# Clandeboye Primary School Raingarden, Bangor

## SuDS used

- *A 12.5 $m^3$ geocellular tank*
- *A 38m long rill*
- *Two Ponds, A and B. Pond A and Pond B provide 54$m^3$ attenuation storage*
- *A bog garden which acts as a broad filter trench providing 12$m^3$ of attenuation storage*
- *Surface water Swale*

## 1. Location

Clandeboye Primary School, Bangor BT20 3JW

## 2. Description

The rainwater garden, situated within the grounds of Clandeboye Primary School in Bangor, Co Down are located within a dense residential area close to the town centre, within an existing green space interspaced with mature trees within the school grounds. The sustainable urban drainage (SuDS) features were proposed by Northern Ireland Water (NIW) to resolve two surface water management issues, an increase in storm water volume and an existing culvert capacity issue resulting in out of sewer flooding in times of heavy rainfall.

Northern Ireland Water had constructed a pumping station within the grounds of Clandeboye Primary, to facilitate the closing of three combined sewer overflows, identified by the NI Environment Agency (NIEA) as unsatisfactory. The new pumping station, along with the site hardstanding, also required a new road to facilitate access. The majority of this additional hardstanding area was to discharge to the nearby Clandeboye stream, an adopted Department for Infrastructure (DfI) Rivers Agency culvert that had capacity issues during heavy rainfall. Secondly, the primary school had issues with its own surface runoff, which flooded a downstream cul-de-sac during heavy rainfall and had been issued a statutory notice by the local roads authority (DfI Roads) to resolve. The raingarden was proposed to resolve both issues.

In parallel to the surface water issues in the area, NIW and its parent department, the Department for Infrastructure (DfI) were keen to promote and demonstrate SuDS within the urban environment, particularly “soft SuDS”, as a sustainable tool to manage surface water and reduce the risk of flooding. NIW applied to the department and were successful in securing funding from the DfI Ministers Special Fund set aside for SuDS demonstration projects. The proposal’s align with the NIW Long Term Water Strategy 2014-39 (LTWS) as well as a number of interdepartmental strategies including the Sustainable Development Implementation Plan 2011-14 (OFMDFM) and the 2010 Education (School Development Plans) Regulations.

The garden’s location, situated within the grounds of a local primary school which included two nursery schools, added significant challenge in the acceptance of the proposals by all stakeholders. Key to acceptance was support by the School Principal and Board of Governors who could envisage how the project could not only help control surface water, but also provide an additional educational resource, visual amenity and elements of play and fun into the school grounds.

## 3. Main SuDS components used

As this project served both a practical purpose, and was to be used as a demonstration project, from an early stage the work scope was defined to include such variety of vegetative surface water management features as feasible within the constraints of the available land area, ground conditions and funding available.

The raingarden is fed from hardstanding areas around the school building. Approx. 300m$^2$ of which have been intercepted by trapped gullies to facilitate silt removal from the system then into a 5m x 5m x 0.5m storage tank with overflow pipework to a rainwater rill. The tank has a sluice gate which when activates allows 10l/s to flow into the rill for 20mins when the tank is at maximum capacity. The discharge is via a grassed feature mound, which is shaped as a turtle with the water discharging from the wooden carved turtle’s mouth.

The rill terminates at a circular stone sinkhole which conveys the flow underground via a 150mm pipe to facilitate the access path to the school, the pipe terminates at pond A which overflows a stone cascade wall to fill pond B.

Pond A is approx. 41.5m$^2$ and pond B 80m$^2$ with overflow pipework set at 450mm and permanent depth of 150mm to provide an overall attenuation volume of 61m$^3$. The ponds were formed with an EPDM pond liner and natural stone cascade wall. Pond B has a timber-dipping platform with timber deck, and a 150mm outfall pipe that discharges into the nearby Clandeboye stream.

Pond A also receives the overland runoff from the existing school hard surfaces playground area. The overland flow travels first through a bog garden which provides 12m$^3$ of storage in the voids in gravel substrate.

A 1 in 3 gradient swale attenuates the surface water that lands on the access road and limited areas of the pumping station, the swale terminates with a proprietary swale inlet unit connected to a 150mm pipe that discharges to the Clandeboye Stream.

Additional features have been incorporated into the design that serve to add value in provision of play facilities for the pupils of Clandeboye Primary school, and provide an "outdoor classroom" facility for educational purposes, whilst also accommodating excavated material from the swale and pond areas to ensure no excavated material required transportation off site. This reduced transportation and disposal costs and environmental impact, with reduced traffic disruption to neighbours. The additional features included a spiral mound with slide and landscape profiling.

## 4. How it works

The drainage strategy involves the interception of overland flows from hardstanding areas around the school and attenuation of these flows before discharging into the Clandeboye Stream. The total area of hardstanding is 2702m$^2$ which for a 1 in 100 year storm return period results in a maximum inflow to the ponds of 70l/s. Maximum outflow is limited to 13.7 l/s which results in a total storage requirement of 54m$^3$.

The hardstanding area can be divided into 3 area each of which have a different SuDS management train.

| | **Source Control** | **Conveyance** | **Site Control** |
|---|---|---|---|
| **Area A:** Car park & access path 261m$^2$ | Surface water is collected by 3 gullies which have been redirected to a 12.5 m$^3$ geocellular tank. | Storm flows are released from the geocellular tank via a valve or high level overflow. The flows discharge into a 38m long rill which in turn discharges into pond A and pond B. | Pond A and Pond B provide 36.5m$^3$ attenuation storage before discharging to Clandeboye stream via a high level overflow. |
| **Area B:** Playground 2097m$^2$ | Surface water gravitates to bog garden which acts as a broad filter trench providing 12m$^3$ of attenuation storage | The bog garden conveys flows through the substrate to pond and pond B | Pond A and Pond B provide 36.5m$^3$ attenuation storage before discharging to Clandeboye stream via a high level overflow |
| **Area C:** WwPS access road 344m$^2$ | Surface water gravitates to swale | Swale conveys flows to Clandeboye Stream | Swale provides filtration and some infiltration as it conveys flows |

The design rationale for the project was to select SuDS components that met the objectives for quantity of water storage, quality of water, amenity and biodiversity. The geo-cellular tank was selected as source control for Area A runoff to retain the required volume at the top of a natural slope water quality is addressed through the provision of sumps on the gullies discharging to the tank. The tank is designed so that flows can be released via a valve which has been incorporated into a turtle sculpture to allow the water to discharge from the turtle's mouth into a rill running down the slope. The design of the conveyance system was focused on providing amenity value to the school children by creating play feature where duck races can take place.

The bog garden collects the runoff from Area B and allows flows to slowly percolate down the natural slope into Pond A. This process filters the runoff removing sediment while also providing 12m$^3$ of storage in the voids contained in the substrate. The planting, logs and rocks that form the bog garden contribute to the biodiversity to the scheme.

Pond A and Pond B collect the flows from bog garden and those discharged from the geo-cellular tank. The ponds are designed to have a permanent water depth of 150mm for aesthetic and biodiversity reasons and a maximum water level of 450mm for safety reasons. A low level overflow is provided to allow attenuated water to slowly drain down to this 150mm depth. A high level weir ensures that the maximum depth of water in the ponds does not exceed 450mm. The ponds are planted with a mix of aquatic plants to form a boundary to the pond margins.

The planting has been selected to ensure that views to the ponds are not obstructed in the event of a child entering the ponds. A dipping platform has been provided to allow children safe access to the edge of the pond in supervised conditions.

A swale was selected as the most suitable SuDS component for collecting the access road drainage as it can follow the horizontal alignment of the road and collect flows along its length. The swale provides filtration of the runoff and a small level of infiltration as it conveys flows to the Clandeboye Stream. The mix of planting in the swale allows it to contribute to the biodiversity of the scheme.

## 5. Specific project details

The raingarden project forms part of a wider drainage area plan (DAP) in the town of Bangor, focusing on the closure of unsatisfactory combined sewerage overflows, as identified by NIEA that discharge to local watercourses and Belfast lough to improve water quality. The SuDS project, comprising of mostly surface water management features, sits in contrast to the more traditional solutions of large pipework upgrades and strategically placed storage tanks, constructed throughout the towns combined sewerage network. Storm separation was an option considered for all elements of the larger DAP scheme. As with many mature UK towns and cities, with long established combined central cores, the vast areas of hard standing required to reduce CSO spills to acceptable levels, combined with the extent of new separate storm systems required, and lack of available green space for alternative options made this unfeasible.

Traditional solutions were identified and included within the options for this element of the project within the school grounds. Geocellular tanks and oversized pipework including manifold systems were assessed, however the added benefit to both the school in terms of added value to the curriculum, alignment with sustainability objectives and benefits through play, combined with the added value derived from increased biodiversity and amenity, resulted in the option being selected for implementation.

Planning and execution of the project necessitated the input of a number of disciplines, including landscape architecture, civil engineering and hydraulic modelling. Due to the location of the raingarden, enclosed within the grounds of the primary school, community engagement in terms of neighbours, included a number of meetings to discuss the overall project and to describe the planned works, along with managing expectations, in terms of disruption during the construction phase of the

works. The key elements of engagement successful to the garden focused around the school management and separately the Education Authority. Detailed visual presentations where initially given to the school headmistress and board who immediately identified the positives of the proposals to the school, both as a solution for the over-ground runoff issue and for the wider benefits. The initial meetings and presentations expanded into a visual design proposal of the project, along with a detailed report and risk assessment carried out by ROSPA as an independent authority in in health and safety assessment. Upon completion of the project, NI Water and DfI along with the school and EA organised an official opening, attended by a wide range of key stakeholders within the sector. An official video was produced for the day and for wider use on social media and future presentations to stakeholders which can be viewed on YouTube titled https://youtu.be/whUqjd8H6L0

## 6. Maintenance & operation

Overall ownership and maintenance of the feature rests with the School and the Education Authority. As part of a "soft landing" it was agreed that NI Water monitor and maintain certain aspects of the feature over a four year period following handover, to ensure vegetation survives the initial planting to maturity, and that design features are suitable in practice. This "extended warranty" was essential to ensure initial buy in, reassure stakeholders of the commitment to make the feature a success and guarantee short to medium term overall performance. The maintenance plan was adopted from CIRIA guidance.

## 7. Monitoring and evaluation

The demonstration nature of the project will ensure continued scrutiny over the long term by a variety of stakeholders, including local council, planning departments, schools across the province and developers. Over the extended maintenance period of the feature, pupils, staff and the school maintenance team as well as Education Authority operatives will monitor the performance of the feature, with maintenance as required provided by the constructor. Both NI Water and DfI Roads will monitor the effectiveness of the project in reducing the risk of flooding via overland flow and incapacity of the drainage system in the downstream cul-de-sac.

## 8. Benefits and achievements

**Paradigm shift** – Following successful launch of the project, a change in thinking has occurred as to the nature of surface water management, the associated risks and benefits and its place within the grounds of a primary school evidenced by the public statement from the Education Authority's Deputy Director of Development welcoming similar schemes across Northern Ireland. Further statements by local elected representatives including the local MP Lady Silvia Hermon, MLA's and local councillor's further support the philosophy and benefit provided by the SuDS project. Various articles in the local media outlets have went further in promoting the benefits and acceptance of surface water management features within the local environment.

**Added Value** – sustainable water management, reducing the risk of flooding and enhancing the local environment by adding biodiversity friendly habitats are well known, positive outcomes of a project of this nature and expected post construction. What wasn't anticipated by the delivery team to such an extent, was the added value in terms of educational resource, and secondary benefits of creating a safe play environment for the pupils of Clandeboye Primary School. Some of the added benefits included a lowering of the schools accident rate, as play was more focused on the features of the garden and away from the traditional games of "chasing" on hard, knee unfriendly playground surfaces, and a noticeable reduction in playground disagreement's, "he said she said" has been observed by staff. Further work by the school has included a designed outdoor classroom including a

mud kitchen and sandpits and included within the learning curriculum. Clandeboye Primary is hosting other schools within the area to tour the feature and demonstrate the added value provided by the Raingarden to the school curriculum.

## 9. Lessons learnt

Key challenges to the project came mainly from legal and grounds maintenance departments representing the interests of the Education Authority, concerned with increased maintenance costs and risk of legal action taken against the Education Authority as a result of permitting the raingarden to be constructed within the school grounds. The importance of SuDS evangelism not only to the immediate sector but also to a broader church of decision makers is essential to encourage acceptance, accelerate change and generally educate wider society as to the purpose and benefits of SuDS solutions where applicable.

This opposition and challenge was welcomed by the development team as a chance to influence at a strategic level within the Education Authority. Below outlined are actual queries regarding the works that may be encountered when developing a similar scheme;

1. What do you envisage as to the Educational benefits of the proposal?
2. Details of similar projects throughout the UK
3. Inclusive detail on how each aspect of the design meets the CIRIA design criteria or betters it. (Design risk assessments as with CIRIA Suds guidance, note on why covering with mesh introduces additional aspects and should be avoided?)
4. Details of the max. velocity and volume of rill
5. Details on testing of water within tank, risk associated with growth of pathogens.
6. Details on the rate of recirculation of water within the ponds and risk of toxins?
7. Details on the suggested maintenance regime for each aspect of the proposal, costed along with a high level cost of the proposal.
8. Details as to what would be required should the EA wish to remove the pond at a future date i.e. storage volume and pipe.

A key lesson was the early inclusion, buy in and subsequent advocacy of the school Board of Governors and in particular the Head Mistress, who's energy, vision and positive approach to perceived obstacles secured the success of the project. The inclusion of the ROSPA Risk Assessment was also critical in allaying valid concerns regarding the inclusion of open water within a school environment, the third party independence and objectivity adding comfort for decision makers.

## 10. Interaction with local authority

The local authority and client for this project are one in the same. The project represents a demonstration of the soft SuDS concept for use as a demonstration project for various Government Departments, local councils, planning officials and developers throughout Northern Ireland to promote, educate and inform.

## 11. Project details

**Construction completed:**

The SuDS project was completed in November 2017 following a 2 month construction phase.

**Cost:**

Overall Project costs £1.6M

SuDS Capital costs £70k

Design Costs £6k incl. supervision and 3rd Party Risk Assessment

**Extent:** 2702m$^2$

## 12. Project team

| | |
|---|---|
| Funders | • Department for Infrastructure DfI (Ministers special fund for innovation)<br>• Northern Ireland Water Ltd |
| Clients | • Clandeboye Primary School<br>• Northern Ireland Water<br>• Department for Education |
| Designers | • AECOM Ltd |
| Contractors | • BSG Civil Engineers Ltd |
| Suppliers | ACO |

## 13. Project pictures / images

Fig 1: Dipping Platform located in pond B

Fig 2: Pond B and weir wall

Fig 1: Pond A with Bog Garden collecting hardstanding runoff

Fig 2: Excavated Pond Material repurposed as play facility

Fig 3: Children at play in the duck race / rainwater rill

Fig 4: The Delivery team at the official opening day