
Glasgow's Smart Canal

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The North Glasgow Integrated Water Management System (NGIWMS) concept outlines the creation of a pioneering drainage system, using a scheduled ancient monument and modern technology, to unlock regeneration within Scotland's Central belt. Using exemplar sustainable drainage principles, the system will use the canal to provide flood risk reduction, water quality management and habitat improvement for local communities.

Re-thinking the use of existing infrastructure

The establishment of the Metropolitan Glasgow Strategic Drainage Partnership over 10 years ago has created a collaborative culture which is now receptive to progressing projects such as the NGIWMS. Most recently, Scottish Canals, Glasgow City Council and Scottish Water formed a drainage partnership that will administer the drainage infrastructure as part of this project. Collective appetite to innovate is now delivering the NGIWMS and supporting the development and realisation of non-standard solutions urban surface water management.

Historically, the canal system has been considered as infrastructure with a single primary purpose – that of navigation. However, it is being repurposed to provide additional recreational and infrastructure opportunities. The Lowland Canal system has a number of unique hydrological, hydraulic and cultural aspects.

Previous work¹ developed a detailed understanding of the Forth and Clyde Canal System and the potential for it to provide alternative drainage options for adjacent development areas. Utilising the existing infrastructure, with a number of potential refinements, it provides a cost effective and sustainable alternative to traditional solutions in constrained urban areas.

Defining water management areas

The feasibility study introduced the concept of developing Water Management Areas (WMAs). This is to ensure that throughout the future development North Glasgow, surface water management is not only considered as the means of removing water from an area, but also in a wider water sensitive urban design (WSUD) context,

The NGIWMS promotes the creation of a drainage system that is optimised for placemaking, whilst meeting the requirements for flood risk and water quality management through the application of technological solutions in water management.

Within each of the WMAs a series of Water Management Systems (WMSs) have been developed which consider the capacity requirements for drainage, treatment, potential resource and landscape character. The WMSs contain a variety of Water Management Elements (WMEs) each of which comprises a variety of functions including conveyance, treatment, management of exceedance, monitoring and control.

This WMA terminology has been specifically developed to ensure that water management is not solely considered in response to drainage requirements, and that water is considered as a resource within each of the management areas. In addition, the boundaries that have been defined in the development of these concepts are not limited by a simplistic approach of defining watersheds, as the construction of future systems create opportunities for trans-catchment responses, as ultimately demonstrated by the canal system. The characteristics of the North Glasgow study area have been assessed, considering a number of factors, which are presented in more detail within a Site Appraisal. The predominant themes of the assessment have included:

- Hydraulic connectivity
- Utilities
- Infiltration potential
- Green infrastructure
- Development potential and existing land use character
- Topography

Using the Forth and Clyde Canal

The primary driver for the creation of the NGIWMS has been the existence and potential of the Forth and Clyde Canal system, locally comprising of the Glasgow branch. This system, although historic in nature, has some unique characteristics, being constructed into the urban centre of Glasgow, having an ability to convey significant flows away from this area, providing the potential to mitigate the effects of development and provide a resource across the Central belt of Scotland - whilst also recognising its status as a Scheduled Ancient Monument.

The location and nature of the canal provides significant opportunities to function as a conveyance system, it currently operates with low inputs from existing feeders, which maintain levels within the system and ensure there is a positive flow to maintain water quality and operations. Previous work developed a hydraulic model of the canal system, incorporating a representation of the canal hydrology and providing a significant understanding of the potential of the canal to convey flows from future development.

The canal has valuable hydrological characteristics relating to the response time of the system to extreme events. Due to its physical characteristics it has a critical duration; the time in which extreme rainfall events cause peak effects, which is significantly longer than that which relates to development areas and associated drainage infrastructure. This feature allows the future drainage infrastructure and the canal to develop a cooperative relationship working in balance with each other.

Supporting economic regeneration

To fully utilise the potential of the canal system in supporting future drainage and resource capabilities, the potential for the canal system to create additional capacity by drawing down the normal water level of the canal in advance of an extreme rainfall event has been explored. The summit pound of the Forth and Clyde Canal covers a significant geographical area, stretching from Maryhill Locks in the West, into Glasgow to Pinkston Basin and to Wyndford in the east.

This creates a unique opportunity to drain water from the canal system, into streams and rivers before any rainfall event and then to be 'primed' to receive runoff from developments and surrounding areas.

The concept is supporting the development and regeneration of 260ha of land, which is otherwise constrained due to lack of drainage capacity. The project evaluated the concept and the alternative traditionally engineered solution, which would require a 2km tunnel to connect to the existing water environment, to develop a business case justification. This demonstrated that use of the existing canal infrastructure realised significant cost efficiencies compared to traditional engineering solutions.

Utilising the canal capacity to provide surface water runoff as well as conveyance reduces the storage requirements within development. The estimated capacity provided within 100mm of canal storage is 55,000m³ – this equates to a traditional onsite drainage infrastructure cost of ~£10million, along with reducing potential development areas.

Optimising with the canal

The NGIWMS concept proposes that the WMS within each WMA accommodate the effects of development within each development boundary. WMSs will attenuate runoff from rainfall events up to the 33.3% Annual Exceedance Probability (AEP), equivalent to the 30-year return period event. Flows equivalent to the greenfield runoff rates, will be drained by gravity to the canal system.

The original concept proposed WMS for each WMA to provide additional attenuation volumes available, however, to create the opportunity for better placemaking and urban design, these are intended to normally store water. In the event of forecasted extreme weather, the WMS will proactively be drained to create an increased capacity for attenuation. This approach has subsequently been removed from the majority of development proposals except for the site at Dundashill, upon which a dynamic SUDS channel has been constructed

In addition, the summit pound of the canal system will also be lowered to create additional capacity for attenuation and water storage, subsequently creating the opportunity for reducing the overall storage requirements within development, which will reduce overall land requirements.

Using meteorological forecasting data and sensors to enable real-time operational management, the concept will make the canal an intelligent water management system proactively providing surface water storage when required. By providing a surface water conveyance route using existing infrastructure and reducing surface water management burdens from developers, the NGIWMS is supporting the development and regeneration of 260ha of land at a much lower cost compared to traditional engineered solutions. For example, 100mm of canal storage gives the ability to store 55,000m³ of runoff or flood volume, which compares to a traditional onsite drainage infrastructure cost of ~£10million.

Modelling of the NGIWMS, including the summit pound of the canal, indicates a requirement for water to be discharged over a 24-hour period prior to an extreme rainfall event and the concept has assessed performance to include the 0.5% AEP events, including an allowance for potential future climate change.

The approach to developing technologies and infrastructure within the canal and WMAs is unique. Whilst there are systems around the world that operate using similar applications, they are limited to wastewater systems and predominantly driven by a requirement to prevent water quality degradation.

Realising water sensitive urban design

The NGIWMS concept is not just limited to the canal system, it is an integrated plan – it includes opportunities for further developing approaches to surface water management and WSUD² in surrounding developments and regeneration areas. For example, community car washing facilities can be incorporated in local developments using treated surface water runoff, which is then re-treated before draining to the canal network, avoiding the requirements to use potable water, but also creating a social community hub. If realised, this would allow Glasgow to be at the forefront of best practice, generating an international destination for water engineers, urban designers and planners, whilst also creating opportunities for development and application of existing and new technologies to support the Scottish Government's Hydro-Nation aspirations.

Governance

A significant challenge and identified early risk for the concept is the overall governance of the proposed system as it is unique and crosses over a number of responsible authorities duties. With the canal being owned and operated by Scottish Canals, Scottish Water being responsible for property drainage provision and Glasgow City Council with local authority duties as well as working as a developer to implement regeneration infrastructure, there have been many conversations, workshops and discussions to develop an appropriate way to deliver and manage this project.

In early 2018, Scottish Canals, Glasgow City Council and Scottish Water entered in a 60 year Drainage Partnership to provide the overall framework for the delivery and long term management of this project. With significant funding from Glasgow City Council and their partners the project entered into the delivery phase and the project is now nearing the end of the construction phase with commissioning due to start imminently.

References

1. Forth and Clyde – Conveyance of Surface Water Runoff from Development Areas – AECOM February 2011.
2. Water Sensitive Urban Design Ideas Booklet, CIRIA 2013.