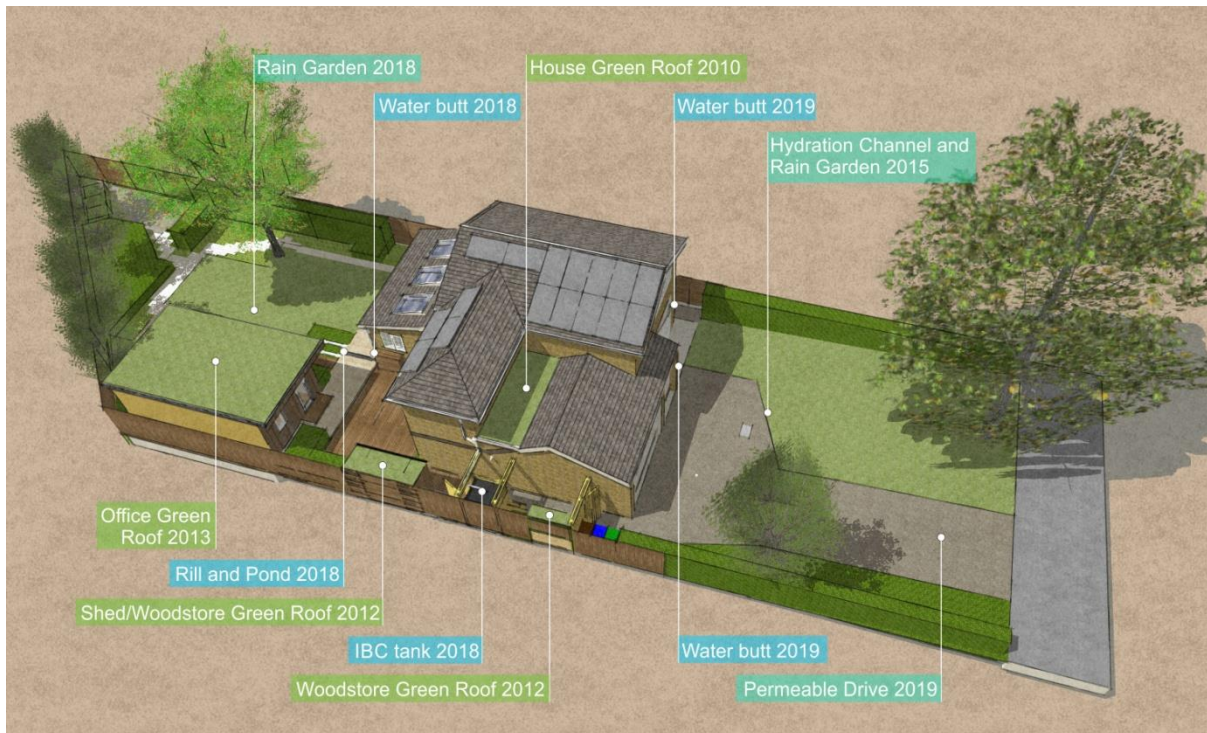


## 2B Landscape Consultancy: House and Garden SuDS Retrofit



### SuDS used

- *Four Green roofs: garage, wood store, shed and office*
- *Water harvesting: four water butts including 1000L IBC tank*
- *Permeable drive (KBI Flexistone)*
- *Hydration channel / Rain garden to front garden*
- *Rill and Pond act as conveyance from rear of house*
- *Attenuation basin / rain garden to rear*

### Benefits

- *All roof areas connected to Water harvesting*
- *Overflow from water harvesting connects to rain gardens or hydration channel*

- *All downpipes disconnected from local sewer*
- *No connections to local land-drain or sewer except in exceedance event*
- *Storm Water falling on the plot is retained and infiltrated in situ*
- *All paved areas are permeable or shed into soft landscape areas*
- *Water infiltration distributed to front and rear, at distance from property, unlike previous soak-aways.*
- *Hydration channel manages root impact of large tree to front and prevents subsidence*
- *SuDS gives additional function to garden which enhances its aesthetic and biodiversity*

## 1. Location

12 Everthorpe Lane, North Cave, Brough, East Yorkshire, HU15 2LF

## 2. Description

This is a domestic SuDS retrofit to the house and garden office of Bill and Elizabeth Blackledge, directors of 2B Landscape Consultancy. Over the last 10 years, every opportunity has been taken to include water-sensitive design in the development of the plot, for example when dealing with a failing flat garage roof, when designing a garden office, and when adding an extension, to design in retrofit SuDS features. These include: green roofs, water harvesting, rain gardens, permeable paving and a hydration channel.

As landscape architects and SuDS advocates, it is important for us to 'put our money where our mouth is', both to provide a reference for other householders and to learn directly from the installation and use of these SuDS features.

## 3. Main SuDS components used

**Four Green roofs:** the flat garage roof was replaced with a green roof in 2010 (8.5m<sup>2</sup>); the wood store (1.1m<sup>2</sup>) and shed (3.8m<sup>2</sup>) were added in 2012; and the office was designed and built with a green roof (36m<sup>2</sup>) in 2013-4.

**Water harvesting (2018-19):** four water butts - 350L to rear, 1000L IBC tank, 400L to side, 200L to front. All house roof downspouts feature GutterMate filter/diverters to filter and direct water into the butts and tank. Excess water is directed to either the Hydration Channel at the front or the pond/rain garden at the rear.

**Rear rain garden/basin (2018):** The IBC tank overflow is piped to the rear garden due to distance and gradient. The rear water butt flows, via a grated rill in the rear patio, into a pond which is made from a recycled bathtub. The pond overflows into the rear rain garden, which is a shallow basin created in the rear lawn. When this basin overtops, it flows through a dry stream bed feature to the rear of the garden, where there is a ditch forming part of the local surface water drainage system.

**Hydration channel / Rain garden (2015):** following subsidence to the property, the house insurers proposed to remove a large ash tree from the front garden. After an impasse, they were persuaded

to find an alternative, which they did, in the form of the Hydration Channel. Essentially, this is a buried crate system which infiltrates water into the path of the tree roots. This does not block the roots, but provides an ideal water source for them, which relieves their need to seek water below the house foundations. The crated channel was set deeper than normal in order to provide a sunken rain garden above it, to take water off the (then) impermeable concrete drive. The channel is fed from the front and side house downspouts, less the small amount diverted to the water butts.

**Permeable drive (2019):** this was installed as the last major construction element following the subsidence repairs and the office and rear extension construction. The former concrete drive (45 years old and well past its sell-by date) was removed for recycling. Type 3 stone sub-base was selected for its void content and permeability, and blinded with coarse sand. The KBI Flexistone was laid to the sides of the house and the front, with simple timber edging, over the course of two days. The drive overlays part of the Hydration channel, allowing a direct path for water into the channel.

## 4. How it works

Roof water is directed into downpipes, intercepted by diverters to the water butts or running directly into the IBC tank. All water not harvested is directed to the Hydration Channel at the front or the rain garden at the rear.

The garage and office green roofs build-up comprises butyl liner and Terram protective membrane overlaid with recycled plastic permeable 'planks' (previously known as 'Aquadyne', now 'EnviroFlow') which provide support, protection and a drainage layer below the planting medium. In the case of the garage roof, and the shed and wood store green roofs, the planting medium was GreenTech GT-4 expanded aggregate, placed above a waterproofing liner. The garage green roof 'slows the flow' of part of the roof water destined for the IBC tank.

For the office, a mix of garden soil and subsoil was retained and re-used from the office foundation excavation. This has led to some intriguing plant colonisation, from plants we knew we had, to many species that we had no idea were present in the soil seed bank. See photo sequence 2014-2018.

The office green roof results in a notable slowing of flow during and after a storm. The residual flow is directed to permeable 'Enviroflow', which links to the rear ditch, although the water is probably mostly absorbed by the surrounding soil.

### Volumes

The volume of the rear basin was calculated to contain a 1:100 year 6-hour storm event + 30% climate change allowance, from the roofs and paving which direct water to it.

No calculation has been made for the front hydration channel and the drive. The hydration channel provides a capacity of around 1m<sup>3</sup> within the crate, and more through sand coring below.

The drive, with an assumed 20-30% void ratio, has an estimated capacity of around 5-7m<sup>3</sup>.

### Water quality

Apart from the Guttermate filters, the only other water quality treatment is incidental to the design. All water in the system is clean rainwater, with the possible exception of a small amount of hydrocarbons on the drive. The drive filters water through the wearing course and sub-base.

Rainwater entering the rear garden is filtered through 'Enviroflow', through which the bath overflows, and through the grass of the rear lawn but, again, has little or no pollution load.

### **Biodiversity**

Many of the SuDS elements are 'hard', although they are placed in a garden which is planted for biodiversity. The small pond is the highlight in biodiversity terms – see below. The rear lawn may one day become a meadow, but not while it serves a function for an aged dog.

### **Amenity**

It's a garden, enjoyed from both house and office. The SuDS functions inform the design and enhance the amenity interest.

## **5. Specific project details**

The house downspouts were previously connected to below-ground soakaways, which were within a few metres of the house, and which likely silted up within a decade of installation. This resulted in roof water being discharged close to the house, potentially worsening the subsidence issue.

Rainwater now infiltrates around 5-10m from the house, across the extent of the hydration channel or the area of the rear attenuation basin, thus preventing point discharge of water near the house foundations.

The formerly impermeable drive drained to a gully which fed directly into a combined sewer. This connection has now been removed, with the drive attenuating and infiltrating water. In event of storm water falling on the drive and exceeding its capacity, it will pass through 'Enviroflow' filtering into the sewer.

What has become clear is that there is no template for SuDS retrofit. There may be a 'kit of parts' but these have to be adapted and combined to suit the peculiarities of any individual plot, such as character, space, layout, topography and existing drainage features.

## **6. Maintenance & operation**

Maintenance is limited to normal garden maintenance, which underlines the benefit of landscape-based SuDS – the level of maintenance specific to the SuDS features is negligible. It is limited to:

- occasional weeding of the roofs to remove self-seeding thugs;
- checking and emptying of the Guttermate filters/diverters after heavy rain. These trap what would otherwise be a significant amount of organic material (moss, lichen and leaves) from the roofs, being deposited into the water butts and tank. These are all accessed at ground level, apart from the filter on top of the IBC tank, which needs a small ladder, but is easy to access.

## **7. Monitoring and evaluation**

The rear garden rill/pond/rain garden is adjacent the garden office, and has been monitored every time there has been a daytime storm. It performs faultlessly, and no water was seen in the rain garden basin until the serious rainfall and flooding event of November 2019, at which time there were a few inches of water and the overflow performed as expected.

The permeable drive, hydration channel and rain garden at the front have also performed as expected throughout all storms, up to November 2019. When surface water entered the property from the adjacent fields and the lane, it overwhelmed the drive's capacity to permeate and infiltrate water, which lead to slight flooding of the garage. Water which ran to the low point at the rear of property flooded the deck and sheds.

The conclusion is that the system performs well for all storm water falling on the property, but is not designed to cope with ingress of water from outside the property – see lessons learned.

## 8. Benefits and achievements

The SuDS features of the property effectively harvest, attenuate or infiltrate storm water and prevent it leaving the site, except in an exceedance event. If it does leave the site, to a ditch at the rear, or a combined sewer at the front of the house, the outflow volume and rate has been significantly reduced.

The SuDS features add definition and purpose to the garden landscape, which again underlines a broad benefit of landscape-based SuDS: they provide a visibly functional purpose for our created landscapes, as well as the very important aesthetic one.

The pond has become a microcosm of biodiversity, with interesting water insects and, this year, tadpoles. The garden birds enjoy a drink and a bath. A range of native marginals and aquatics have been introduced, bringing new textures, colours and smells to the garden.

The combination of water harvesting and storm water attenuation / infiltration is important for any building. Whilst a domestic grey water system would have been better still, it was beyond the scope of this domestic retrofit. The harvested water is used principally for garden watering and some cleaning.

## 9. Lessons learnt

### Green Roofs

In the current (Spring 2020) drought, the green roofs are not green at all, but brown. Whilst this is not a functional problem, it does remove the flowering plants for pollinators and green cover for other species. The intention is to fit a solar powered irrigation system to draw water from the largest tank (IBC, 1m<sup>3</sup>) – and possibly add another tank .

Green roofs can be left alone, but they will tend to revert to a dominant set of tolerant plants. In the case of the office roof, the main success story has been marjoram! The green roofs are tended and can be occasionally replanted to maintain variety and interest.

### **The Importance of Guttermate Filters**

As noted elsewhere, the downpipe filters catch a significant amount of organic material and dust, which would otherwise end up the water butts. They are simple, effective and easy to empty. They should be standard feature of all water butts and rainwater harvesting.

### **Waterbutts as attenuation?**

There is an argument that a sufficient number of water butts, emptied before a storm, will collectively provide a significant attenuation volume. This is potentially true, but would need to have a level of automation associated with it to be successful. If the water butt has been emptied on the basis of a threatening weather report, and the storm ends in the middle of the night, by the morning it will be empty again. If this is followed by a drought (e.g. Spring 2020!) the water butt will not be able to fulfil its primary function of catching and storing water for re-use. Automation of opening/closing the water butts might allow both function to take place.

### **The cost of water storage**

Water butts are relatively expensive for the volume of storage they provide. Second-hand IBC tanks are relatively cheap for the high volume of storage they provide, but:

- They take up more space than a typical water butt;
- it is important to ensure that they are internally cleaned and suitable for storing water;
- it may be necessary to visually screen an IBC tank – the ‘I’ stands for ‘Industrial’;
- black tanks are less likely to grow algae than transparent ones, but are harder to find.

### **You can’t harvest too much water**

When there are months of drought, even 2000L of water doesn’t go very far.

### **SuDS vs NFM**

The investment in retrofit SuDS (see below) was effectively for the benefit of other properties downstream. It did not make the property notably more resilient in the event of surface water ingress to the plot, although it may have helped absorb a proportion of the inbound water.

The lesson of November 2019 flooding was that a much wider perspective and action is required than just retrofit to one property, no matter how worthwhile that work. Consequently, the owners are setting up a catchment-based partnership with flood risk agencies and local parish councils, and proposing Natural Flood Management to address the bigger picture across the region.

### **Permeable paving is harder to clean after a flood**

The floodwater carried a silt load from surrounding fields – but was otherwise thankfully ‘clean’. The permeable drive acted as sump for some of the flood water which left its silt on top. Determined power-washing and brushing was required to remove silt from the wearing course. Impermeable paving would have been easier to wash off. However this one small price is worth paying, for the overall improvement in functionality.



## 10. Interaction with local authority

As this is a domestic context, there has been limited interaction with the local authority, although the rear extension and office both required planning approval and building control. The roof drainage to rain garden infiltration was approved by building control, albeit that it was somewhat outside their normal experience.

## 11. Project details

**Construction completed:** At intervals associated with various repair or build elements, from 2010-2019.

**Costs:**

Hydration channel: covered by house insurance

Garage: green roof extra-over £1200; Office: green roof extra-over £2000.

Water-related earthworks/hardworks £1000;

Water harvesting: 350L butt £400; 400L butt £193; 4x Gutter Mate £110; IBC tank £67;

Pergola+Screening £1000;

Permeable Flexistone drive £5800; Drive Excavation and base £5800;

Indicative total cost (over 10 years): £17,570

**Extent:** Total plot area 670m<sup>2</sup>. Areas draining to SuDS, or forming part of SuDS, are approx 480m<sup>2</sup> or 70%. Remaining areas are mostly planted or lawn.

## 12. Project team

Funders	<ul style="list-style-type: none"> <li>Bill and Elizabeth Blackledge / 2B Landscape Consultancy</li> </ul>	 <p>assessment - design - visualisation - realisation</p>
Clients	<ul style="list-style-type: none"> <li>Bill and Elizabeth Blackledge / 2B Landscape Consultancy</li> </ul>	
Designers	<ul style="list-style-type: none"> <li>2B Landscape Consultancy</li> </ul>	
Contractors	<ul style="list-style-type: none"> <li>Landmark Yorkshire Ltd: earthworks, hardworks</li> <li>Chris Woodcock Joiner: pergola for downpipe and screen fencing to IBC tank</li> <li>East Yorkshire Roofing: green roof to garage</li> <li>KBI: permeable (Flexistone) drive</li> </ul>	  
Other		

