

## **Chapter 6 Hydrology and water quality**

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### **Introduction**

- 6.1 WSP was commissioned by Countryside Properties to carry out the hydrology and water quality assessment for the development proposals. Hydrology and water quality was scoped as an issue of primary significance for consideration in the EIA.
- 6.2 There are three watercourses at or near to the site, Pingle Brook, Gagle Brook and an unnamed watercourse, as well as a number of field drains. Issues for consideration include the risk of flooding for the site itself and the potential for the development to increase the flooding risk downstream.
- 6.3 For further information on the ground conditions and contamination at the site, reference should be made to chapter 13.

### **Legislation and policy**

- 6.4 Water resources in England and Wales are protected by law under the Water Resources Act (1991) and the Environmental Protection Act 1990 (as amended by the Environment Act 1995). It is the responsibility of the Environment Agency (EA) to enforce this legislation and control discharges to surface waters through the regulation of industry and through its powers as a statutory consultee in the planning process. Other discharges enter the public sewerage system and are controlled and monitored by the Regional Water Companies under the provisions of the Public Health (Drainage of Trade Premises) Act 1937 and the Water Industry Act 1991. Discharge consents are required by the EA and the Regional Water Companies respectively.
- 6.5 The Water Resources Act (WRA) 1991 is the principal legislation relating to water resources in England and Wales. Under section 85 of the Act, it is an offence to 'cause or knowingly permit the discharge or other entry of poisonous, noxious or polluting matters or any solid waste matter into controlled waters (as defined under s104 of the WRA 1991)'. Most waters will meet this definition, including groundwater. Any parties intending to discharge such substances, or those discharging trade or sewage effluent directly into controlled waters, must obtain a consent from the EA.
- 6.6 The Cherwell District Council Revised Deposit Draft Local Plan (July 2004) includes a number of policies relating to water resources, water quality, flood defence and surface water run-off and source control.

#### *'Water resources*

*EN11 Development will only be permitted where adequate water resources exist, or can be provided without detriment to existing use.*

### *Water quality*

*EN12 Development which will adversely affect to a material level, the water quality of surface or underground water bodies, including rivers, canals, lakes and reservoirs, as a result of directly attributable factors, will not be permitted.*

### *Flood defence*

*EN14 In areas at risk from flooding, new development, the intensification of existing development or land raising will not be permitted if the proposals would:*

- i) result in a net loss of floodplain storage*
- ii) impede the flow of flood water, or*
- iii) increase the risk of flooding elsewhere.*

### *Surface water run-off and source control*

*EN15 New development generating increased surface water run-off likely to result in an adverse impact to surface drains and water courses, such as an increased risk of flooding, river channel instability or damage to habitats, will not be permitted unless the proposals include appropriate source control and / or attenuation measures. Developers will be expected to cover the costs of assessing the impact of development on run-off generation and of any appropriate mitigation works, including long term management.'*

## **Methodology**

- 6.7 The EA, Cherwell District Council highways authority and the statutory undertakers (Thames Water Utilities) have been contacted by WSP to determine the existing drainage networks and restrictions on greenfield site run-off. The investigations were carried out in the period from April to August 2005. The data sources and references used in preparation of this chapter are shown in figure 6.1.

WSP, South West Bicester Environmental Statement, Technical Appendix: Hydrology and Water Quality, December 2005
Environment Agency, Groundwater Vulnerability Map and Regional Appendices
Cherwell District Council, Cherwell District Revised Deposit Draft Local Plan, July 2004
Interim Code of Practice for Sustainable Drainage Systems, published by the National SUDS Working Group in July 2004
Planning Policy Guidance Note 25: Development and Flood Risk, Published by DTLR in July 2001 (Now from ODPM)

Figure 6.1 Data sources and references

- 6.8 The EA has been consulted on the flooding potential of the existing watercourses on site and nearby. Flood maps were received from the EA setting out the extent of the 1 in 100 year flood plans of Pingle Brook and Gagle Brook.

- 6.9 The EA has advised that a flood risk assessment (FRA) should be undertaken in accordance with PPG25. This FRA requirement is a general requirement for all sites greater than one hectare. **The FRA has been submitted as technical appendix 3a.**
- 6.10 The EA Groundwater Vulnerability Map and Regional Appendices have been examined to identify whether the site is underlain by an aquifer. These plans and appendices make up part of the published 'Policy and Practice for the Protection of Groundwater'. This divides the underlying strata in England and Wales into major, minor and non-aquifers dependent upon their potential for potable water supply.

### ***Impact assessment***

- 6.11 The master plan and proposals have been examined with regard to the baseline hydrology and water quality environment. An estimate of the impermeable surfaces developed by the proposals has been determined in order to predict storm water run-off rates and potential effects on site balancing requirements.
- 6.12 The impact assessment involves the identification of the hydrology and water quality potential effects arising from the development. Where adverse potential effects have been identified, consideration has been given to the mitigation measures. The residual effects, following mitigation, have subsequently been determined.

### ***Assessment of sensitivity***

- 6.13 The significance of potential effects on the water environment has been determined from criteria developed from best practice techniques and specialist experience. The significance criteria used have been derived from measures of the magnitude or scale of effect, and the importance or sensitivity of the resource affected.
- 6.14 The categories for magnitude of change and sensitivity or importance of receptors for water are shown in figures 6.2 and 6.3 respectively.
- 6.15 There are no known published 'standard' significance criteria for assessing the effects of development on water. Reference has therefore been made to a wide range of criteria relating to the nature of the receptors, expected duration of impact and the predicted change in relation to the baseline situation. The aforementioned magnitude and sensitivity criteria have been combined to produce the definitions of potential significance shown in figure 6.4.

### **Baseline**

#### ***Surface water features***

- 6.16 The proposed development site has two distinct established points of outfall; Pingle Brook and an unnamed watercourse, which springs from a point due east of Whitelands Farm.
- 6.17 To the south of the site is Gagle Brook, which is the most significant of all these watercourses. Gagle Brook is outside of the proposed development area.
- 6.18 The general gradient trend of the site is from the north-west to south-east. Storm water falling within the site is captured by a succession of ditch watercourses which fall towards

Oxford Road (A41). All three watercourses cross the Oxford Road (A41) before progressing down and joining the River Lang.

- 6.19 The topographical survey indicates that the majority of the area to the south of Whitelands Farm falls towards Gagle Brook; and that to the north of the farm to Pingle Brook. Some of the centre section and to the south-east of the farm falls into the minor unnamed watercourse.

***Characteristics of the on site surface water features***

- 6.20 Pingle Brook is the primary watercourse serving the surrounding area of south-west Bicester. The Brook appears to spring from a location due south of Gomwell Farm, which is to the north of the Highfields Estate (the housing area north of Middleton Stoney Road). It then passes down through this estate collecting surface and storm water from much of the residential development.
- 6.21 Pingle Brook passes through the north-eastern corner of the site for approximately 700m where it is joined by two watercourses, one of which appears to be highway run-off from Highfields Estate and Middleton Stoney Road, the other is a spring which is probably issuing water from the aquifer.
- 6.22 Pingle Brook discharges from the north-east corner of the site via a rectangular concrete culvert, which passes under Oxford Road at a location approx 120m south of the Middleton Stoney Road junction. Due to the flat topography of the site at the north-eastern corner, the culvert has become significantly silted up and this has progressively caused flooding back into the site.
- 6.23 The presence of organic material at this corner of the site appears to be a result of previous quarry workings on either side of Pingle Brook over the last 500m before Oxford Road. The boreholes indicate that the workings reached a depth of approximately 1.5 m below ground level, apparently to remove rare white limestone gravel. Following the excavations, these areas have been partially backfilled with made ground comprising clay, with many carbonized plant stems. Above this, it has been infilled with organic material washed down by the brook. The north-east corner of the site has established itself as a marsh/bog area with an influx of marsh reeds and bog plants.
- 6.24 The unnamed watercourse is a smaller watercourse which passes down a shallow ditch before crossing Oxford Road via a small diameter pipe.

***Flooding potential of the existing water courses***

- 6.25 The EA's predictive plans show that the 1 in 100 year floodplain of Pingle Brook extends into the north-east corner of the site (see figure 6.5). Surface water would therefore be constrained from discharging from the site during a severe storm event. Gagle Brook is also indicated as flooding along its length, although the extent of the floodplain does not enter the site.
- 6.26 The EA's flood plans indicate that during a 1 in 100 year event the downstream watercourses from Wendlebury and Merton also flood. The plans indicate that the Pingle Brook could be expected to back up approximately 500m into the site. Although this

flooding is relatively minor it is indicated as extending as far as 30m either side of the Brook.

- 6.27 The EA has advised that the Pingle Brook is defined as an 'ordinary watercourse' and that under the **Land Drainage Act 1991, as amended by the Land Drainage Act 1994**, and the local Land Drainage Byelaws 1981 their prior written consent is required for works in, over, under or within 8m of these watercourses. They perceive that development in close proximity to these watercourses may prejudice flood defence interests and adversely affect the character of the watercourse, and restrict necessary access for maintenance; the character, nature and accessibility of this watercourse must therefore be preserved.

***Storm drainage from the existing residential development, north Middleton Stoney Road***

- 6.28 The Highfields Estate has clearly been subjected to storm water discharge control measures. These measures have comprised the canalisation of the Pingle Brook into an open concrete channel, which varies between a 2.0m wide vertically-sided channel section, and a 3.0m wide trapezoidal section (i.e. wider at the top than the bottom) channel further downstream.
- 6.29 A 'dry' balancing lagoon, with a surface area of approx. 6,500 sqm, has been constructed on the line of the Pingle Brook near Shakespeare Drive. This balancing pond has a weir associated with the attenuation system. This is approximately 1.5m high and therefore the pond would contain approximately 10,000 cubic metres of water when filled during a severe rainfall event. However, historic evidence indicates that this pond has never been flooded. The balancing pond discharges into the trapezoidal channel section before progressing down through the estate, and then crossing Middleton Stoney Road.
- 6.30 Drainage records received from Thames Water Utilities (TWU) indicate that a piped network of storm water sewers exists to serve the western end of the Highfields Estate. The drainage system discharges into the storm water balancing system where it is regulated and attenuated by the outfall weir, before discharging to Pingle Brook.
- 6.31 The TWU records indicate no formal storm water drainage network serving the eastern end of Highfields Estate. Discussions with Cherwell District Council confirm that this area of the estate is drained by soakaways which discharge surface water by infiltration to the Cornbrash sub-strata aquifer.
- 6.32 In addition, the TWU records do not indicate any formal, piped, surface water sewers serving Middleton Stoney Road. It is therefore presumed that the surface water gullies along Middleton Stoney Road connect indirectly into Pingle Brook via highway drains.
- 6.33 As the road drains appear to discharge straight into Pingle Brook, there is no attenuation of storm water. Therefore, the only contamination mitigation measures provided are the sump to the road gullies, which trap hydrocarbon spillage and silt.

### ***Water quality***

- 6.34 The EA classifies inland waterways (rivers and canals) according to the General Quality Assessment scheme (GQA). The GQA scheme is designed to provide an accurate and consistent assessment of water quality changes over time. The chemistry GQA describes quality in terms of three chemical measurements, which detect the most common types of organic pollution.
- 6.35 Gagle Brook, Pingle Brook and the on site drains are not classified. However, there is an unnamed off site drain to the east has a GQA of grade D (fair). The water quality of Pingle Brook is potentially affected by the existing road gullies in Middleton Stoney Road, it has therefore been assumed that the water quality of these watercourses is fair. It is not proposed that any further water quality monitoring be carried out at a later stage.

### ***Groundwater***

- 6.36 The EA Groundwater Vulnerability Map was examined to identify whether the site is underlain by an aquifer. The underlying Cornbrash and Forest Marble formations at the site are classified as a minor aquifer, with the Kellaways Clay formation classified as a non-aquifer. Minor aquifers often do not provide large quantities of water for abstraction, but may be important locally in providing base flow to rivers.
- 6.37 Results from the borehole survey undertaken as part of the site investigation indicate that generally the occurrence of groundwater was intermittent across the site, seeping from within the Cornbrash or at the upper levels of the mudstone, wherever this was encountered. There was also groundwater seepage into the central eastern quarry area. The direction of groundwater flow is reasonably assumed to be south easterly, relating to the topography.
- 6.38 In the north-east corner of the site, the occurrence of ground water was considered to be as a result of the proximity of Pingle Brook. All groundwater levels may be seasonal, and historically high groundwater levels have occurred during the winter months on this site.
- 6.39 There are four licensed groundwater or surface abstractions located within 500m of the site, one adjacent to Whitelands Farm. Three of the abstractions are to provide water for general agricultural use in adjacent farms, whilst the fourth is the water supply for the caravan site east of the A41.
- 6.40 There are two consents to discharge, one in the north-east corner of the site and the second approximately 750m east of the site adjacent to the sewage treatment works.
- 6.41 With regard to groundwater quality, the ground conditions site investigation confirmed that there was no significant level of contamination in any of the groundwater samples taken (see chapter 13). This indicates that it is unlikely that any mobile contaminants are being transferred off site and similarly that there is a low risk of contaminants migrating onto the site. However, there is a possibility that the groundwater at the site is affected by potential contamination at Whitelands Farm complex.

### *Future baseline*

- 6.42 If the development was not forthcoming, it has been assumed that the site will remain as agricultural land and the farm's operations will continue as at present. If there is contamination at Whitelands Farm, this could potentially influence the water environment in the future. However, this is considered to be low risk and it is unlikely that this continued use of the site would significantly change the baseline environment of the site in the future.

### *Assessment of sensitivity*

- 6.43 The surface watercourses at and near the site are considered to be of medium sensitivity to the potential changes to water quality arising from the proposals. This includes Pingle Brook, Gagle Brook and the unnamed watercourse.
- 6.44 In terms of changes to flood risk, Pingle Brook and any downstream properties are considered to be of high sensitivity. The groundwater and the abstraction points are considered to be of medium sensitivity.

### **Potential effects**

#### *During construction*

- 6.45 During construction, the surface water quality of Pingle Brook and the unnamed watercourse could potentially be affected by pollution from spills or silt. These watercourses are considered to be of medium sensitivity. However, the magnitude of change varies as a result of proximity of the proposed works to these watercourses. With regard to Pingle Brook and the unnamed watercourse, the magnitude of change is considered to be small, resulting in an adverse effect of moderate significance.
- 6.46 Gagle Brook is also sensitive to pollution from spills. However, due to the distance between the proposed development area and this stream, the magnitude of change is considered to be negligible and no significant effects have been predicted.
- 6.47 The proposed realignment of Pingle Brook and the unnamed watercourse during construction could potentially result in an increase in silt affecting water quality, potential flood risk and the ecology of the watercourses. A section of Pingle Brook will be realigned during construction and the unnamed watercourse will need to be moved to avoid the area of open space and formal sports provision. The EA has advised that this should be in the format of a two-staged channel no shorter than the existing watercourses, with all connections maintained, which will minimise any residual effects.
- 6.48 There is also potential for groundwater quality to be affected by spills arising during the construction work. The groundwater could be affected by seepage and it is considered to be of medium sensitivity. Without appropriate controls during construction, there is the potential for a small change and an adverse effect of moderate significance.
- 6.49 A further issue is the potential impact of groundwater flow on foundations. This is unlikely to be significant, as foundations will be taken to competent soil.

- 6.50 The potential effects associated with the release of existing contamination at the site have been addressed in chapter 13, ground conditions.

***Post-construction***

- 6.51 Post-construction, there is the potential for contamination to arise as a result of the increase in run-off from the development. Pingle Brook and the unnamed watercourse are considered to be of medium sensitivity. The magnitude of the change is considered to be small and an adverse effect of moderate significance will result.
- 6.52 Gagle Brook will not be affected due to the distance between the proposed development area and this watercourse. The magnitude of change is negligible and no significant effects have been predicted.
- 6.53 The increase in run-off from the development could also potentially affect the groundwater quality by pollutants infiltrating through the soil. This receptor is considered to be of medium sensitivity and without appropriate controls, there is the potential for a small change and an adverse effect of moderate significance.
- 6.54 The development proposals will potentially lead to an increase in run-off quantity on-site which could impact on flood risk. The on-site watercourses and downstream areas are at risk. The sensitivity of receptor is high and the magnitude of change is considered to be medium to high. Without mitigation, this adverse potential effect is considered to be of very substantial significance.
- 6.55 There will be a minor realignment of Pingle Brook to accommodate the proposals. Discussions with the EA have confirmed that a realignment is acceptable providing the length of the brook's bed is not reduced and the adjoining watercourses remain connected and are not extended. The realignment maintains the overall length of the brook and the adjoining watercourses will remain connected. With regard to changes to the hydrology of Pingle Brook, the magnitude of change associated with the realignment is considered to be negligible and no significant effects have been predicted.
- 6.56 The alignment of the unnamed watercourse will change as a result of the development proposals. This unnamed watercourse will be incorporated into the proposed drainage scheme for the balancing pond to the south-east of the site. The discharge point of outfall of the unnamed watercourse will remain. This unnamed watercourse is very minor and is not considered to be sensitive to the proposed changes. No significant effects have been predicted.
- 6.57 The groundwater could be affected by the change to the hydrology of the site due to the incorporation of SUDS into the development. The groundwater is of medium sensitivity and the magnitude of change is considered to be medium. This will result in an adverse effect of substantial significance.
- 6.58 The development proposals could potentially lower the groundwater levels at the site through an increase in impermeable surfaces and reduction in recharge levels. This is unlikely to cause significant effects given the large permeable areas of the site and the potential use of SUDS in some parts of the site.



- 6.59 The proposals for foul water drainage are set out in chapter 3. There is capacity at the main Bicester sewage treatment works to serve the proposed development. A new sewer will be needed to connect the development to the sewage treatment works. It may be necessary for the lower southern parts of the site to be served by a sewage pumping station. It is expected that a gravity connection can be made for the majority of the site. These measures will ensure that the development is adequately served with respect to foul water drainage. No significant effects on hydrology or water quality have been predicted.
- 6.60 There is a severe constraint on potable water supply extraction within the Bicester area and no spare capacity. This situation is being resolved by the laying of a new trunk water main to bring new supplies to the area from Farmoor reservoir west of Oxford. This will provide sufficient strategic supplies to Bicester. The local distribution system within Bicester may need some upgrades and reinforcements to serve the new development. **Thames Water has confirmed that an adequate potable water supply can be provided for the development.** This will not impact on existing supply in the area. No significant effects have been predicted.

### **Mitigation**

- 6.61 Best practice techniques will be used by all the developers during the construction phase. This will include reference to emergency equipment for use in the event of accidental spillage. Any ground contaminated by spillage of fuel oils and hydraulic oils during construction will be excavated and removed to an appropriately licensed waste disposal site. Personal protective equipment will be provided to construction workers where necessary. These measures will ensure that any spills during construction are dealt with promptly and appropriately to ensure no residual effects on surface water or groundwater will result.
- 6.62 Surface water drainage measures will be designed in accordance with best practice with appropriate pollution prevention measures. This will ensure that the run-off from the development will not affect the surface water bodies or groundwater after construction. Maintenance of the trapped gullies, swales, highway drainage systems, interception facilities and infiltration basins, including the pollution prevention equipment, will ultimately be the responsibility of Cherwell District Council and Oxfordshire County Council. Until adoption, however, the developers will carry out the necessary maintenance of these systems and facilities. Waste water and materials removed during routine maintenance will be disposed of to an appropriately licensed waste disposal site.
- 6.63 The Interim Code of Practice for Sustainable Drainage Systems requires that volumes of run-off for the developed scheme do not increase compared to undeveloped or greenfield sites. This will be achieved using infiltration SUDS, e.g. soakaways and swales, where appropriate. If infiltration does not prove practicable for certain areas of the site, the excess volume will be stored on site and discharged at greenfield flow rates. This storage can be provided by overland flow routing and temporary surface flooding of areas such as car parks and landscaped areas. These measures will ensure that the development has a negligible impact on downstream areas of the catchment with respect to increased flood risk.

### **Residual effects**

- 6.64 The best practice measures proposed for the construction work will ensure there will be no residual effects on surface water or groundwater during this work.

- 6.65 The design of the sustainable drainage system and associated pollution prevention and control measures will ensure that the increase in run-off from the development will not affect surface water or groundwater. These measures will also ensure that the local aquifers are not affected by the incorporation of SUDS into the development. The magnitude of change will be reduced to negligible and no significant residual effects have been predicted.
- 6.66 The measures proposed to address the change to run-off quantity and associated flood risk will reduce the magnitude of change to negligible. No significant residual effects will result.

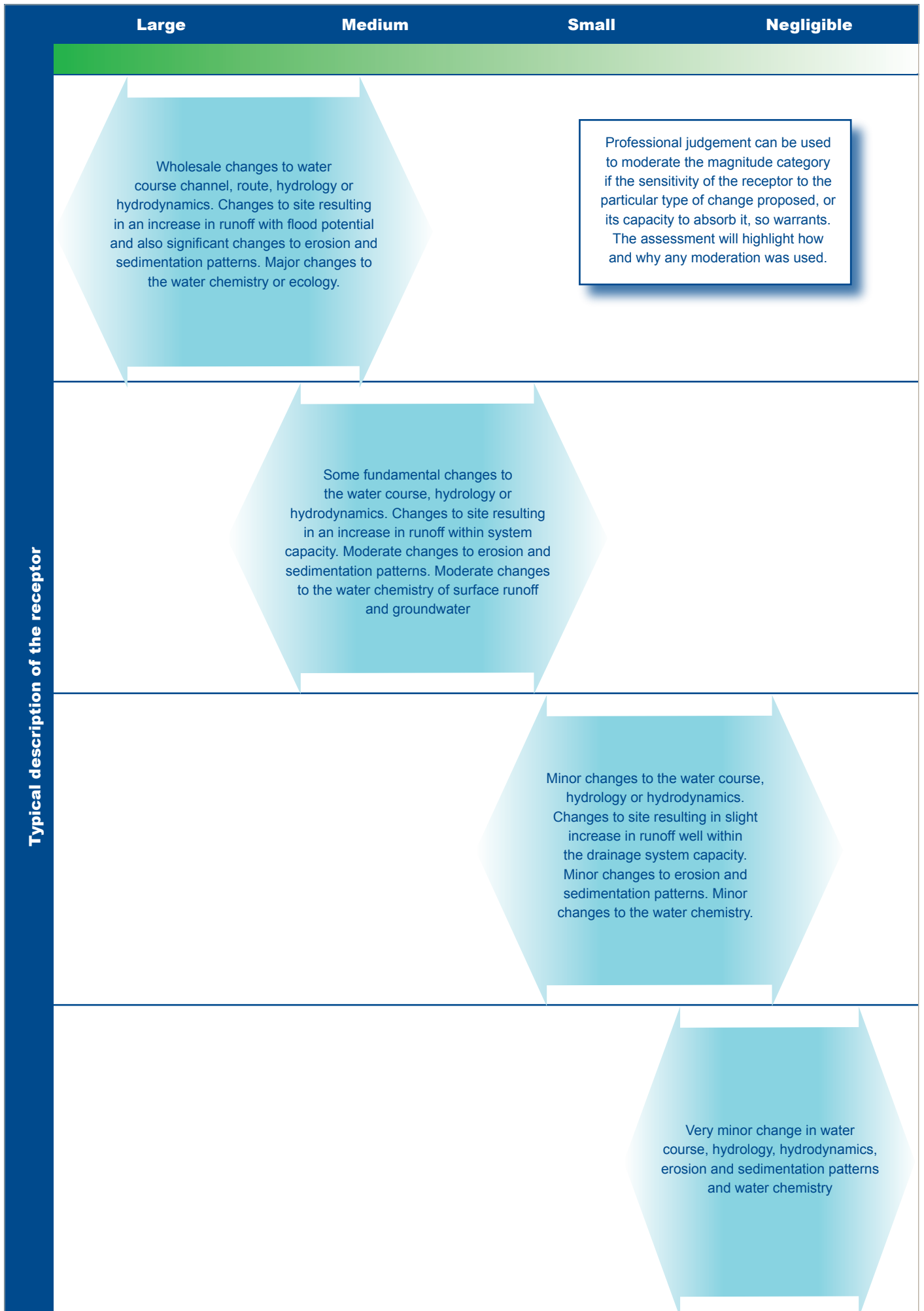
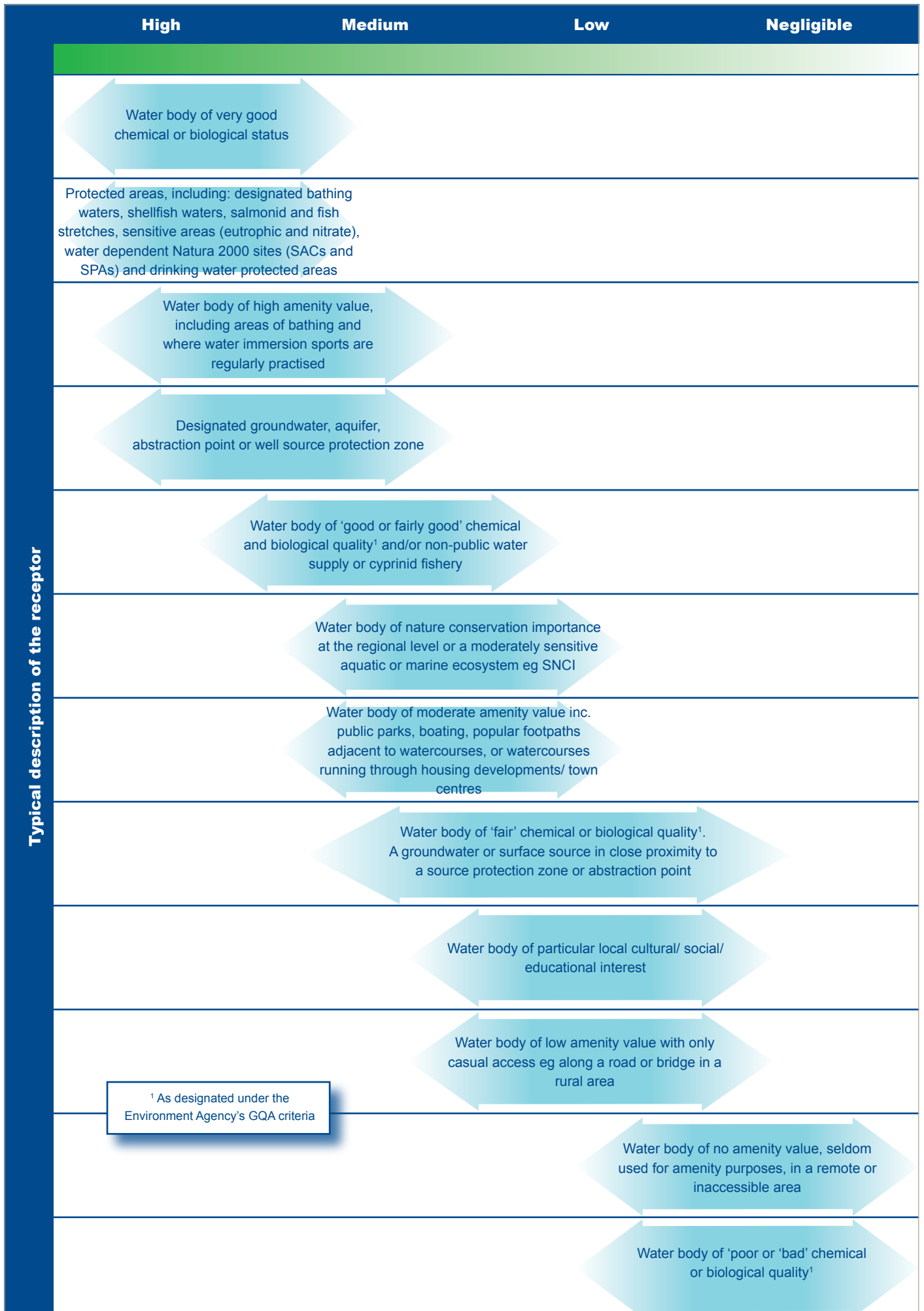


Figure 6.2 Hydrology and water quality: magnitude of change





<sup>1</sup> As designated under the Environment Agency's GQA criteria

Figure 6.3 Hydrology and water quality: sensitivity or importance of receptor



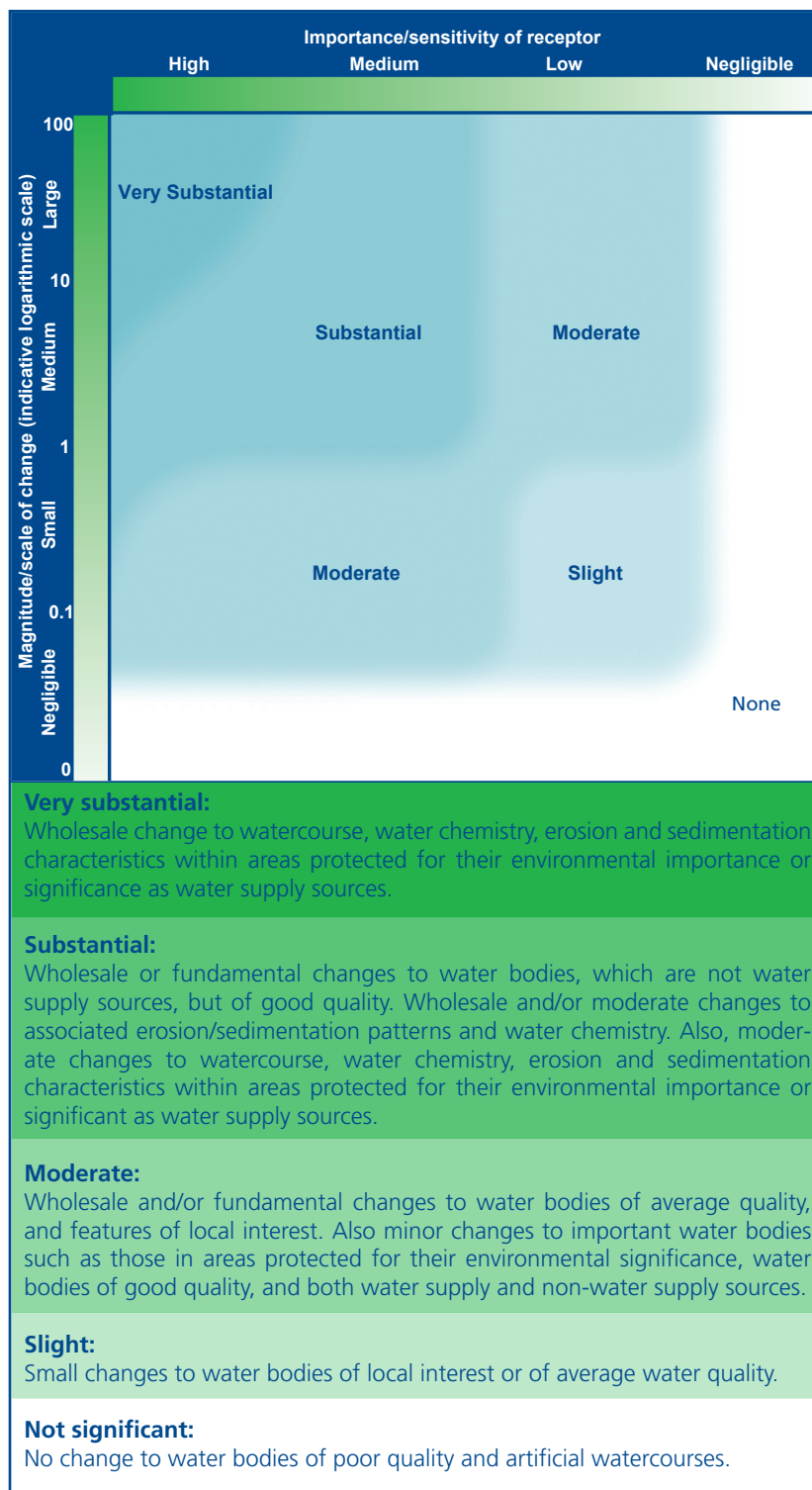
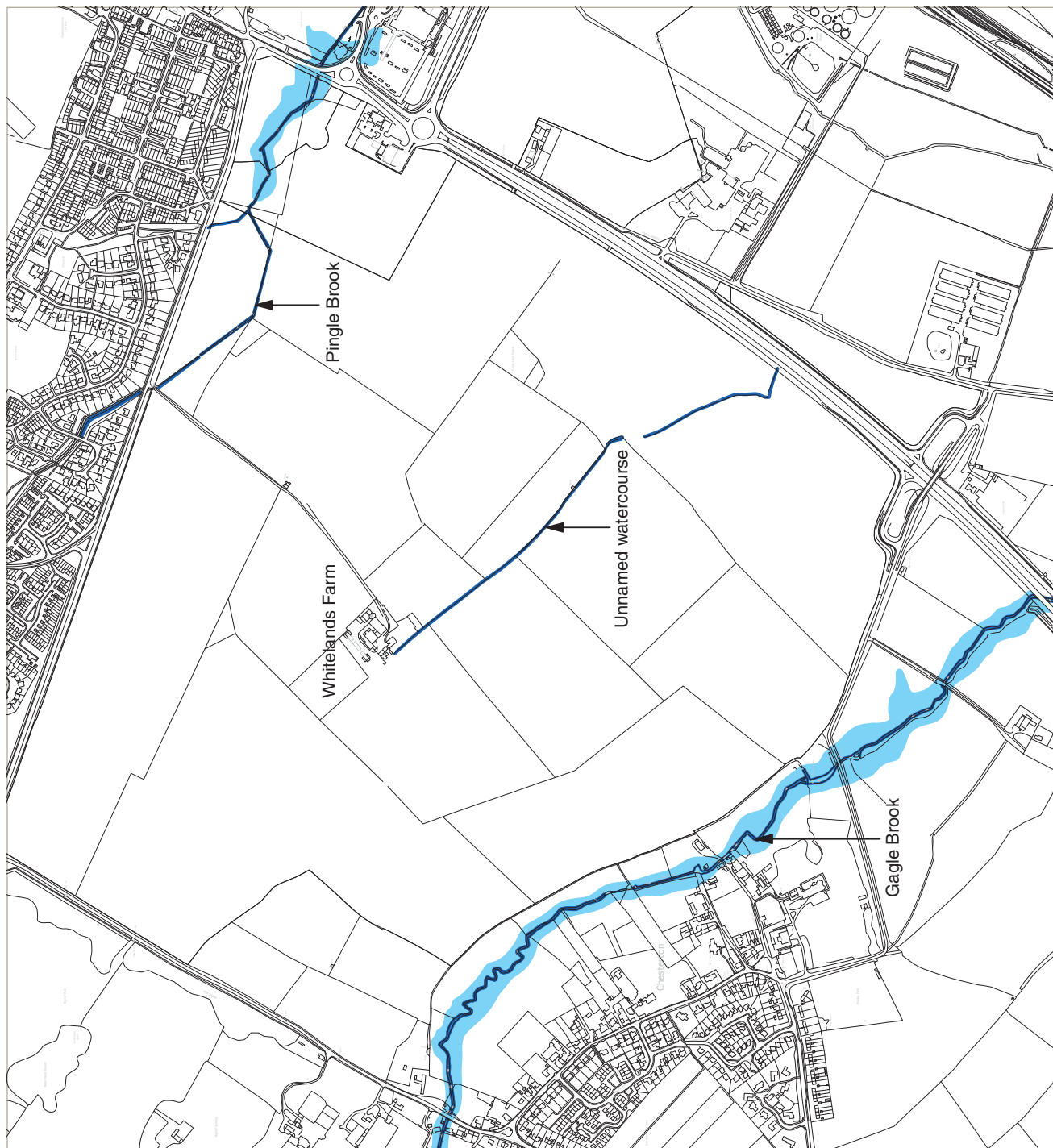


Figure 6.4 Hydrology and water quality significance matrix







- Existing watercourses (Pingle and Gaggle Brook)
- Areas affected by 1 in 100 year flood

NOTE

\*Information taken from WSP drawings:  
1546/UD/002RevP1 (Site Constraints) July 2005  
1546/SI/001RevP1 (Borehole and Trial Pit Locations) August 2005  
1546/D/001RevP1 (Proposed Storage Pond Layout) August 2005

Figure 6.5 Water features at or near the site and flooding potential of existing water courses