EZH, the South Holland power company). Approximately 195,000 euros of this amount was expended in 2004 for the emergency measures in the Rietveldgracht and Vlaminggracht, and for investigation (the future survey) and support from the urban design and architectural bureau Rappange. The amount remaining is approximately 250,000 euros. Agreements have been made with Delfland on the division of costs on the assumption that the Water Board is responsible for the functional part and the municipality for the urban integration.
The municipality of Delft, also on behalf of the Water Board for Delfland, applied for a grant on 1 April 2004 within the framework of the National Administrative Agreement on Water (NBW) under the 'Provisional scheme for a nonrecurring payment for combating regional flooding'. The implementation plan submitted covers two projects, the city centre project and the Hap/Lap project. The grant applications for both projects were accepted. The contribution for the city centre is approximately 25% of the execution costs with a maximum of approximately 750,000 euros.

6. CONCLUSIONS

The recovery of the singel structure in Utrecht contributes only modestly to the issue of insufficient water storage. It does so only where an incidental separate system can be created and storm water can be discharged through that system into the surface water. However, the municipality foresees the installation of a separate system in the city centre in the long term. If and when this happens, there will be a great need for more storage capacity, among other things in the form of more surface water. In this sense, restoration of the singel structure is a necessary long term investment in urban water management.
It is logical to use underground water storage to reduce the frequency of overflows in the Utrecht situation, because the facilities already exist. However, where this is not the case, which will be true in many other cities, it would be worth considering creating underground water storage directly adjacent to the open water, singel, or canal being restored.

The Breda project involves both public and private interests. It was therefore only natural to place the project development and implementation with a public-private partnership (PPP). In that respect, agreements could have been made on a distribution of the costs in proportion with the revenues. In that case it would not have been the municipality, the Chamber of Commerce and the entrepreneurs who

acted as the client for the study into the economic impacts, but the PPP, and then the outcomes of the study conducted by the BRO might not have revered the maximum variant as emphatically as it did. However, Breda did not opt for a proportional risk-bearing participation involving the municipality and private parties. Instead, a sharp separation of responsibilities was opted for. The municipality has taken responsibility for the restructuring of the public area with the plan for the 'New Mark' as the projected result.
The attractiveness of the public space was the prime consideration in the restoration of the harbour in Breda. Improving the water management in the city centre was not among the key objectives of the plans. Also with hindsight, the plans made only a modest contribution on that point. The main contribution was a possibly faster discharge of the water from south to north through the central area, which is needed in heavy rainfall when the natural watercourses bring in much water from the south. Flooding sometimes occurs under these conditions in the urban area to the south of the old centre. The plans also involve a modest increase in the quantity of surface water and in the water storage capacity in the central area. This additional storage capacity can scarcely be put to effective use in the existing situation because of the absence of a separate sewer system, in common with almost all old town centres.

As mentioned, old city centres are nearly always built on the higher locations in the landscape, which provide natural protection against flooding. However, the Delft situation indicates clearly that flooding can also happen in city centres. Indeed, the urban expansions were built in the lower-lying polders, which discharge their excess water into the outlet waterway water. The outlet waterway water is by definition the open water with the highest level relative to the surroundings, and the old centre is connected to that outlet waterway water. The level of the outlet waterway water rises during heavy rainfall because it is the main discharge for the entire urban area, and is effectively the aorta of the urban water system. The solution to this problem that has been devised in Delft can also be applied in other city centres subject to flooding.

REFERENCES

Municipality of Utrecht, *Milieubeleid voor een leefbare en duurzame stad, Milieubeleidsplan 2003-2008 (Environmental policy for a liveable and sustainable city, Environmental policy plan 2003-2008)*. Houten 2004.
Municipality of Utrecht, *Masterplan Stationsgebied Utrecht (Utrecht Station Zone Master Plan)*, Utrecht 2003.
Municipality of Utrecht, *Ontwerp structuurplan Stationsgebied Utrecht (Draft Utrecht Station Zone Structure Plan*. Utrecht 2006.
Municipality of Utrecht, *Structuurvisie Utrecht (Structural concept for Utrecht) 2015-2030*. Utrecht 2004.
Bestuur Regio Utrecht, *Regionaal StructuurPlan (Regional Structure Plan) 2005-2010*. Utrecht 2005.
Municipality of Breda and others, *Hoofdrapport, Ontwerp Waterplan Breda (Main Report, Draft Breda Water Plan)*. Breda .
Municipality of Breda, *De Bredase Waterkrant (The Breda Water News-sheet)*. Breda 2001.
Municipality of Breda, *De Nieuwe Mark (The New Mark)*. Breda 2006.
Municipality of Delft, Delfland Water Board, *Delft Water Plan: a blue network*. Delft 2000.
Bestuur Regio Utrecht, *Regionaal StructuurPlan (Regional Structure Plan) 2005-2010*. Utrecht 2005.
Delfland Water Board, *Beleidsvisie waterplannen, Samen werken aan een duurzame leefomgeving (Policy concept for water plans, working together on a sustainable living environment)*. Delft 2004.
Municipality of Delft, Delfland Water Board, *Document: Delft water structure concept*. Delft 2005.
Municipality of Delft, *Memorandum: afsluitconstructies grachten oostelijke binnenstad (water retaining structures for canals in the east of the city centre*. Delft 2004.