SUDS, Sculptures, Habitat and Waterway Rewilding in Knocklyon

Discussion document with potential ideas for water features in Knocklyon

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1.0 Introduction

Knocklyon Network CLG approached FH Wetland Systems in the winter of 2023 to explore opportunities for implementing Sustained Urban Drainage Systems (SUDS) and associated water features at a number of locations within the Knocklyon area. As part of this process members of the local community met with Féidhlim Harty of FH Wetland Systems on 17/4/24 to assess a number of suitable sites and to examine possible options for stormwater management and water-related biodiversity projects. This meeting and report were made possible by the generous assistance of a grant through the local LAWPro officer, Éanna Gallagher.

1.1 Site Location and Background

The main site assessed was for a potential stormwater wetland alongside the Dodder at Cherryfield. At this site there is an opportunity for a relatively easy overhaul of the existing stormwater pipework exiting the road that passes overhead the Dodder River; and to amend the topography in the parkland below to provide a stormwater wetland for filtration, attenuation, habitat and amenity.

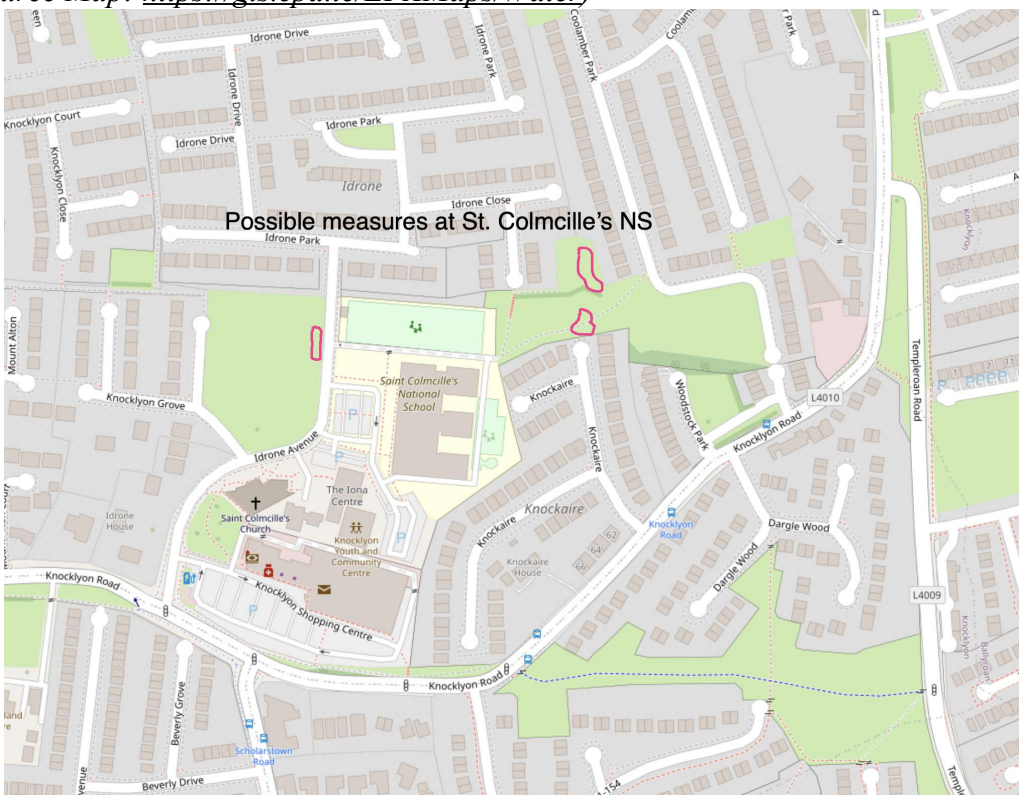
Proposed location of stormwater wetland and SUDS features at Cherryfield.
(Source Map: https://gis.epa.ie/EPAMaps/Water)

There are also opportunities throughout Knocklyon for smaller SUDS elements such as small stormwater wetlands, bioretention areas, rain gardens, water butts, rainwater planters and other measures for holding and filtering water and introducing wetland flora into the urban space.

As part of the site meeting we examined areas adjacent to St. Colmcille's National Schools for potential measures there. As an example of waterway work that could be done in the area for habitat and amenity value, and as an educational resource for the

local schools, this site has the potential to expose a piped stream and/or stormwater pipe and bring it back out into the air as habitat and for the benefits offered to water quality, hydrology and hydromorphology (the channel shape and structure). Thus there is an opportunity for a waterway rewilding process to introduce habitat, filtration potential, oxygenation, beauty and a haven for people and wildlife alike into the urban environment.

Possible SUDS and water measures near St. Colmcille's National School.
(Source Map: https://gis.epa.ie/EPAMaps/Water)



This document and the accompanying drawing are intended as an overview of ideas and suggestions for discussion amongst the local community, for their feedback and input. This feedback will then feed into the final stormwater and habitat designs for the area at a future project stage.

2.0 Dodder River water quality

Water quality is often expressed in terms of Q-values. These measurements are based on biological assessments of a watercourse, specifically the number and diversity of a suite of macroinvertebrates (insects and other similar aquatic fauna). They offer a picture of the habitat value of a river or stream and thus a good overview of general water quality over an extended time period.

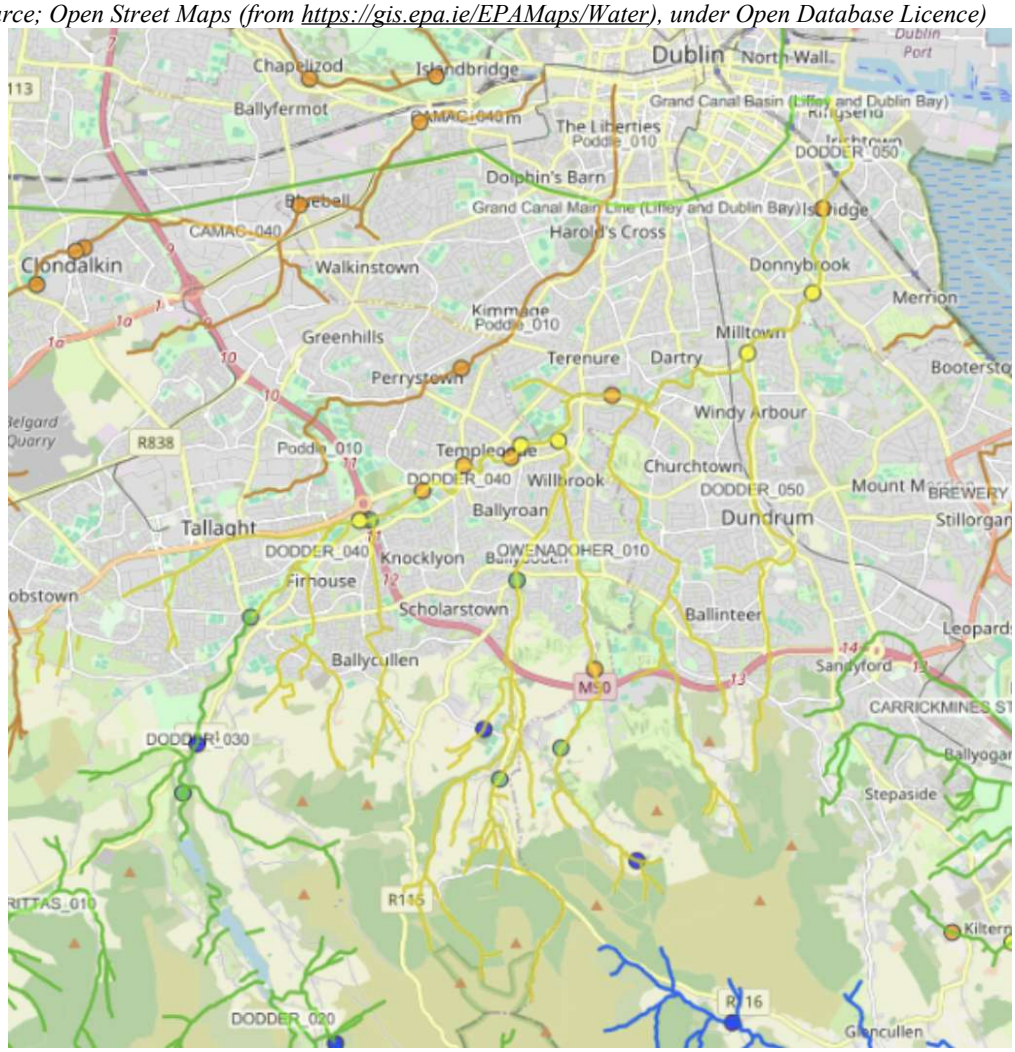
Q-values are expressed on the EPA maps (https://gis.epa.ie/EPAMaps/Water) and reports by both colour and number; where Q5 is classed as high quality water and Q1 is classed as bad quality water.

The colour of the river channel on the map shows the overall river quality status (Q3; yellow below for the main Dodder channel), which takes into account the macroinvertebrate Q-value analysis as well as physical and chemical lab analysis and the overall hydromorphology of the waterbody (the shape and structure of the river and the degree of engineered interference over the decades or centuries).

Ireland has an obligation under the Water Framework Directive to achieve good (Q4; green) status for all rivers by 2027; an obligation that we are can achieve only with miraculous shifts in priorities for both urban and agricultural water management. In this light, all measures, large and small, that can help with improving the water quality in the river are highly recommended, and the proposed SUDS measures in this document can be part of the overall set of solutions available.

The latest Q-values for the Dodder River (https://gis.epa.ie/EPAMaps/Water) show that the river water quality close to the sites in question is in poor shape. Downgradient of the two sites the Q-value analysis for the river is shown to have poor quality (Q2; orange dot; shown below) and from there to the joining with the Liffey the water quality hovers between moderate (Q3; yellow dots) and poor (Q2; orange dots).

Dodder River catchment showing river quality status (channel colour) and Q-value results at distinct locations shown (coloured dots)
(Source; Open Street Maps (from https://gis.epa.ie/EPAMaps/Water), under Open Database Licence)



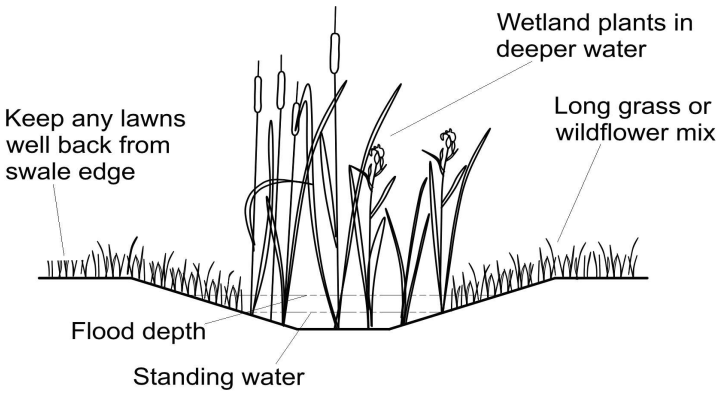
3.0 SUDS Measures Suitable for Knocklyon

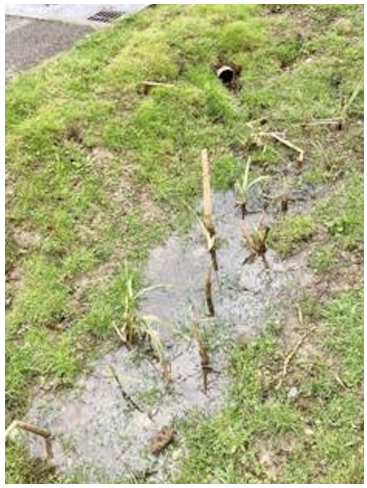
There is a whole suite of SUDS options which can be used for attenuation and filtration of stormwater. The most natural of these are presented below, but a more complete list is included as an appendix at the end of this report. The main measures which appear suitable for Knocklyon are swales, bioretention areas or rain gardens and stormwater ponds and wetlands. These may be augmented with rainwater planters or water butts at individual houses, churches or school grounds for additional benefits to local hydrology.

3.1 Swales

Grassed or wetland planted channel set on or close to the contour for filtration of water en route to the river. (See *In Praise of Swales* in Horticulture Connected, 2019, for more Info: https://horticultureconnected.ie/?s=feidhlim+harty&post_type=post)

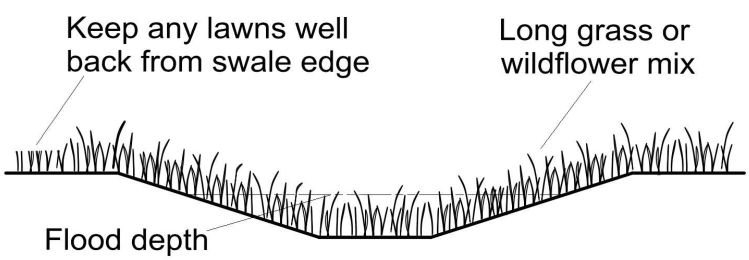
Section through planted wet swale. Note that the wet swale detail below can be designed to have a maximum flood depth of 100mm (4"). In essence, a wider version of this set-up serves as a stormwater wetland. (Image: FHWS).





This is an example of a shallow wet swale in Geashill, Co. Offaly, filtering runoff from the car park in the local park, en route to the community pond. (Photo: Geashill Tidy Town)

Swales may also be grassed where the site is suitable. This allows for seasonal mowing if required, while still offering the benefits of water filtration during wet weather.



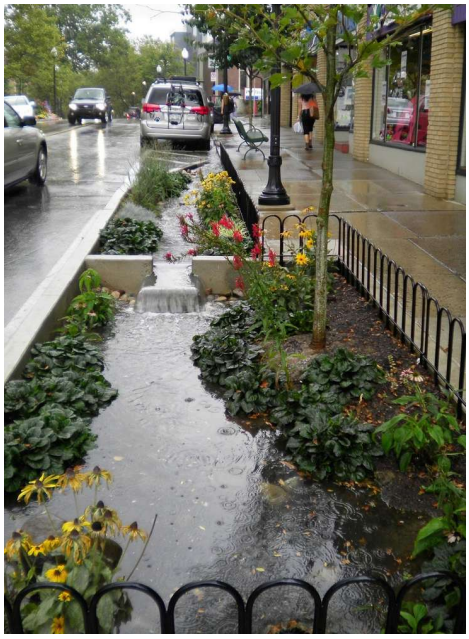
Section through a grassed dry swale (R). Careful contouring of suitable ground can create opportunities for filtration with very little cost. Example from housing estate in Denmark. (Image: FHWS)

Wet swale serving road runoff from a housing estate in Denmark. Depth is c. 6". Water continues on to wetland basins and ponds as part of the wider stormwater management and amenity features of the development.

Roadside swale in north Cork, with earthen check-dams and pocket pools planted by volunteers as part of local community scheme.

3.2 Bioretention areas / rain-gardens

Planted infiltration areas for receiving runoff from roads or car park areas to provide both filtration and attenuation of the runoff en route to ground. These may have an overflow facility to surface water for excess volumes during storm events, but during dry weather flows are typically able to store and percolate all inputs. (https://horticultureconnected.ie/horticulture-connected-print/2020/spring-2020/site-drainage-with-an-eco-twist-feidhlim-harty/)



Rain-garden during downpour (R) Reproduced with permission from State College PA, USA.
https://www.statecollegepa.us/345/On-Street-Rain-Gardens

Sunken rain-garden strips between parking rows (below)

3.3 Stormwater ponds and wetlands

Filter marsh or pond areas that can receive rainfall runoff from streets for storage and filtration en route to the river. Some infiltration may occur, but the base is sufficiently impermeable to support a wetland habitat (in the case of stormwater wetlands) or is lined with indigenous clay, peat or synthetic liner membrane (in the case of ponds). (See: https://www.wetlandsystems.ie/Stormwater.html or more info.)

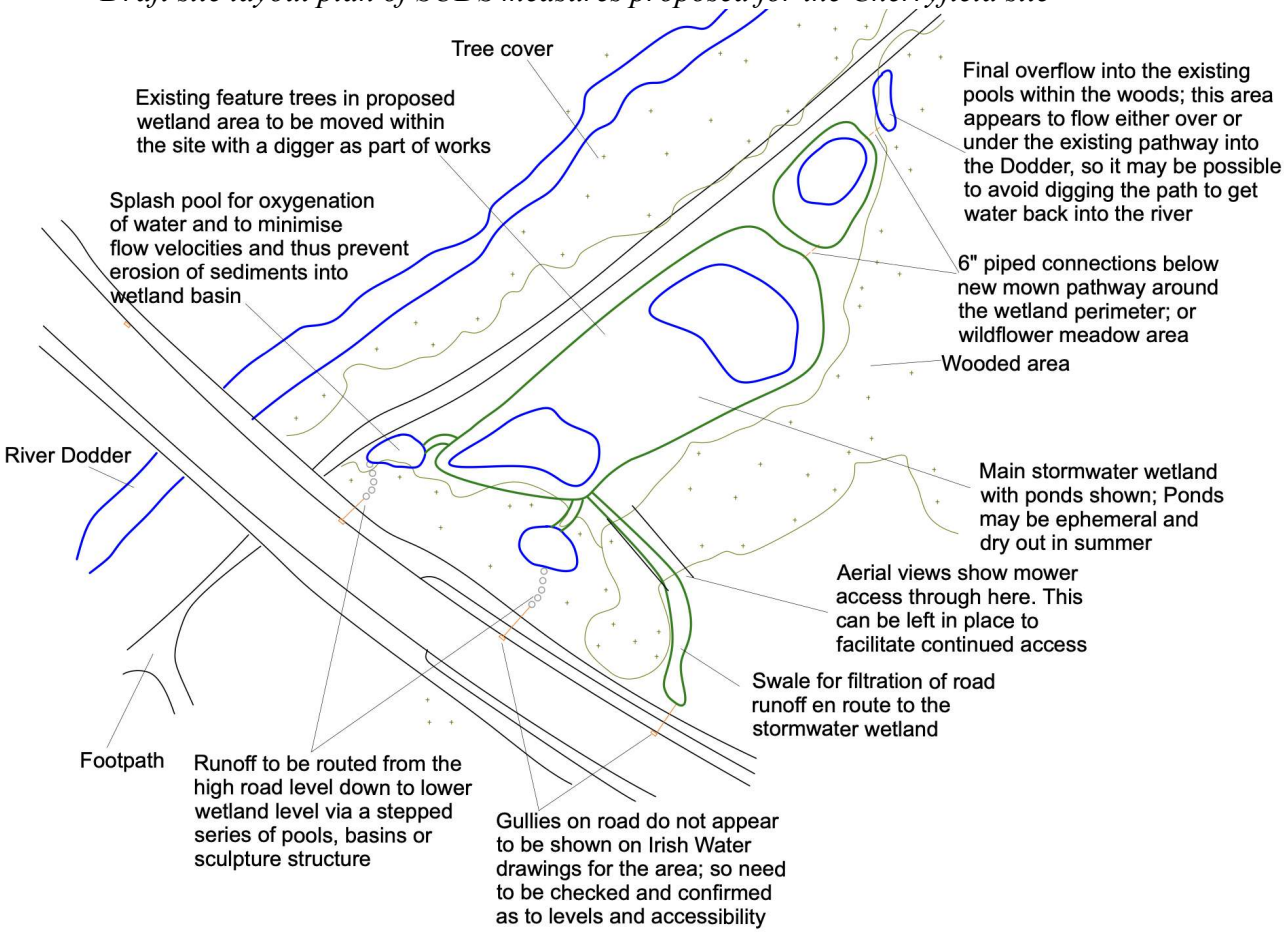
Stormwater wetland at University of Limerick (below)

Bulrush (upper right) and early planting (lower right) at the Moycullen stormwater wetland, Co. Galway

4.0 Proposed SUDS measures at Cherryfield

There are a number of measures which may be adopted at the Cherryfield site, as set out in the draft site layout plan below. These include a large stormwater wetland area, with ponds, stormwater wetland areas or bioretention basins (depending on the infiltration rates measured at a later stage of the process) and swales.

Draft site layout plan of SUDS measures proposed for the Cherryfield site



There is a need to bring water down from the road level to the wetland level without causing erosion of the existing embankments. Inherent in this, there is also an opportunity for introducing additional interest in the form of a sculpture or engineered measures to create a cascade or other water feature which would highlight the flowing quality of the water and also add oxygenation and revitalisation of the stormwater exiting the roads.

There are many possible options which could be incorporated into this design, as well as other possible sculpture features which would add interest to the wetland at this location. These are set out in the next section.

5.0 Image Board – Incorporation of Water Art and Sculpture

The following pages comprise an Image Board which includes a collection of images to act as inspiration for the River Dodder Cherryfield stormwater wetland site. The images presented in this image board are intended as discussion prompts for local community input and to help inform the final designs in due course; taking into account such factors as biodiversity value, aesthetic appeal, community engagement, construction feasibility and costs.

Discuss the images amongst the committee and select those that are considered most appropriate to the aims of the project and also to the aesthetic desired for the area in question.

5.1 Conveyance from Stormwater Inlet Pipes to Field Level

In terms of chronology of flow, the first consideration is to achieve a drop in water level from the elevated road surface down to the lower field level below. The requirements here are that the water would be conveyed down without causing erosion of the embankment or clouding of the water on entering the lower level by sheer flow velocity.

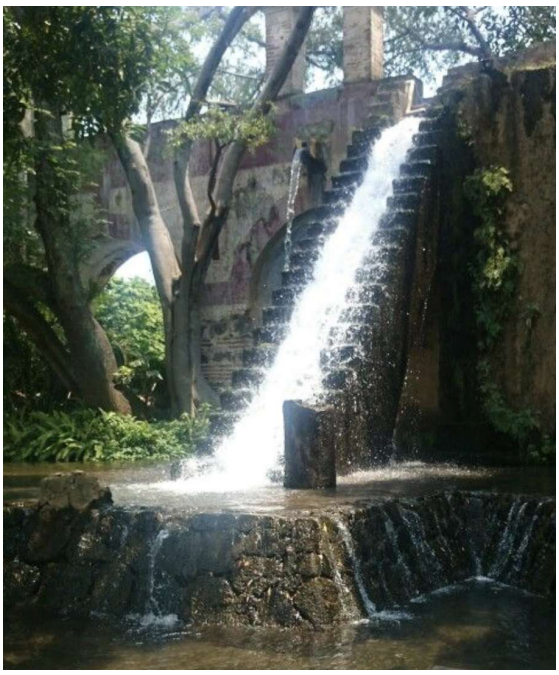
A secondary consideration is to follow the permaculture principle: *obtain a yield*. Thus there are opportunities for an aesthetic finish well above and beyond that of a concrete or plastic pipe. There are also opportunities for ongoing public engagement with the project through creation of sculptures that use the water flows and irregularities to provide interest on the site with each new walk, particularly in wet weather. An additional opportunity is to use the kinetic energy of the water from the higher level to power a sculpture or device or to generate energy for another feature on the site. Note that in this context, generation of lighting is discouraged for wildlife reasons. A suitable use may be to create a fountain feature or flow form pump feature for a later stage of the stormwater filtration process so that cleaner water is either further improved or is made available closer to the pathway for people to interact with as part of the art engagement process.

Flow form units were developed by Austrian Scientist Victor Schauberger to improve water quality and provide extra life force within the water.

https://rosemancreekranch.com/2011/01/inspiration-farms/

This stepped flowform type arrangement would allow for stormwater to be routed from high up at the road surface down to field level via a series of small vortex pools, providing beauty, water sounds and an oxygenating, revitalising element to the water itself.

https://i.pinimg.com/736x/04/3d/ea/043deac6ff8565d7e27497ca83ac8623.jpg



This stepped cascade feature (R) and fish-ladder type arrangement are other potential approaches for routing water into the site. This will provide oxygenation and interest even though no fish will be present.

https://www.pinterest.com.au/pin/1266706139598731/
https://www.pinterest.com.au/pin/1092967403291402678/

A very basic set-up would be to build a rock gabion stepped arrangement to route water down without causing erosion. As shown here it could also double as a play feature within the site, although this would need to be examined in the context of potential contaminants entering the site from the road above.
https://www.pinterest.com.au/pin/jardins-de-chuva--281543716723706/

Energy can be captured from the stormwater flows via a turbine or a vortex generator such as shown here, although the latter may have a minimum system size requirement in excess of our projected input flow volumes.

https://www.turbulent.be/projects

A series of stepped dishes could provide a way to have trickling water at very low throughput volumes for interest during our typical soft days, while also being designed to route storm flows safely from A to B.

https://www.pinterest.com.au/pin/730146158343275133/

https://watersculptures.co.nz/

On a more elaborate scale, a larger sculpture could also be used if greater artistic flair is desired. The aim of routing water into the stormwater wetland below would be a key component in the overall sculpture design.

https://www.scoop.it/topic/art-installations/p/4041181896/2015/04/11/alice-aycock-whirls-and-swirls-and-a-vortex-on-water

A simple concrete structure may be built to achieve the same essential task of routing water down, with waving elements for beauty and interest, and/or fluted inserts for oxygenation and an additional element of interest and interplay during higher flows.

https://www.bergerpartnership.com/work/adams-elementary-rain-garden/

A more natural approach may be to build a stone cascade (using a concrete or gabion base for resilience).

https://www.pinterest.com/pin/a-pondless-waterfall-flows-down-a-wooded-hillside-the-basin-was-designed-to-pool-up-a-little-water-for-the-many--558164947544949525/

Or simply pipe the stormwater flows out to a point where the water can fall into a reinforced pool in a single run, with a high-walled glade of quick growing wetland trees such as willow, alder and birch, with longer term rainforest species encouraged such as ivy, ferns and others.

https://society6.com/product/jungle-waterfall283950_print?curator=nicklasgustafsson

5.2 Features Within the Wetland Area

In term of the wetland area itself, there are many features which could be included such as stepping stones or sculptures.

Stormwater by definition is not particularly clean due to hydrocarbon and other inputs from the road, but in the latter stages of the filtration process the water should be clear enough to include features such as a sunken walkway though a pond.

http://themuseumtimes.com/the-miracle-moses-bridge-near-halsteren-netherlands/

Other features such as stepping stones would be a much lower budget way to achieve interaction with the water.

https://www.dezeen.com/2013/10/06/botanical-garden-in-australia-wins-world-landscape-of-the-year-2013/

https://www.dexigner.com/news/29005

5.3 Wind, Water or Electrical Elements

There are wind sculptures that move or sing with the wind...

https://windfirewater.art/

...or water powered sculptures which move or interact with the element of water fed from a height or pump-fed using electricity generated on site from the main stormwater inputs.

https://www.pinterest.com.au/pin/397231629646786179/

A Colorado based water treatment company offers products based on the principles of Victor Schauberger and others (R). This sort of sculpture could be used at any point within the site if fed using electrical inputs from an on-site generator.

https://truespring.wordpress.com/2013/05/

Another Schauberger inspired sculpture which could be fed from on-site hydro power and placed in a pond within the stormwater wetland. By siting in the centre of the pond area, it would reduce the potential for theft or vandalism.

https://www.pinterest.com.au/charlesq2082/victor-schauberger/

6.0 Water & Amenity Measures near St. Colmcille's National School

Towns and cities were often started along the lower reaches of rivers, at the point where the river meets the sea. In an undisturbed landscape, this area naturally serves as a valuable flood plain for rivers, as well as being a delta habitat of rich soils, marsh areas, pools and a myriad of intermediate habitats such as scrub, riparian wetland, wet grassland and the like. As urban areas grew, the drier areas of these deltas were initially farmed, then paved, then built upon; while the wetter areas, the streams and rivers, were straightened, narrowed and sometimes even piped and covered over.

Along with a relentless drive to restrict the natural flow of water through both urban and rural landscapes, waterway management over the centuries has focused on removing rainfall from urban environments and routing this water into rivers and streams as quickly as possible. While this was well intentioned as a localised flood prevention measure it can directly lead to exacerbation of flooding downstream, as well as serious degradation of water quality and all of the wildlife and habitats that rely on clean water with healthy flow dynamics. We're in the midst of the sixth known mass extinction event on our planet, this one due to anthropogenic causes. As such we have the responsibility to reverse habitat erosion and create spaces for nature to thrive wherever the opportunity arises. One of the many ways we can do this is to improve water quality and also create wetland habitats, which are valuable hubs for biodiversity in many ways.

The St. Colmcille's NS site offers an exciting opportunity to take stormwater drains, areas that may well once have been streams, back out from underground and expose them to the sun, the air and the many types of wildlife that need wetland habitats to live and thrive.

Overleaf is a map excerpt from South Dublin County Council showing the surface and stormwater drainage system for the area. There is an opportunity to open up the 1.2m diameter stormwater pipe shown and route it out as an attractive stream once again.

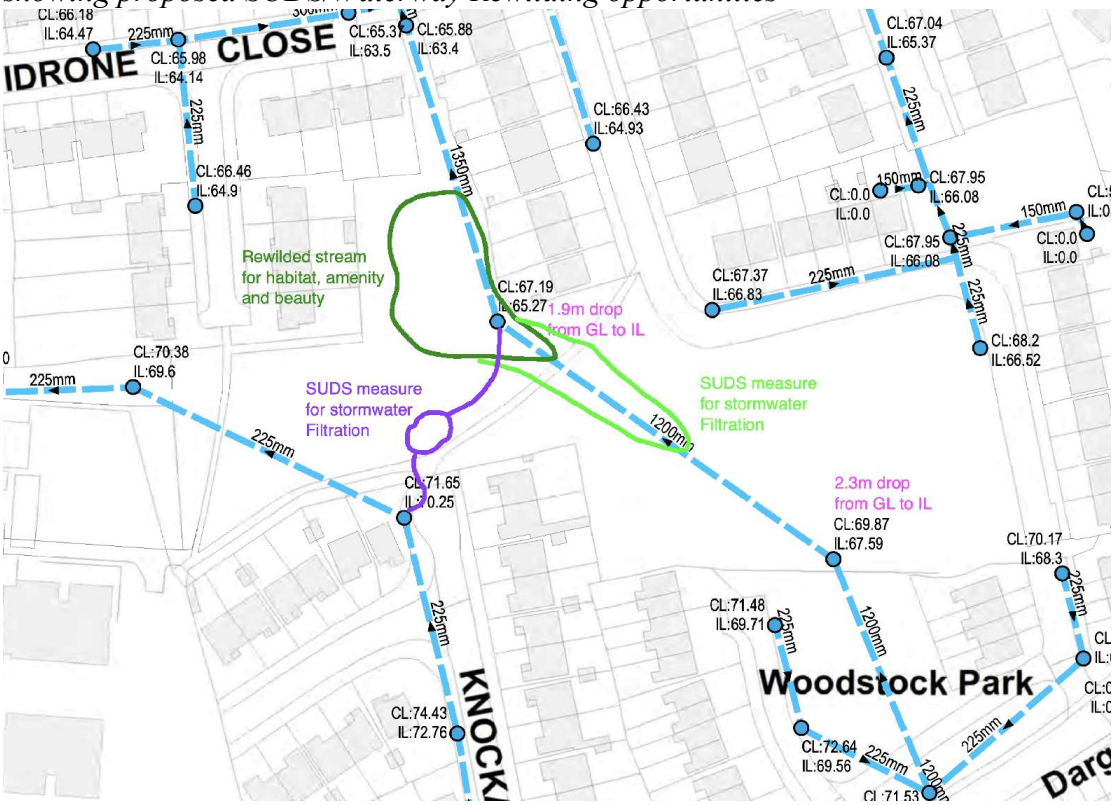
To improve the water initially, the area shown in light green could be used as an initial SUDS type stormwater wetland to provide both attenuation and filtration. The area shown in dark green is all at a much lower elevation than the upper manhole (IL 67.59) and would thus be possible to re-contour at a very shallow level to provide a safe and attractive wetland habitat area within this green space.

It would be possible to create a longer stream run, from the upper manhole down through the green space, but the excavation at the upper end of the run would require a drop of *c*. 2.3m from existing lawn down to the top level of the water in the stream or stormwater pipe. Given that much more suitable elevations exist further down-gradient in the site, it is deemed that such a deep excavation and re-contouring is unnecessary and excessive.

Another feature which could be readily adopted at this site is to take runoff from an adjoining estate and route it into a new SUDS wetland or bioretention area / rain garden in the lawn area (shown overleaf in purple). This runoff could be simply surface level runoff from the area immediately over the wall from the lawn area, or the 225mm diameter stormwater drainage pipe could be brought overground at this

location and routed through a SUDS unit in the lawn and routed back into the 1.2m diameter stormwater pipe (or newly opened stream) for any excess that does not infiltrate naturally through the base of the SUDS unit.

South Dublin County Council Surface / Storm Water Drainage System (excerpt), showing proposed SUDS/Waterway Rewilding opportunities



Taking streams back above ground and restoring them to a state of ecological health and function is a young but developing area. The following images are from projects in the US and New Zealand, showing examples of successful restoration projects which have brought piped streams back out into the open for greater habitat, biodiversity, climate, hydrological and amenity benefits.

Photograph excerpt from tributary restoration project in Auckland: "Te Auaunga stream restoration project daylights seven piped tributaries", by Damien Holmes

https://worldlandscapearchitect.com/te-auaunga-daylights-seven-piped-tributaries/?v=3a1ed7090bfa

Two images excerpted from USEPA video, *The Restoration of Long Creek. An Urban Stream Gets New Life.* https://www.youtube.com/watch?v=K2x20Q1df48. These shallow streams are close to the ground level on either side, allowing for easy access by frogs and other wildlife, and connectivity during flood events, to hold excess rainfall during storms.

7.0 Conclusion

This report sets out a summary of the site meeting discussions between FHWS and the Knocklyon Network members, outlining potential SUDS measures for the Cherryfield/Dodder site for filtering and attenuating road runoff and creating habitat and amenity; as well as other examples in Knocklyon.

SUDS measures proposed include a combination of swales, bioretention areas / rain gardens and stormwater wetlands or ponds. The information presented here is a proposal of a suite of the most suitable measures, but does not constitute a design per se. Further research or design input may be needed for certain areas to ensure that flooding or erosion are not exacerbated in either case.

Overall there is a lot of potential for water filtration and attenuation at the Cherryfield site. In a modest way, the measures proposed will help to regulate the flow dynamics in the Dodder River. A further benefit of such measures is that they will help to improve water quality en route to the Dodder. Ultimately, by introducing such measures across the catchment of the river, the inputs would be greatly improved and the water quality and biodiversity value of the river could be greatly enhanced.

In the wider area, there are opportunities for waterway rewilding at the St. Colmcille's NS site, and for taking roof water and street runoff into modest SUDS areas. All of the standard SUDS benefits of filtration and attenuation will apply here also. What is arguably a larger benefit here is the potential for opening up the piped stream and creating a wooded stream glade for wildlife interest, water filtration, attenuation and beauty within this urban landscape. Another aspect is that this will provide an invaluable educational element directly beside the schools in the area.

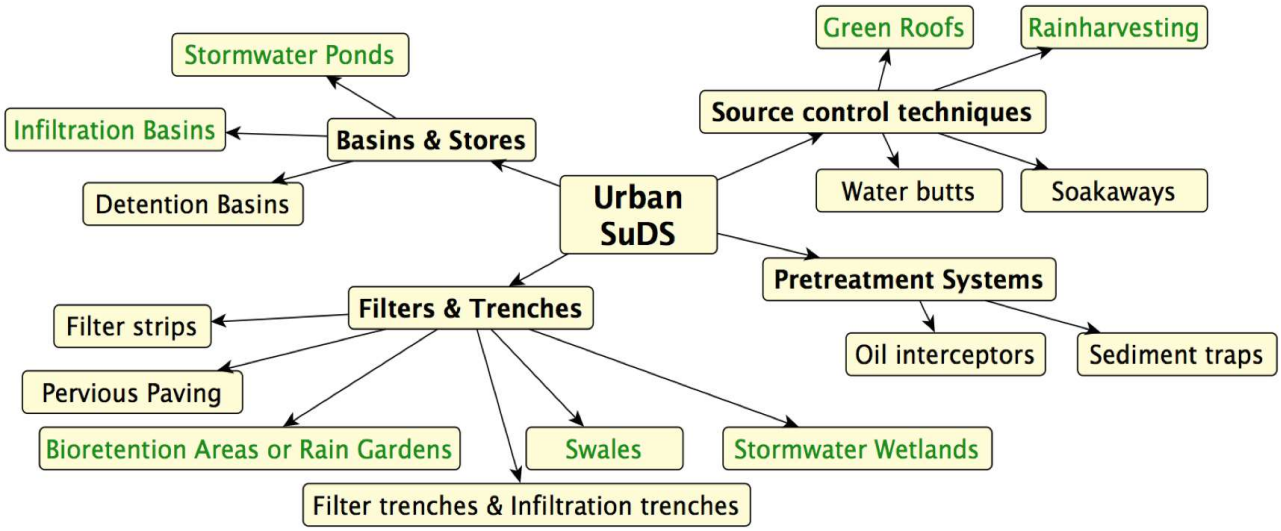
The next steps are to discuss these proposals amongst the local community and decide upon which measures to move forward first. Also to approach South Dublin County Council, the Office of Public Works, National Parks and Wildlife Service, Inland Fisheries Ireland and the Local Authorities Waters Programme (LAWPro) for their input as to the feasibility of the measures outlined.

At a later stage of funding, specific measures outlined in this report can be designed in full and implemented on the ground.

Appendix 1.0 Sustainable Urban Drainage Systems (SUDS) Options

The water flowing from paved surfaces is termed stormwater. Sustained Urban Drainage Systems (SUDS) or Sustainable Drainage Systems (SuDS) are techniques or technologies that are used to protect waterways from silt, nutrients or other contaminants in stormwater. SUDS were developed as a design solution in an urban context to help prevent flooding downstream of new developments or existing urban areas. SUDS are designed specifically to offer hydraulic buffering for flood control, and can also offer water filtration as part of their overall design, depending on the system selected.

Overview of urban SUDS options. Green denotes planted or more ecofriendly options



Following are some of the different categories of SuDS units that can be used for urban runoff:

- Source control techniques include **green roofs**, **soakaways**, **water butts** and **rainwater harvesting systems**. These minimise the volume of water contributed to the wider catchment during a storm event, making storage and treatment more straightforward and effective.
- Pre-treatment systems such as **oil interceptors** and **sediment traps** are typically concrete or plastic tanks which are useful (and/or necessary) where hydrocarbons are stored or likely to be part of stormwater runoff.
- **Filter strips** are wide grassed or thickly planted buffer zones adjacent to impervious surfaces for treatment of runoff water. These are typically used alongside new motorways, but perimeter planting adjacent to car parks can be an effective urban application.
- **Filter trenches** and **infiltration trenches** are gravel filled trenches which treat runoff water from road edges or paved areas.
- **Swales** are wide grassed channels which (typically) permit infiltration as well as transporting runoff water and/or providing storage. These are useful on sites where the topography supports an easy introduction of open drainage rather than covering in pipework.
- **Bioretention areas** are shallow planted areas that temporarily store stormwater runoff and allow it to percolate into the ground. Sometimes called

Rain Gardens, these are typically engineered areas that are filled with soil, gravel or other medium and planted with plant species that can tolerate cycles of flooding and drying. They are used most often in urban landscapes for receiving road runoff as a landscaped feature within a street or car park. They are also useful for receiving roof runoff from individual buildings in the form of a raised planter.

- **Detention basins** are designed for water quality improvement as well as storage of runoff in storm events. They are typically dry basins, but built to facilitate flooding to a considerable depth as needed for storage purposes, then releasing water to the receiving environment or the next stage of the SUDS treatment train. They are often plastic lined and not necessarily as effective at pollution removal as stormwater wetlands for example, so while they provide flood water storage, they are not necessarily the best option where uptake of residual oil/petrol or silt inputs are likely.
- **Infiltration basins** function in a similar manner to detention basins, but are designed specifically to facilitate infiltration of all flows into the ground. These can be very cost effective to build, and can often simply rely on contouring of existing ground within green spaces down-gradient of runoff areas.
- **Pervious paving** allows water to flow into a gravel substrate beneath the paved surface where it is stored for percolation, reuse or for filtration through the substrate to the receiving water or next stage of the SUDS.
- **Geocellular systems** are preformed plastic media which can be used to store runoff water below ground beneath paved areas. They are expensive to install, particularly in existing sites and do not offer a filtration function.
- **Sand filters** are typically used from industrial yards or urban runoff areas where elevated pollution loads are anticipated, or where receiving water sensitivity is high. They require more regular maintenance than some other solutions such as ponds, stormwater wetlands or infiltration basins.
- **Ponds** are a popular SUDS component for both motorway runoff and urban runoff. They are designed to maintain a sufficient depth of water, as well as providing runoff water storage and filtration. They can double as a habitat for wetland wildlife.
- **Stormwater wetlands** are relatively shallow wetland areas that are designed to both store and filter the water volume generated during a storm event. They can be low cost to build and maintain, and provide valuable wildlife habitat.

Regardless of the application any SUDS unit needs to be carefully designed and constructed or installed in order to fulfil the required objectives, in this case amelioration of an existing runoff issue in terms of both volumes and quality. The CIRIA SUDS Manual[1] is a useful reference for SUDS design. Note that many of the low-tech, low-cost solutions can often involve lower maintenance in the long term, as well as being more affordable at the start. Where green areas are present, contouring of the ground can provide an effective infiltration basin or filter wetland, depending on the infiltration rate in the indigenous soils on site.

1 Woods-Ballard B, Kellagher R, Martin P, Jeffries C, Bray R, Shaffer P (2007) The SUDS Manual. CIRIA, London

Appendix 2.0 Background and Contact Details

FH Wetland Systems
Féidhlim is an environmental consultant, writer and educator living in Lahinch, Co. Clare. His company, FH Wetland Systems (established in 1996), offers guidance and consultancy on waterway repair and rewilding, eco-friendly wastewater treatment training and education, and holistic landuse management for catchment protection and regeneration.

His books include *Septic Tank Options and Alternatives, Permaculture Guide to Reed Beds* and *Towards Zero Waste*. On his teaching courses and workshops he brings in his knowledge about the solutions for environmental change and a passion for building a world we can be happy to create together.

For additional details on FH Wetland Systems or to sign up for workshops or courses visit www.wetlandsystems.ie

LAWPro
This project has been funded under a grant from the Local Authorities Waters Programme (LAWPro) under the Community Water Development Fund. The local LAWPro Communities Officer for the area is Éanna Gallagher, who works in the Midlands and East LAWPro region, specifically in the Fingal, Dublin City Council and South Dublin County Council. Éanna has been closely involved in this project since the initial discussion phases within the local community and has been instrumental in helping with both funding and facilitation as the project has proceeded in these initial stages.

For additional information on LAWPro visit https://lawaters.ie/