

Flood Study Report

King George Park, Wokingham

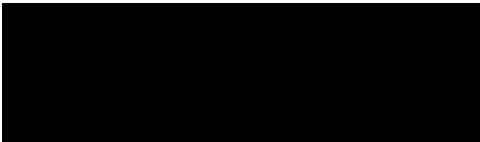
Client: Wokingham Borough
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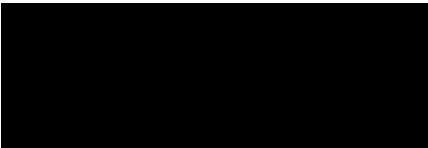
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1 Executive Summary

Site Location	King George V Playing Field, Wokingham, RG40 2EE
Proposed Development	Sustainable Drainage (SuDS Design) to be implemented to reduce overland runoff from the playing fields onto the properties of Goodchild Road.
Vulnerability Classification	Park is classed as “Water-compatible” so very low vulnerability, Residential properties are classed as “More vulnerable”.
Tidal Flooding	Low and acceptable risk
Fluvial Flooding	Low and acceptable risk
Pluvial Flooding	Medium to High Risk, the proposed development seeks to reduce this.
Groundwater Flooding	Low and acceptable risk
Sewer Flooding	Low and acceptable risk
Reservoirs, Canals & Artificial Sources	Low and acceptable risk
Flooding from the development	N/A
Ground Conditions	NSRI Soils mapping details “Freely draining slightly acid loamy soils”. The site is underlain by the London Clay Formation, nearby borehole records indicate freely draining superficial deposits may only be present to a depth of 2m. Trial pits and infiltration tests are recommended as part of the SuDS design.
Surface Water Drainage Proposals	Based on topographical maps and the pluvial flood maps it would appear that surface water flooding comes from the highway (see Section 2). The SW drainage proposals are as follows: to provide interception infrastructure (gullies/channel drain) at the entrance to the park, provide raingardens alongside the main entry pathway of the park, to redirect flows to a wider storage area within the park for attenuation and infiltration prior to outfalling downstream (back into the sewer or highway network at a reduced rate/volume) in Seaford Road.

2 Introduction

The King George Playing Field in Wokingham serves as a crucial recreational space for the local community, offering a variety of sports and leisure facilities. Given the increasing frequency and severity of flood events attributed to climate change, it is imperative to assess and manage the flood risks associated with this valuable community asset. Wokingham Borough Council (WBC) is looking to mitigate against the current and potential future flood risk to the homes and areas adjacent to the park. WBC has approached Polypipe to see what they are able to offer. Polypipe have referred the project to The Environmental Protection Group (EPG) their retained consultant.

This report aims to provide a review of the flood risks affecting the King George Playing Field. Through this study, we aspire to furnish Wokingham Borough Council and other stakeholders with actionable insights and recommendations. These will aid in the development of robust flood management plans, ensuring that the King George Playing Field remains a safe and enjoyable environment for all.

2.1 The Site and Development

2.1.1 Existing Site

King George Playing Field (shown in figure 1), located in Wokingham, is a prominent green space that serves the local community. It is characterised by its extensive grassed areas, which are maintained to accommodate a variety of sports and recreational activities. The field includes several football pitches, a cricket ground, and areas designated for informal games and picnicking.



Figure 1. Image of King George Playing Field

The playing field is also equipped with modern amenities such as a playground, seating areas, and pathways that facilitate easy access and mobility for visitors of all ages. Mature trees and hedgerows surrounding the perimeter of the field provide a pleasant, shaded environment, enhancing the aesthetic appeal of the area while supporting local biodiversity. A new series of pathways have just been installed within the park.

The playing field is relatively flat but does have a gentle fall from 66mAOD in the Southwest corner to 63mAOD in the northeast corner.

EPG will be focusing on interventions along the northern boundary adjacent to Goodchild Road.

2.1.2 Infrastructure

The existing park is greenfield, and it is assumed that sewers and highway drainage is located within Goodchild Road flowing north-east. Sewer records will be required for further assessment.

Figure 2 shows that there is no impediment to ingress into the park (or the driveway of Number 25) from Goodchild Road due to the dropped kerb that is not served by gullies or channel drainage, however, as we see in Section 2, exceedance flows are also likely to arise from Easthampstead Road and the upstream catchment situated west of the site.



Figure 2: Streetview screenshot of entrance to park. Body text

3 Flood Risk Assessment

3.1 Flood Risk Aims

The key aims of this flood risk assessment are to:

- Assess the flood risk and demonstrate the feasibility of designing a mitigating feature.
- Assess the potential impact of the development on flood risk elsewhere and demonstrate that this can be mitigated by using sustainable drainage systems.
- Satisfy the requirements of the National Planning Policy Framework.

This assessment has been carried out in accordance with the National Planning Policy Framework (NPPF). The aim of the NPPF is to ensure that flood risk is considered at all stages in the planning process and to direct development run-off away from the areas at highest risk. Where new development is necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible to reduce flood risk overall.

The NPPF require that all sources of flooding are considered including: flood risk from rivers (fluvial), flood risk from the sea or tidally influenced rivers, surface water flood risk (pluvial), groundwater flood risk and flood risk from sewers, drains or artificial sources. Each source will be assessed in turn.

Further regional and local planning policies which apply to this area include:

- Wokingham Borough Council Local Flood Risk Management Strategy, 2015, WSP

These documents have been referred to and their guidance incorporated into the development proposals where appropriate.

The site is within Flood Zone 1 however, this FRA has been requested due to the medium to high risk of pluvial flooding.

3.2 Flood Risk Sources

3.2.1 Flood risk from River (Fluvial)

Watercourses flood when the amount of water in them exceeds the flow capacity of the river channel. Flooding can either develop gradually or rapidly, depending on the characteristics of the catchment. Land use, topography and the development can have a strong influence on flooding from rivers.

The site is located within Flood Zone 1 which is defined as land that has less than 1 in 1000 (<0.1%) annual probability of fluvial flooding and is categorised as 'low risk'.

Residential dwellings are classed as "more vulnerable", and in accordance with the NPPF, this is appropriate for FZ1. The sequential test is passed, and the exception test is not required.

Overall, Flood Risk from Fluvial Sources is **low** and **acceptable**.

3.2.2 Flood Risk from the Sea (Tidal)

Flooding to low-lying land from the sea and tidal estuaries is caused by storm surges and high tides. Where tidal defences exist, they can be overtopped or breached during a severe storm, which may be more likely with climate change.

The site is not near the sea or a tidally influenced river therefore Flood Risk from Tidal sources is **low** and **acceptable**.

3.2.3 Surface Water Flood Risk (Pluvial)

Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas, this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this.

Overland flow paths should be considered in spatial planning for urban developments. Flooding can be exacerbated if development increases the percentage of impervious area.

Figure 3 shows the pluvial flood risk map for the site and surrounding area. There is **medium to high pluvial flood risk** located in the low spot caused by the topography. It is assumed that highway flooding ingresses to this point and then shortcuts the return back to the highway and downstream via the residential dwellings of Orchard Close.

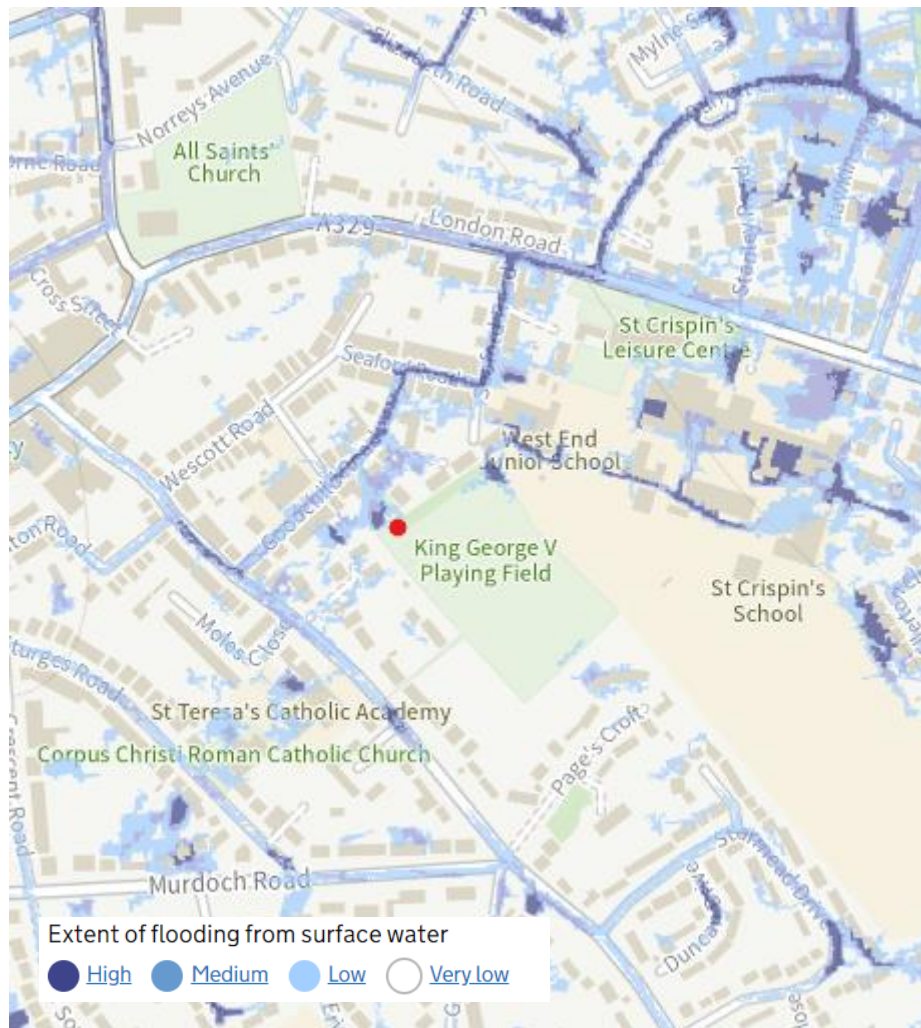


Figure 3: Extract of Surface Water Flood Map

Historic mapping from the 1960's indicates the presence of a land drain to the rear of dwellings 15-23 which boundaries the park near the play area, images from previous decades hold no indication of a watercourse or land drainage ditch.

Based on Scalgo overland flow data (Figures 4 & 5), it appears that surface water from Easthampstead Road (and upstream) shortcuts along the backs of the properties before arriving at the site location, this ditch therefore could simply be a measure to allow for infiltration of this highway exceedance.

The Wokingham Borough Council LFRMS 2015 indicates that *highway drainage systems are only design for a 1 in 10 year storm and that storms over and above this design event are likely to exceed the capacity of the existing drainage system, resulting in overland flows and localised flooding.*

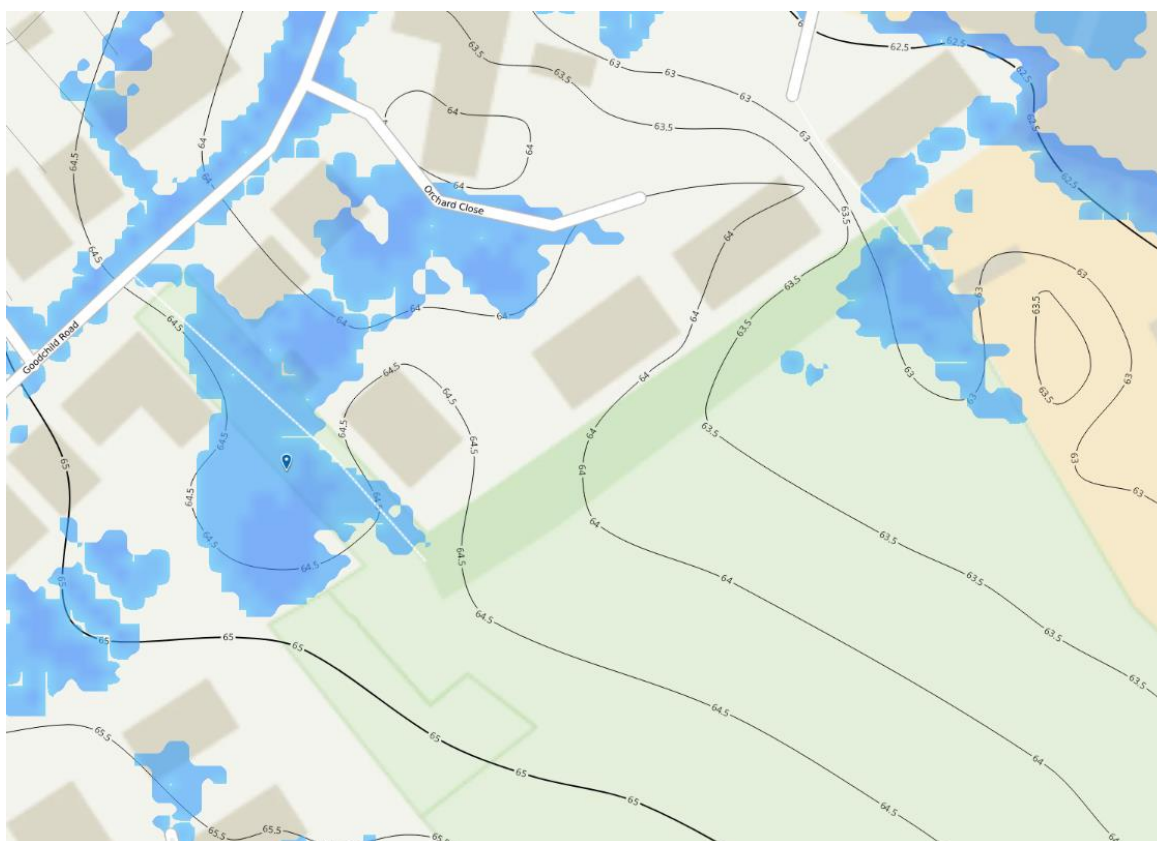


Figure 4: Extract of Scalgo with Surface Water Flood Map

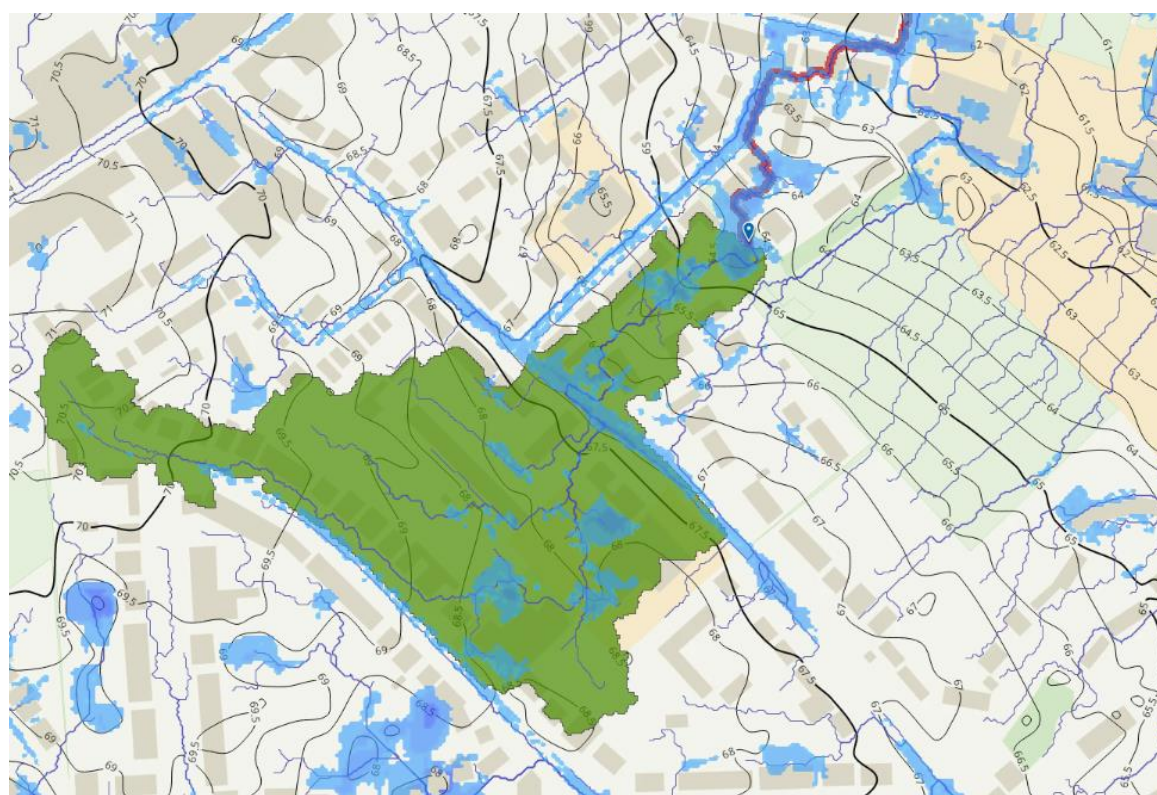


Figure 5: Extract of Scalgo with Surface Water Flood Map and Flow Paths showing the upstream catchment

3.2.4 Groundwater Flood Risk

NSRI Soils mapping details “Freely draining slightly acid loamy soils”. The site is underlain by the London Clay Formation and nearby borehole records indicate freely draining superficial deposits may only be present to a depth of 2m and water seepage is noted at this point.

Unfortunately, although these are the nearest records, they are in a separate geology (Bedrock of the Bagshot Formation) and so Trial pits and **infiltration tests are recommended** as part of the SuDS design.

Groundwater flood risk is therefore considered to be **low**. Rainwater that infiltrates the upper layers may be prevented from infiltrating the London Clay at the same rate, which could cause some surcharging or relocation of infiltrated volumes – while this could be seen as groundwater flood risk, the source is from pluvial or highway runoff so this will be addressed in those sections.

3.2.5 Flood Risk from Sewers

In urban areas, rainwater is frequently drained into sewers. Flooding can occur when sewers are overwhelmed by heavy rainfall or become blocked. Sewer flooding continues until the water drains away.

Sewer records will be assessed when they are made available. Based on the available information, flood risk from sewers is **low** and **acceptable**.

Flood Risk from highway drainage has been discussed within the pluvial flood risk section.

3.2.6 Flood Risk from Artificial Sources

Non-natural or artificial sources of flooding can include reservoirs, canals, and lakes. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure.

The site is not within a reservoir flood zone, therefore flood risk from artificial sources is **low** and **acceptable**.

3.3 Flood Impact Assessment

The incorporation of SuDS features such as bioswales, basins and linear drains will provide **betterment** to flood risk by allowing attenuation and infiltration of flood volumes and will redirect exceedance flows to re-enter the highway drainage network downstream at a reduced rate.

3.4 Climate Change

The NPPF makes it a planning requirement to account for climate change in the proposed design. The site lies within the “Loddon and tributaries Management Catchment” and so an additional 40% allowance for peak rainfall will be assessed.

3.5 Residual Risk & Exceedance

Flood Risk can be mitigated but never removed entirely. There will always be residual risk, e.g., from storm events that cannot be practicably accounted for, that far exceed the design event.

Exceedance flows will be directed east as per the existing topography, however, rather than shortcutting through the highly vulnerable dwellings of Orchard Close, they will be redirected into the less vulnerable highway of Seaford Road.

3.6 Access & Egress

The site is within Flood Zone 1 and therefore safe access and egress is provided.

4 King George Park Improvements

As can be seen within chapter 2, there is a risk of flooding presented by surface water. The EA maps show that the northern entrance to the park from Goodchild Road suffers from a high risk of flooding, this is shown within Figure 6.

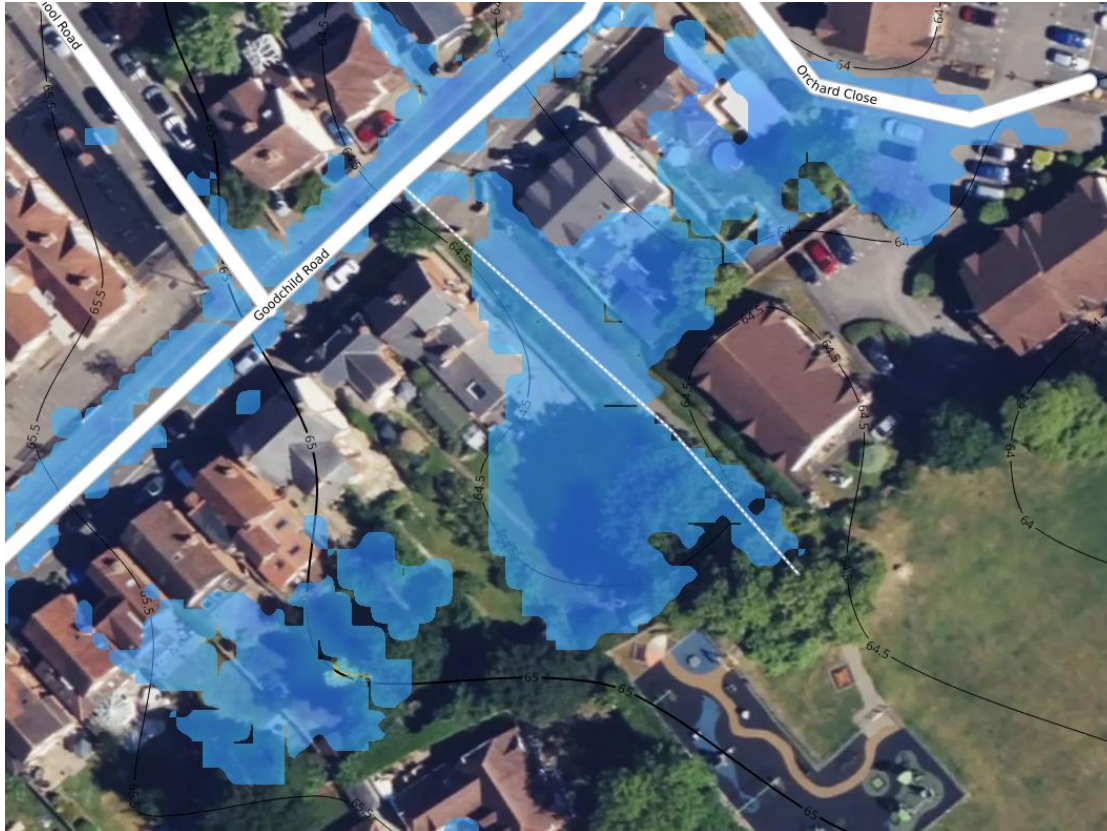


Figure 6: flooding at entrance to the park.

Within this document EPG will use a program called SCALGO to identify the volumes, depths and locations of potential flooding.

SCALGO is a hydrological analysis software used for flood risk management. SCALGO is designed to process large-scale geographical data, enabling detailed and accurate modelling of water flow and flood risks. It can simulate how water moves across landscapes, taking into account various factors such as terrain, land use, and climatic conditions. By providing precise and actionable insights, SCALGO is being used to make informed decisions to mitigate flood risks on the King George Playing Field and enhance its resilience.

4.1 Existing

Figure 7 shows a SCALGO image focusing on the extent of flooding at the northern entrance to the park.



Figure 7. Showing the SCALGO identified flooding at the northern entrance to the park

Analysis shows that there is potentially 133.6cu.m of water that can pond/flood in this location during the 30 year storm event with 201cu.m of water here during the 100 year storm event. The maximum depth of which has been identified as 276mm.

4.2 Proposed Mitigations.

To mitigate against the risk of flooding EPG will use Sustainable Drainage System (SuDS) principles. In accordance with SuDS Philosophy, surface water runoff should mimic the pre-development greenfield scenario as much as possible. This typically includes both the rate and destination of surface water run-off (although betterment should be pursued where possible, i.e. by prioritising infiltration in accordance with the drainage hierarchy).

4.2.1 Sustainable Drainage Systems (SuDS)

The use of sustainable drainage systems to reduce the impact of the development on the natural water environment has become increasingly common over the past decade, in response to government guidance and the proactive approach of regulatory agencies such as the Environment Agency (EA) and the National Planning Policy Framework (NPPF). Limited discharge consents for

surface water outfalls are now routinely applied to development sites across the UK and the rate of water leaving development sites is controlled using storage techniques such as ponds, tanks, and pervious pavements.

Runoff from developments contains a cocktail of pollutants including hydrocarbons, heavy metals, and organic material and these reduce the quality of water entering rivers and streams and harm wildlife. It must be addressed by the development industry and site-specific drainage solutions need to be developed that provide an appropriate combination of SuDS features to effectively remove pollution and adequately control run-off volumes to prevent potential flooding to property and infrastructure both within and beyond each development.

The majority of pollution occurs from relatively frequent rainfall events (less than 1 in 1 year return period) or from the first part of larger events (known as the first flush) and these need to be captured and treated. Thus, the performance of the SuDS needs to be assessed for a wide range of storm events. The SuDS system should also seek to provide biodiversity and amenity benefits and the use of features such as ponds and swales in conjunction with specific plant species can often provide habitats for wildlife species that have been identified within local conservation action plans. These can often (but not always) be effectively designed into a drainage scheme by utilizing space that is already earmarked for landscaping. However, site levels, local topography, and the nature of the development will dictate how feasible or desirable it is to include such surface SuDS features.

4.2.2 Design Parameters

Accordingly, EPG has reviewed the information provided and considered an approach based on previous experience of similar sites and current SuDS guidance provided in:

- National Planning Policy Framework (NPPF 25)
- Building Regulations (Part H)
- Environment Agency Pollution PPG3
- CIRIA report C753 (2016); The SUDS manual
- CIRIA Report C724 (2013) Creating water sensitive places-scoping the potential for water sensitive urban design in the UK
- BS 8582:2013, Code of practice for surface water management for development sites
- British Water Flows and Loads

The NPPF requires that surface water arising from a developed site should as far as practicable be managed in a sustainable manner to mimic the surface water flows arising from the site prior to re-development. Opportunities to reduce the surface water run-off and the associated flood risk should be identified and climate change should be taken into account. Building Regulations (Part H), NPPF and Environment Agency advice notes require the consideration of sustainable drainage techniques based on a hierarchical approach to the management of surface water, with the emphasis on the use of Source Control techniques and a treatment train as the preferred option.

4.2.3 Proposed

The main proposal for the mitigation of the flooding is to introduce a vegetated raingarden alongside the new pathway that has been installed with a French drain installed along the entrance pathway that connects the park with Goodchild Road.

4.2.4 Raingarden

A vegetated raingarden (as shown in Figure 8) is a landscaped area specifically designed to capture and manage stormwater runoff. Typically planted with a variety of native plants, shrubs, and grasses. The raingarden's substrate and vegetation work together to filter pollutants, reduce runoff volume, and promote groundwater recharge. The raingarden will contain a Permavoid attenuation layer with Passive irrigation. The benefits of a vegetated raingarden are multifaceted: it enhances the aesthetic appeal of the park, provides habitat for wildlife, and supports biodiversity. Moreover, raingardens help to mitigate flooding by slowing down water flow and absorbing excess rainwater, thereby reducing the burden on local drainage systems. They also contribute to improved water quality by naturally filtering out contaminants before they can reach water bodies. In addition to these environmental advantages, raingardens offer educational opportunities for the community, demonstrating sustainable practices and raising awareness about the importance of stormwater management.



Figure 8. Image of Raingarden Credit: Royal Botanic Garden Edinburgh

Various landscaping techniques can be used across the system to maximise the benefits of a raingarden system. The benefits include:

- Creating water storage capacity
- Reducing flow rates from the system
- Delivering source-control treatment of the runoff

- Creating attractive green spaces in dense urban environments
- Creating aesthetically pleasing environments, which positively impact the mental wellbeing of the community and increase the monetary value of nearby property
- Reducing local temperatures through heat absorption and retention
- Returning moisture to the atmosphere through evapotranspiration from the vegetation (also delivering evaporative cooling)
- Potential for enhanced amenity through integration with local development plan
- Creating high quality habitats for native plants and wildlife
- Noise reduction via vegetative buffering
- Air quality improvements for local pedestrians

4.2.5 Permavoid

Raingardens often use aggregate drainage layers to attenuate and convey the runoff they have collected. The gravel can be substituted for Permavoid in areas that need greater volumes of water being managed, as Permavoid has a high void ratio in comparison to gravel.

The Permavoid attenuation system is a specialist system with dedicated components that have all been designed to work holistically as a structural attenuation system in green infrastructure. The Permavoid attenuation element is made up of 85mm and 150mm interlocking geocellular units that can be combined to produce deeper attenuation systems (85mm, 150mm, 235mm, 300mm, 450mm, etc.). The Permavoid incorporates high compressive strength and bending resistance within joints to create a horizontal structural 'raft' that is ideal for shallow attenuation of rainwater. The modules have a very high void ratio (92/95%) to achieve highly efficient water storage capacity. The Permavoid components have been specifically designed to work with a green infrastructure enabling a grey/green hybrid approach which maximises the benefits of green infrastructure while exploiting the high void rates, the quick and more traditional construction methods and timings, and the other individual offerings of the Polypipe range.

Passive irrigation (shown in figure 9) can be introduced to the Permavoid within the raingardens to allow the green roof element to become healthier and have greater access to water. The Permavoid units can contain irrigation cone units and will be wrapped with Permavoid 'W' Wicking Geotextile. Through the use of these Permavoid passive capillary inserts and Permavoid W wicking geotextile, a passive on-demand irrigation system could be provided for landscaped areas proposed on the development. The depth of water in the layer can be controlled such that a pre-determined proportion of the attenuated volume is retained for irrigation. This is easily achieved by either using membrane upstands to create reservoirs of water locally around the vegetation or by adjusting the discharge level at the outlet. The irrigation volume would be topped up by every rainfall event or routinely from mains or similar. In either case, the key benefits are that the irrigation is on-demand of the vegetation, and the irrigation is from collected rainwater, which reduces the amount of rainfall needing to be managed and going to the adjacent sewerage system.

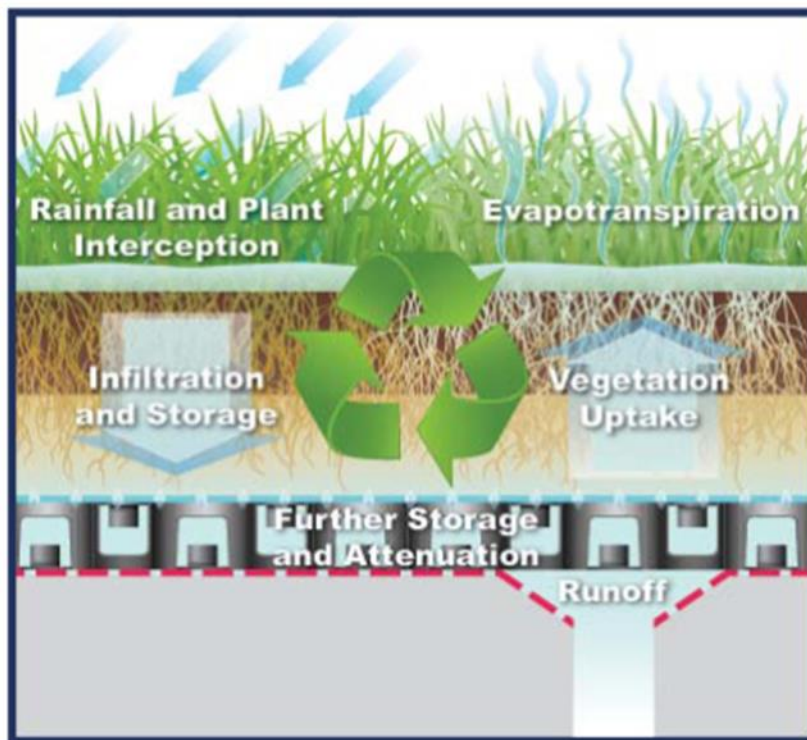


Figure 9: diagram of the passive irrigation system

Using passive irrigation the evaporative losses during the summer months means that the amount of water being discharge is significantly reduced, while ensuring the vegetation is robust and healthy during prolonged periods of dry weather.

4.2.6 Polysync

To enhance the benefits that the Permavoid passive irrigation a smart RWH & Attenuation management system has been proposed, Polysync.

The Polysync system is a real-time Surface Water Optimisation System (SWOS) for the retention, re-use and release of rainwater. To offer a reduction in the amount of water discharging to the sewers and or watercourses while maximising the amount of water made available for re-use and harvesting. The Polysync system is used for the retention, re-use and release of rainwater. The system an intelligent, real-time, surface water control solution that uses highly accurate and secure hydrological and metrological data, state of the art sensors, management systems, actuated valves and flow monitoring technology. It delivers intelligent control of stormwater attenuation tanks, with levels set to optimise reuse.

The outline principle of the system is to hold the water for re-use which essentially changes attenuation tanks into rainwater harvesting tanks, by collecting the rainwater and not allowing discharge and encourages greater volumes of water to be re-used. Ahead of any storm events the system will review what capacity it has and what is required, making a decision to discharge AHEAD of the storm, so discharges are not simultaneous with wider site discharge. This means that the system discharges when the sewer is empty not full, reducing the risk of CSO spills.

The Polysync has been installed and monitored within a site in Manchester, and in winter (Nov, Dec, Jan, and Feb), there was an average of 44.5% reduction in the volumes of water discharged to the receiving sewer. In the summer (May, Jun, July, and August), the average reduction in rainfall discharged to sewer is 99% (i.e. only 1% of the rainfall falling on the roof ends up being discharged to the sewer). The overall average reduction throughout the year is 57%. The combination of the Polysync system and passive irrigation system lead to these figures.

The Polysync system can be integrated on a wider site principle with each roof and tank working both as an individual intelligent attenuation/RWH tank but communicating between each other to ensure that water is balanced throughout the development. The benefits of this include greater potential for passive irrigation and rainwater re-use, which reduces potable water demand and encourages vegetation growth, urban cooling and reduces the urban heat island impact. Figure 10 shows an outline schematic of how the Polysync system works

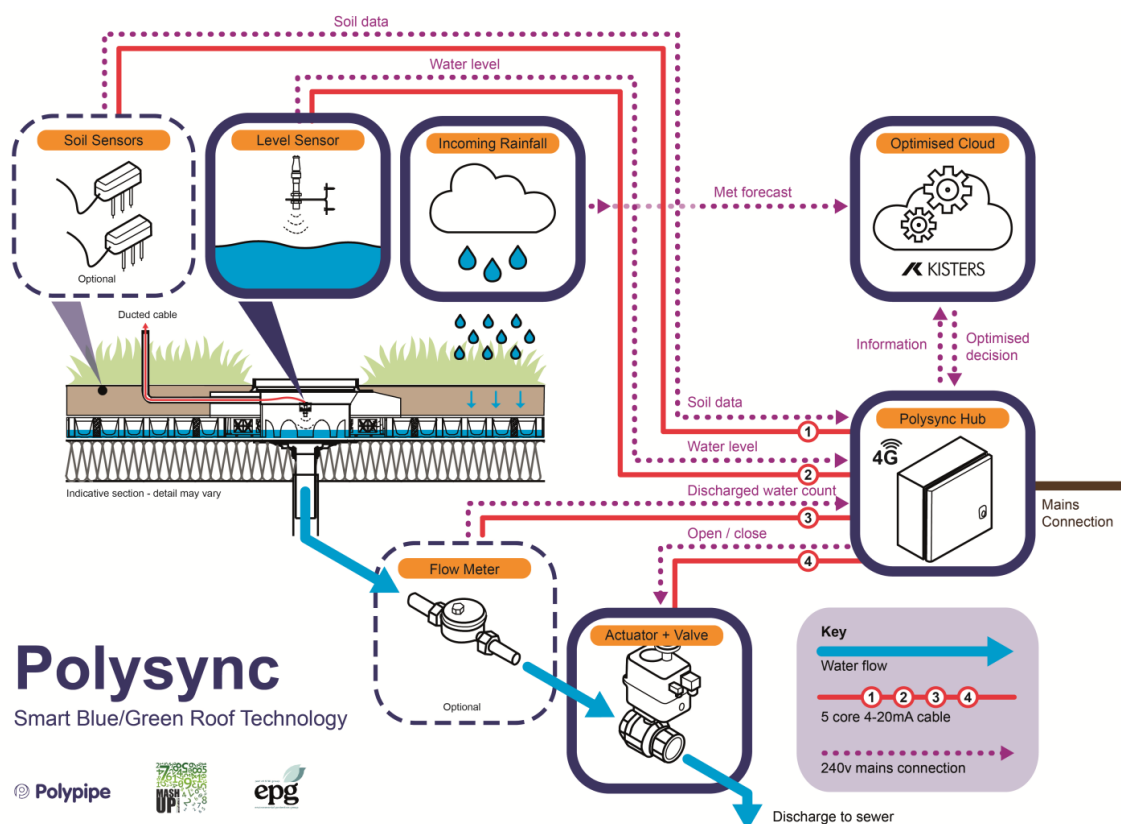


Figure 10: Polysync Schematic

4.2.7 Design

Figure 11 shows an outline design for the park.

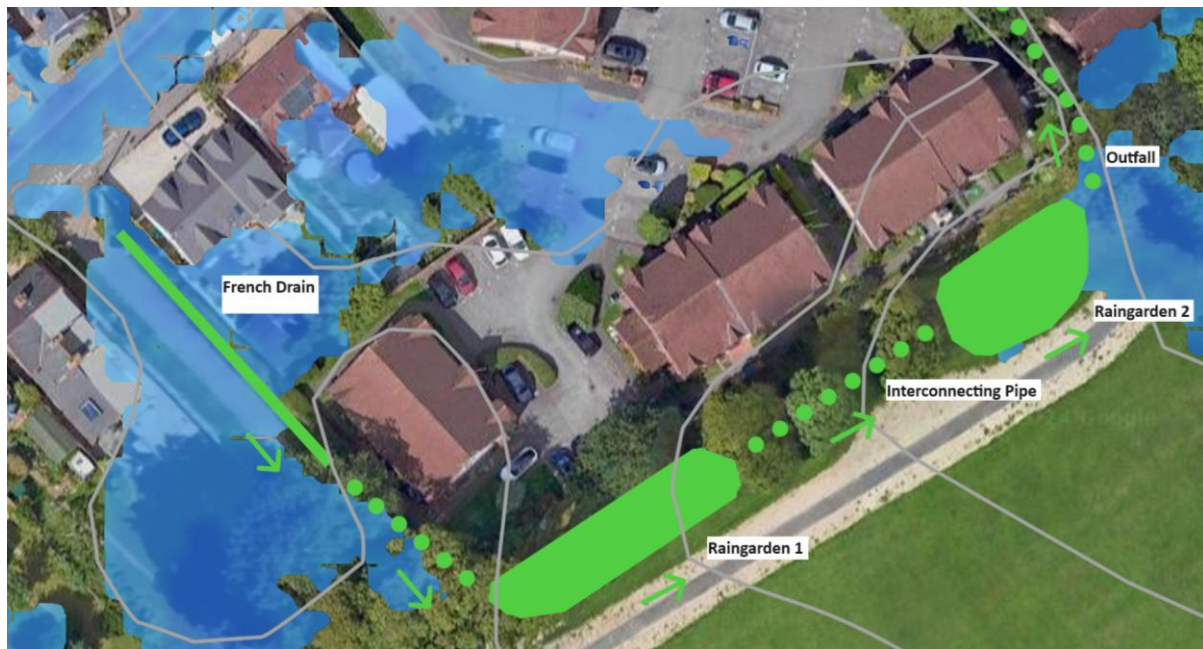


Figure 11: outline design for the proposed park

Raingardens will be introduced along the northern edge of the new footpath, where they can fit in. Halfway along the footpath trees associated with properties on Orchard Close are backing on to the park at present. As such the raingarden will break at this point to avoid damaging the tree roots. The raingardens will outfall at the northeast of the development.

A French drainage is to be introduced into the entrance path to drain water from the pathway and the vegetated verges and bring the water into the raingardens. Raingardens have not been proposed in this area because it appears that these verges are fairly busy with potential services and tree roots.

The make up of a raingarden is shown in Figure 12. This make up is not exclusive, but is flexible and can be adjusted to suit the demands of each development.

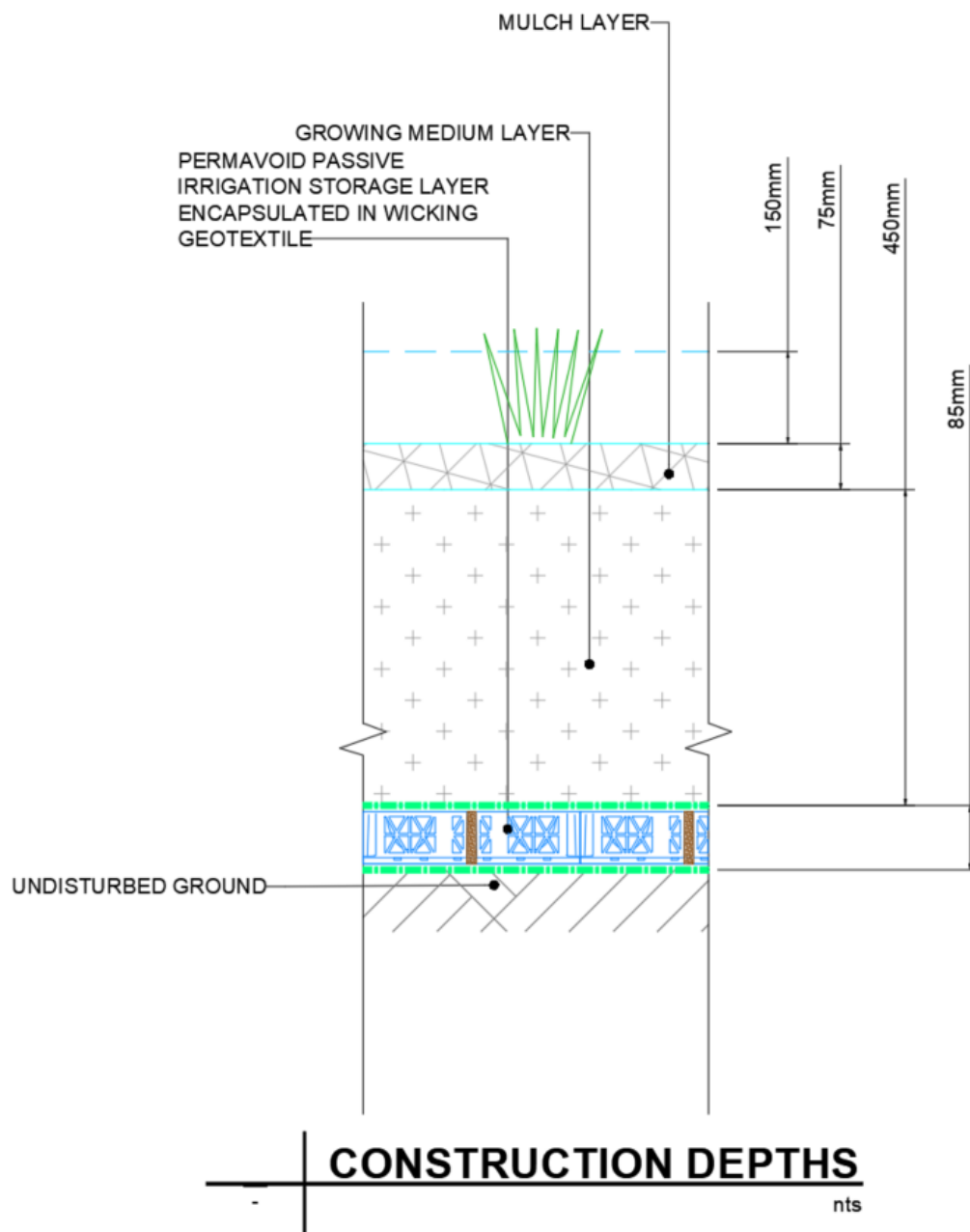


Figure 12. Raingarden make up.

Raingarden 1 is to be approximately 290sq.m with a make up similar to as shown in figure 11. Based on these figures and at the existing gradient on the development Raingarden 1 has 112cu.m of storage.

Raingarden 2 is to be approximately 241.5sq.m with a make up similar to as shown in figure 11. Based on these figures and at the existing gradient on the development Raingarden 2 has 93.cu.m of storage. This give a total storage within the two raingardens as 205cu.m. Figure 13 and 14 shows the two raingardens modelled into the park and the effect it is having on the flooding on the entry path. As can be seen, the flooding has been collected and is being managed within the raingardens.



Figure 13: the modified ground showing the raingardens from SCALGO



Figure 14: the modified ground showing the raingardens over a satellite image

Figure 15 shows typical vegetated raingarden with Permavoid Passive Irrigation, which will be similar to the proposals set out in Raingardens 1 & 2.

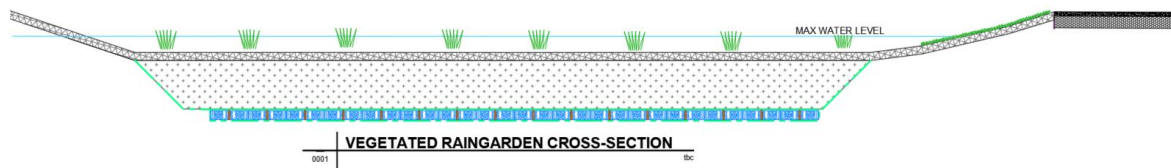


Figure 15: showing cross section through Raingardens



Figure 16: Illustration of the raingarden.

5 Conclusion

5.1 Maintenance

Maintenance requirements of sustainable drainage systems vary and whilst it may not take less time overall to maintain a SuDS feature (as opposed to a traditional gully and pipe drainage system) it does have the potential to be both easier and more safe and for this reason, could be carried out by non-specialist maintenance workers or even residents; SuDS are typically shallow, open, with issues being easy to spot and rectify without requiring specialist experience, equipment or permissions.

It is important to make all site users aware of the drainage network so that accidental pollution incidents are avoided (for example to deter paint or chemical disposal into drainage infrastructure).

5.2 Discussion

The development is not at risk of fluvial flooding, but is at risk of surface water flooding and there is evidence of flooding occurring in similar locations to those identified by the EA.

SCALGO modelling software, identifies flooding in a similar location as the EA map and has identified 201cu.m of flooding in this location during the 100 year storm event.

EPG have identified two locations for raingardens, ideally one raingarden would be better, however, on the edge of the park there are several trees in close proximity to where the raingardens would be proposed, as such the raingardens are being split to avoid existing roots. The total depth of the raingardens is 760mm and will be able to manage a combined 205cu.m. If this volume is to be increased, rather than increasing the size of the beds, EPG would propose the use of leaky checkdams to slow the flow of water and spread it across the entirety of the raingarden. A French drain should be introduced along the entrance pathway to collect the water that floods in this location and to move it toward the raingardens.

The measures introduced should reduce the risk of flooding at the pathway into the development and will enhance the biodiversity and amenity of the park.

Permavoid 85mm is proposed beneath the raingardens to maximise the volumes of water attenuated, to reduce the number of truck cycles to the development, and integrate water re-use into the design through the use of passive irrigation.

Polysync can be introduced into the system which will make the vegetation more robust, maximise the volume of water managed, maximise the amount of rainwater re-used, and minimise the amount of water discharging from the development.

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