C Recommendations for future developments

C.1 Reducing flood risk through site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Most large development proposals include a variety of land uses of varying vulnerability to flooding.

The Practice Guide to PPS25 states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. parking, recreational space) can be located in more high risk areas.

Areas along known surface water flow routes can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives.

Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

C.1.1 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is a very effective way of reducing flood risk to the site in question, particularly where the land does not act as conveyance for flood waters.

However, in most areas conveyance or flood storage would be reduced by raising land above the floodplain, adversely impacting on flood risk downstream. Consequently, compensatory flood storage would be required. Storage should equate to level for level compensatory volume. Where the site is entirely within the floodplain it is not possible to provide onsite compensatory storage, therefore this may not be a viable mitigation option, but the option of offsite compensatory storage could be explored as it may be feasible/acceptable for larger developments. Compensation schemes should be environmentally sound.

C.1.2 Building design

The raising of floor levels above flood height within a development reduces damage occurring to the interior, furnishings and electrics in time of flood.

In areas at risk of a breach in the tidal defences, floor levels should be raised 300mm above the maximum water level caused by a defence breach during a 0.5% annual probability event plus climate change event. This additional height that the floor level is raised is referred to as the 'freeboard'.

In areas at risk of surface water flooding this approach could also be adopted to limit the consequence of flooding. The level above which the freeboard is applied should be informed by a flood risk assessment in conjunction with discussion with Adur and Worthing Councils.

Making the ground floor use of a building water-compatible is also an effective way of raising living space above flood levels.

Putting a building on stilts is not considered an acceptable means of flood mitigation for new development. However, it may be allowed in special circumstances if it replaces an existing solid building, as it can improve flood flow routes. In these cases, attention should always be paid to safe access and egress, and legal protection should be given to ensure the ground floor use is not changed.

Single storey developments are not acceptable in flood risk areas.

Overall the development should be made structurally safe against the effects of flood waters.

C.1.3 Resistance and resilience

There may be instances where flood risk remains to a development. In these cases (and for existing development in the floodplain), additional resistance and resilience measures can be put in place to reduce damage in a flood and increase the speed of recovery. Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA. However, these measures should not be relied on as the only mitigation method.

Temporary barriers

Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water. The Environment Agency provides a list of manufacturers, with the Kitemark, of temporary defences on their website (www.environment-agency.gov.uk).

Temporary or demountable defences are not acceptable flood protection for a new development; however they are useful for protecting existing properties against flood risk.

Temporary defences or demountable defences should only be installed where there is a flood warning with an adequate lead-time to provide enough time for the defences to be put in place.

Permanent barriers

Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers (Figure C-6.1).

Figure C-1.1: Permanent flood barriers

Wet-proofing

Interior design to reduce damage caused by flooding, for example:

- Electrical circuitry installed higher level with power cables being carried down from the ceiling not up from the floor level.
- Water-resistant materials for floors, walls and fixtures.

If redeveloping existing basements, new electrical circuitry installed higher level with power cables being carried down from the ceiling, not up from the floor level, to minimise damage if the basement floods.

Non Return Valves

Non-return valves prevent water entering the property from drains and sewers. Non-return valves can be installed within gravity sewers or drains, within the property's private sewer upstream of the public sewerage system. These need to be carefully installed and should be regularly maintained. The CIRIA publication, 'Low cost options for prevention of flooding from sewers', provides further information. Additionally, manhole covers within the property's grounds could be sealed to prevent surcharging.

Pumps

When redeveloping existing buildings it may be acceptable to install pumps in basements as a resilience measure against surface water or groundwater flooding. However for new development this is unlikely to be considered an acceptable solution.

C.2 Drainage capacity

The capacity of internal drainage infrastructure is often limited and is at or near capacity under existing conditions. Development that leads to increased peak runoff within the drainage catchments may lead to infrastructure capacity being exceeded, with the potential for increased sewer (foul and surface) flood risk. Development locations should be assessed to ensure capacity exists within the foul sewer network, and where possible SuDS should be implemented before considering connection to the surface water sewer.

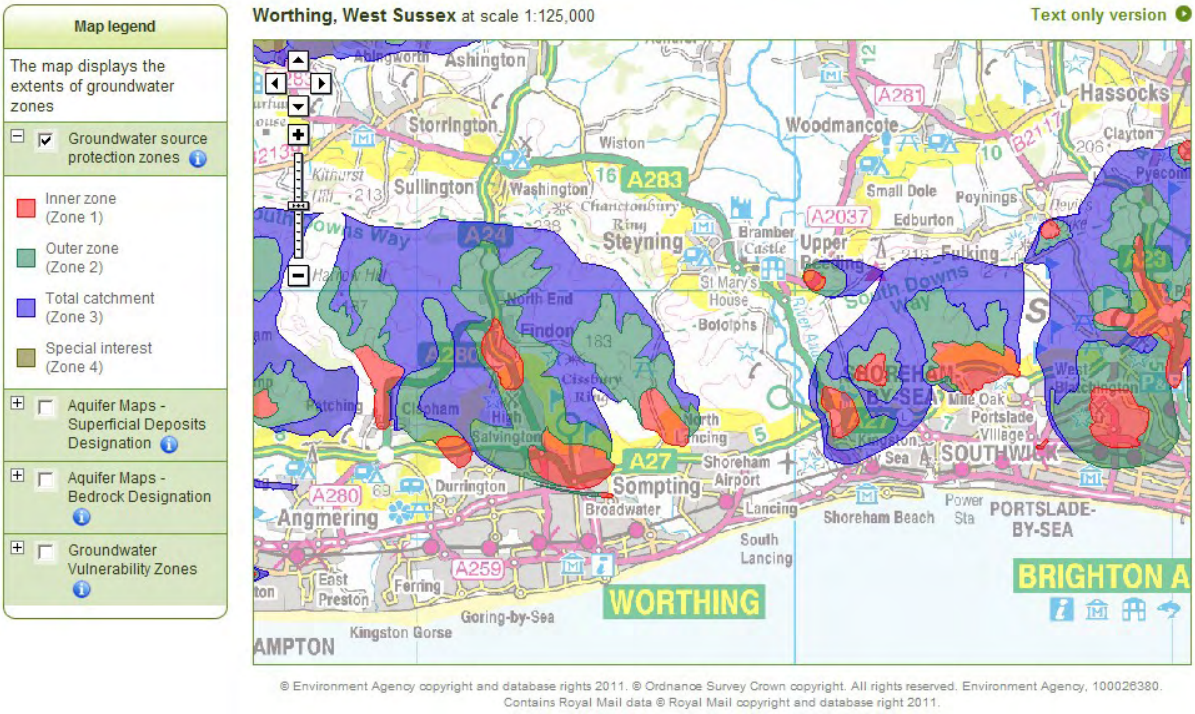
C.3 Application of Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are management practices, which aim to mimic the natural processes of infiltration, attenuation and removal of sediments and pollutants, enabling surface water to be drained in a more sustainable manner. Once Schedule 3 of the Flood and Water Management Act (2010) is enacted the designated SuDS Approval Body (anticipated to be the LLFA - West Sussex County Council) in consultation with the Local Planning Authority will give approval to all proposals' to construct SuDS in the Adur and Worthing plan areas. In addition, the SuDS Approval Body will have the power to inspect construction and monitor the operation of the system to ensure it is in line with the proposal. Responsibility for maintaining the SuDS will give regard to the national standards.

The effectiveness of a flow management scheme within a single site is heavily limited by site constraints including (but not limited to) topography, geology (soil permeability), and available area. The design, construction and ongoing maintenance regime of such a scheme should be carefully defined, and a clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential. Additionally, for infiltration SuDS it is imperative that the water table is low enough and a site specific infiltration test is undertaken. Where sites lie within or close to groundwater source protection zones (which are extensive across the northern half of Adur and Worthing, Figure C-6.2) further restrictions may be applicable, and guidance should be sought from the Environment Agency.

There are many different SuDS techniques which can be implemented. Some examples are listed below. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA) SuDS Manual. In order to obtain the maximum benefits from SuDs systems, the design should consider flood risk management alongside the water quality, bio-diversity and amenity benefits that well designed SuDs can offer a development.

Figure C-1.2: Groundwater source protection zones across Adur and Worthing[14]



C.3.4 Living (green) roofs and walls

Living roofs and walls can vary in type from Roof Gardens, Roof Terraces, Green Roofs and Green Walls. This approach utilises plants and their substrate to provide temporary storage of rainfall. The water retained by the substrate and lost through evaporation and evapotranspiration minimises runoff from the roof.

Green Roofs have been successfully implemented within urban environments. An award winning example of a green roof is Gold Lane Social housing Project, Edgware, London. (Figure C-1.3). This was London's first green roofed social housing project, it utilises green roofs for aesthetics and reduction in surface water runoff. Other examples of successful green roof projects can be found in the Mayor of London's 'Living Roofs: Case Studies' document[15].

[14] EA (2012) http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=513500.0&y=103500.0&topic=drinkingwater&ep=map&scale=7&location=Worthing, West Sussex&lang=_e&layerGroups=default&textonly=off#x=518104&y=108348&lg=1,&scale=6 (accessed January 2012)

[15] GLA (2005) Living Roofs: Case Studies MoL/Nov05/VL D&P 765

Figure C-1.3: Example of a green roof in Edgware, London

Gold Lane, Edgware © Project 35 English and Konu Architects

C.3.5 Basins and ponds

Basins and ponds enhance flood storage capacity by providing temporary storage for storm water through the creation of landscape features within a site (which can also provide scope for the creation of wildlife habitats). Basins, ponds and wetlands can be fed by swales, filter drains or piped systems. .

C.3.6 Filter strips

Filter strips are vegetated areas that are intended to treat sheet flow from adjacent impervious areas. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and providing some infiltration into underlying soils. This approach to SuDS also provides scope for the creation of wildlife habitats and biodiversity gain.

C.3.7 Infiltration devices

Infiltration devices drain water directly into the ground. They may be used at source or the runoff can be conveyed in a pipe or swale to the infiltration area. They include soakaways, infiltration trenches and infiltration basins as well as swales, filter drains and ponds. Infiltration devices can be integrated into and form part of the landscaped areas.

C.3.8 Permeable surfaces and filter drains

Pervious pavements such as permeable concrete blocks, crushed stone and asphalt will allow water to infiltrate directly into the subsoil before soaking into the ground. Filter drains are gravel filled trenches which trap sediments from run-off and provide attenuation. Flow is directed to a perforated pipe which conveys run-off back into the sewerage network or into a water body. Filter drains are used mainly to drain road and car park surfaces.

C.3.9 Rainwater harvesting

Rainwater harvesting techniques, such as the installation of water butts, can aid in increasing the attenuation of rainfall and contribute to the on-site recycling of water.