Drainage Strategy – Sidlesham (Manhood Peninsula)

We'll update and republish this Drainage Strategy as we continue to engage with our customers and stakeholders.

You can find further information on how to share your feedback via our website:

southernwater.co.uk/drainagestrategies

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Executive summary

The Drainage Strategy for Sidlesham (Manhood Peninsula) focuses on the current pressures and future challenges that will impact on the sewerage network and wastewater treatment works.

It will enable us to take a more strategic approach to drainage planning across the area, providing a long-term (25-year) strategy to ensure we deliver a reliable and sustainable wastewater service for the region while accommodating population growth, new development, climate change and stricter environmental quality standards.

The Sidlesham wastewater catchment includes the villages of Almodington, Birdham, Bracklesham, Selsea, Sidlesham, East/West Wittering and West Itchenor in the Manhood Peninsula, south of Chichester.

Long-term outcomes

Our Five-year Business Plan 2015 to 2020 sets out details of the improved water and wastewater services we will provide in the future. It was developed as a result of the company's biggest ever consultation programme which included feedback from more than 34,000 customers and stakeholders.

The business plan is built around the delivery of six outcomes which our customers and stakeholders told us were their priorities. For each outcome, we have developed a clear set of promises that detail what we will achieve for our customers. Three of these outcomes are relevant to the Drainage Strategy for Sidlesham and are shown in figure 1 below alongside the relevant promises associated with them.

Figure 1. Outcomes relevant to the Drainage Strategy for Sidlesham (Manhood Peninsula)

Removing wastewater effectively

- *Minimise flooding due to wastewater and surface water with a 25% reduction in internal sewer flooding incidents by 2020*

Looking after the environment

- *Minimise wastewater pollution so that by 2020 there will be no serious (Category 1 & 2) pollution incidents caused by our operations. We are also aiming to halve the number of minor (Category 3) incidents from 2017 onwards*
- *Maintain wastewater treatment works compliance by ensuring that any releases to the environment comply with permit conditions*
- *Maintain 'excellent' bathing water quality and improving other bathing waters*

Better information and advice

- *Improve advice on how to prevent blocked drains to help reduce blockages*

Current issues and future challenges for Sidlesham (Manhood Peninsula)

Over the next 25 years, population growth is expected to result in a 12% increase in domestic properties connecting to our sewers in the Sidlesham wastewater catchment. Climate change and urban creep are expected to add to surface water flows into our sewers which, in turn, will increase the number of properties at risk from surface water flooding.

Maintaining and improving bathing water quality is essential for encouraging tourism and supporting economic prosperity in the region. The Manhood Peninsula has a 'Blue Flag' award for its West Wittering beach. At Selsey, we are working with the local authorities, the Environment Agency and other organisations to find and fix the causes of pollution which are preventing the bathing water from being consistently rated as 'excellent'. Some rivers, groundwater and other water bodies in the catchment were classified as 'bad' to 'moderate' status in 2015 according to the Water Framework Directive (WFD) and require improvement to 'good' status by 2027. Partnership working will be key to achieving the higher environmental standards required under the WFD.

We have assessed the risks to the delivery of our key outcomes if we were to do nothing, summarised in table 1. These risks will be identified, assessed and reduced through our 'business as usual' activities.

Table 1. Key outcomes at risk in the Sidlesham catchment (Manhood Peninsula) if we do nothing

Key outcome	Risk of not delivering the outcome by:		Comments
	2020 to 2025	2040	
Maintain compliance at wastewater treatment works	Medium to high	High	Sidlesham Wastewater Treatment Works is currently operating at its treatment capacity and is likely to require an uplift in treatment capacity and dry weather flow consent in line with the anticipated growth in new connections. Additional capacity could be delivered in parallel with development.
Minimise flooding due to wastewater	Medium	Medium to high	The Sidlesham network can accommodate approximately 53% of the forecast new wastewater connections over the next 25 years without an unacceptable deterioration in our wastewater service. Additional capacity could be delivered in parallel with development.
Minimise flooding due to surface water and groundwater	Medium	Medium to high	Groundwater infiltration is considered to be significant across the catchment and has been an issue in the village of Sidlesham where repairs have been carried out. Groundwater levels may get higher as a consequence of rising sea levels due to climate change. Surface water flooding has been a significant issue due to the limited capacity of the land drainage system. Flooding is likely to increase due to more intense storms caused by climate change and more run-off due to urban creep.
Minimise pollution	Low	Low to medium	The number of pollution incidents in 2015 and 2016 were relatively low. The likelihood and severity of pollution incidents may increase due to additional wastewater, surface water and groundwater in the sewerage system.
Improve water bodies (river, lake, coastal groundwater)	Medium	Medium	Nine out of 11 water bodies on the Manhood Peninsula are predicted to achieve 'good' status by 2027 with the remaining two at 'moderate' status. Partnership working will be key to achieving the higher environmental standards required under the WFD.
Maintaining 'excellent' bathing water quality	Low to medium	Low to medium	Three out of four bathing waters in the region have generally 'excellent' bathing water quality. At Selsey, we are working with partners to improve bathing water quality to 'excellent' by 2019–20.

We are assessing a range of traditional engineering and alternative strategies to tackle the current drainage issues and future risks that have been identified for the area. We are also investing in the development of innovative techniques that will bring a significant improvement to our capabilities and performance. Potential strategies are being assessed against whole life costs, constraints and benefits to both the environment and stakeholders. Table 2 lists the key outcomes at risk and offers potential strategies which could be implemented to overcome the issues and challenges that threaten them.

Next steps

We will update and revise this drainage strategy to reflect consultations with our customers and stakeholders in the region. We will continue to work with the local community to gain important feedback from our customers and local stakeholders which we will use to shape our solutions. We have already begun discussions with our regional drainage partners and we will work collaboratively to agree and implement a strategy that ensures a reliable and effective wastewater service for the region in the long term.

Table 3 provides an action plan for this strategy which we will implement in partnership with other stakeholders in the region.

Table 2. Key outcomes at risk and potential strategies for Sidlesham (Manhood Peninsula)

Key outcomes at risk	Potential strategies
Maintain compliance at wastewater treatment works	• Collaboration with the local authority and developers to understand the timing, size and location of developments with planning certainty
	• Reduce groundwater infiltration of foul sewers
	• Provide additional treatment capacity at the works as required
	• Transfer wastewater to other treatment works with spare capacity
Minimise flooding and pollution due to wastewater	• Collaboration with the local authority and developers to understand the timing, size and location of developments with planning certainty
	• Upsize foul/combined sewers, pumps and rising mains as required
	• Reduce groundwater infiltration of foul sewers
	• Transfer wastewater to other treatment works with spare capacity
	• Construct offline storage tanks to attenuate high flows
	• Reduce surface water flows in combined sewers
Minimise flooding and pollution due to surface water and groundwater	• Remove misconnections of surface water to foul sewers
	• Maintain public sewers, highway drains and land drainage system
	• Upsize surface water/combined sewers and pumps as required
	• Construct offline storage tank/s to manage the impact of high flows
	• Installation of sustainable drainage systems (SuDS)
	• Separation of surface water from foul water in combined sewers
	• Reduce groundwater infiltration of foul sewers
Improve water bodies to 'good' status by 2021–27	• Implementation of Integrated Water Cycle Management and working with external stakeholders to reduce the pollution of water bodies
Maintain 'excellent' bathing waters	• Minimise pollution due to additional wastewater, surface water and groundwater flows using the potential strategies described above

Table 3. Action plan for the Drainage Strategy for Sidlesham (Manhood Peninsula)

No.	Action	Lead action owner	Supporting action owners	Due date	Action delivery status
1	**Through the drainage strategy, identify current drainage issues, key risks, shared outcomes and potential actions**	SW	WSCC, EA, CDC	End of 2016	A draft drainage strategy was issued to external stakeholders in November 2016 for comment and discussion. Feedback has been received from WSCC, CDC and the EA during the winter of 2016-17.
2	**Publish the drainage strategy on the Southern Water website**	SW	All stakeholders	Following receipt of comments from external stake-holders	The drainage strategy will be updated with feedback from external stakeholders before publication.
					Customers and other stakeholders will have the opportunity to provide feedback on the final drainage strategy.
3	**Improve Selsey's bathing water quality to 'excellent'**	SW	WSCC, EA, CDC	2019–20	In May 2017, Selsey was named as one of seven bathing waters to be improved to 'excellent' as detailed in the action plan for the bathing water.
4	**Review the needs and options identified in the Sidlesham DAP**	SW	WSCC, EA, CDC	End of 2017	In March 2015, a meeting was held with external stakeholders to identify risks in the Sidlesham catchment to inform the DAP.
					Structural, operational, growth, flooding and environmental needs and potential options have been identified and are being reviewed.
5	**Produce an action plan following completion of the Sidlesham DAP**	SW	WSCC, EA, CDC	Summer 2017	A Sidlesham DAP action plan is provided in appendix B of this drainage strategy.
6	**Complete the Pagham DAP which covers part of the Manhood Peninsula**	SW		2018	The Pagham DAP will be produced as part of Southern Water's ongoing 2015 to 2020 DAP programme prior to updating the drainage strategy for the Manhood Peninsula.
7a	**Identify sewerage flooding issues and remedial measures in Selsey (SWMP Ref. SELS_004)**	SW		Not stated in SWMP	An investigation of the sewer flooding issues in the eastern part of Selsey has been carried out as part of the Sidlesham DAP using hydraulic modelling of the sewerage system. A potential cause of sewer flooding has been identified as a lack of capacity in parts of the sewerage system. Possible options to reduce sewer flooding have been identified and will be considered during the assessment of all options identified in the DAPs in the Southern Water region.
7b	**Identify sewerage flooding issues and remedial measures in Sidlesham. Local residents have reported concerns about foul flows in Jury Lane. (SWMP Ref. SIDL_009)**	SW		Not stated in SWMP	As part of the Sidlesham DAP, sewer flooding issues have been investigated in property flooding clusters to the south and west of Sidlesham village. The flooding mechanism has been identified as possibly being due to groundwater infiltration or surface water inundation of the foul sewer network.
					Southern Water carried out surveys and repairs for groundwater infiltration in the village of Sidlesham in 2013. Ongoing monitoring of flow levels are to be carried out to check whether the repairs have been successful or whether further infiltration reduction is required. Southern Water does not manage sewers in Jury Lane, Sidlesham.
7c	**The foul pumping station on Pound Road in West Wittering is thought to be the cause of sewer flooding (SWMP Ref. WWIT_004)**	SW		Not stated in SWMP	An investigation of sewer flooding issues in West Wittering was included in the Sidlesham DAP. Hydraulic modelling has predicted potential flooding in Pound Road. Groundwater infiltration of the foul sewer network may be a cause of the flooding and requires further investigation using long term flow monitoring and possible CCTV surveys of the sewers.
8	**Investigate the use of SuDS to manage surface water issues**	SW	WSCC, EA, CDC	2018	Consultants have been appointed to carry out a study on the benefits of SuDS for Southern Water and its customers. Drainage partners are to be consulted on SuDS policy and implementation in each region.
9	**Provide support and funding for Operation Watershed Active Communities Fund**	WSCC	Community groups, town and parish councils	Ongoing	Communities are being encouraged to prepare for and reduce the risk and impacts of flooding in West Sussex through the provision of funding of £1.25m in 2013, £1.1m in 2014–15 and £0.5m in 2016–17.

(SW=Southern Water, EA =Environment Agency, WSCC=West Sussex County Council, CDC=Chichester District Council, DAP= Drainage Area Plan, SuDs=sustainable drainage systems, SWMP=surface water management plan)

Contents

1. Introduction

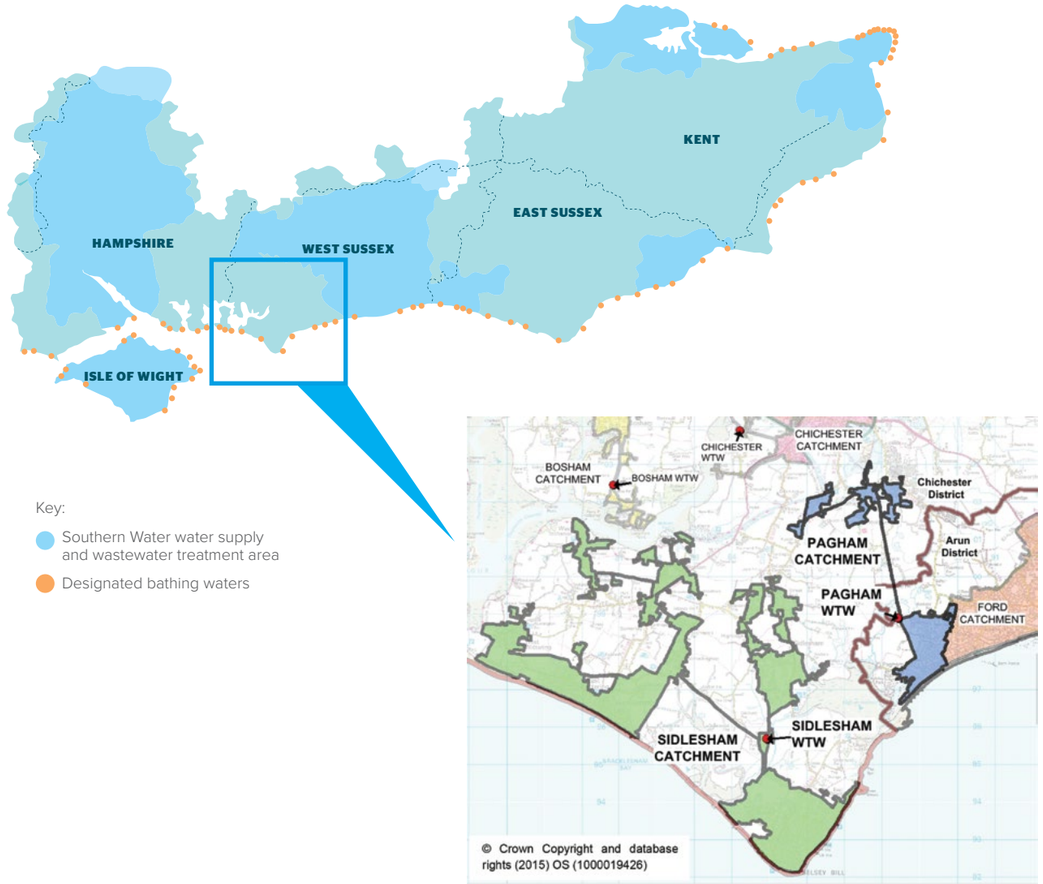
The Manhood Peninsula is located south of Chichester and falls within the administrative boundary of Chichester District Council and West Sussex County Council.

The region extends from Chichester Harbour in the west to Pagham Rife in the east and to Selsey at the southernmost tip of the peninsula. Villages in the region include Almodington, Birdham, Bracklesham, East/West Wittering, Sidlesham and West Itchenor.

Sidlesham Wastewater Treatment Works (WTW) treats wastewater that Southern Water collects from a catchment which covers an area of approximately 16km^2 as shown in figure 2. The works serves approximately 10,500 properties connected to the public sewerage system and also treats the wastewater produced by visitors to the region and trade effluent where these businesses connect to public sewers. Some rural areas are not connected to the public sewerage system and properties in these areas may discharge their wastewater into septic tanks or private sewage treatment systems which are not operated by Southern Water.

The wastewater from the Manhood Peninsula villages of North Mundham and Hunston flows southwards to the Pagham WTW which serves a catchment area of approximately 4km^2 and approximately 4,000 properties connected to the public sewers. This drainage strategy will be reviewed and updated when information is available from the Pagham drainage area plan as discussed in section 2.

Figure 2: Location of wastewater catchments serving the Manhood Peninsula



2. What is a Drainage Strategy?

The Drainage Strategy for Sidlesham (Manhood Peninsula) will enable us to take a more strategic approach to drainage planning across the area.

It will provide a long-term (25-year) strategy to ensure a reliable and sustainable wastewater service for the region while accommodating population growth, new development, climate change and stricter environmental quality standards.

To help develop the strategy, we have adopted the Drainage Strategy Framework (Environment Agency et al., 2013), outlined in figure 3. This framework recommends a four-stage planning process when preparing drainage strategies. This is similar to that used in the development of surface water management plans.

The Drainage Strategy for Sidlesham (Manhood Peninsula) covers the first (initialise/prepare) stage and the second (risk assessment) stage.

Our activities as part of stage three include an options appraisal of both traditional and alternative strategies which we will be undertaking in collaboration with our key local drainage partners.

What is a Drainage Area Plan?

This drainage strategy incorporates information from the Sidlesham Drainage Area Plan (Southern Water/MWH, 2015).

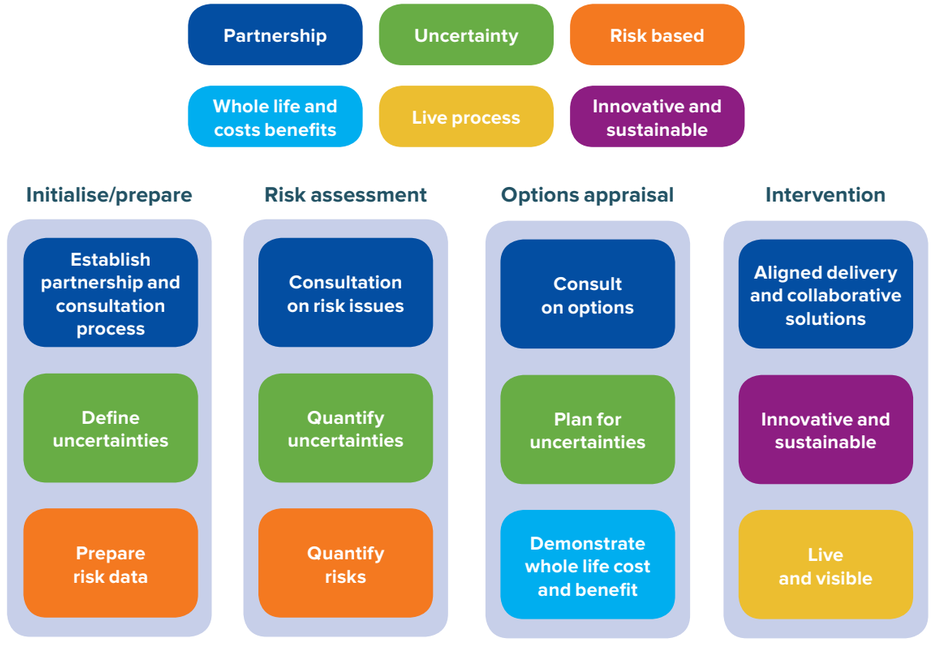
Southern Water maintains a rolling programme of drainage area plans (DAPs). The Pagham DAP is included in our DAP programme for 2015 to 2020 and when it is completed we will update this drainage strategy.

We prioritise the production of DAPs with the highest priority being those catchments with existing issues such as sewer flooding, and where there are proposals for future development which may affect the performance of the sewerage system. Sidlesham was selected as a priority DAP for these reasons.

The schemes identified from all DAPs are reviewed and prioritised against competing needs across the region and are critical in identifying investment requirement in the production of five- yearly business plans.

DAPs are internal Southern Water documents and are not intended to be public-facing. DAPs are a major source of information for drainage strategies which have a wider remit and are designed for public consumption.

Figure 3. Four stage process for the development of Drainage Strategies



3. Working in partnership

To ensure we develop and implement the most effective and sustainable strategies, we will need to work in partnership with other organisations who also have important drainage responsibilities.

For the Sidlesham catchment (Manhood Peninsula) this will include:

- Chichester District Council
- West Sussex County Council (Lead Local Flood Authority)
- Environment Agency
- Parish Councils
- Manhood Peninsula Partnership
- Local Flood Action Groups (eg West Manhood, Birdham & Earnley, Sidlesham)

We will work with our key stakeholders to improve our knowledge and understanding of issues such as population growth, climate change and urbanisation of green spaces.

A high level representation of the main stakeholders who contribute to the development of an effective drainage strategy is shown in figure 4.

Since the South-West Sussex Internal Drainage Board was dissolved recently, there is no internal drainage board for the Manhood Peninsula.

Figure 4. Roles and responsibilities for drainage

4. Current Drainage and Flooding Issues in the Manhood Peninsula

4.1 Environmental quality

The Manhood Peninsula benefits from a high-quality environment which includes a number of designated sites where wildlife, habitats, landscapes and heritage are protected as detailed in table 4.

Table 4. Designated sites on the Manhood Peninsula

Designated Site Description	Sites on the Manhood Peninsula
Ramsar and Special Protection Areas (wetlands, rare and migratory birds)	Pagham Harbour, Chichester & Langstone Harbours
Special Areas of Conservation (habitats and non-bird species)	Solent Maritime
Marine Conservation Zones	Selsey Bill and the Hounds, Pagham Harbour
Sites of Special Scientific Interest	Selsey East Beach, Pagham Harbour, Bracklesham Bay, Chichester Harbour
Local Nature Reserves	Pagham Harbour

Under the Water Framework Directive (WFD), the South-East River Basin Management Plan aims to achieve at least a 'good' status for all water bodies by 2027 with some expected to reach this status by 2021 (Environment Agency, 2016). Table 5 shows the current and predicted status of the different water bodies on the Manhood Peninsula.

Table 5. Water body status on the Manhood Peninsula in December 2015 (EA, 2016)

Water body name	Category	Status type	Classification (2015)	Predicted outcome (2021)	Predicted outcome (2027)
Broad Rife	River	Ecological	Bad	Poor	Good
		Chemical	Good	Good	Good
Bremere Rife	River	Ecological	Bad	Bad	Good
		Chemical	Good	Good	Good
Pagham Rife	River	Ecological	Moderate	Moderate	Good
		Chemical	Fail	Fail	Fail
Chichester Harbour	Transitional water	Ecological	Moderate	Moderate	Good
		Chemical	Good	Good	Good
Pagham Harbour	Transitional water	Ecological	Moderate	Moderate	Moderate
		Chemical	Good	Good	Good
Pagham Lagoon	Transitional water	Ecological	Good	Good	Good
		Chemical	Good	Good	Good
Sussex	Coastal water	Ecological	Moderate	Moderate	Good
		Chemical	Good	Good	Good
Chichester Canal	Canal	Ecological	Moderate	Moderate	Good
		Chemical	Good	Good	Good
South East Hants Bracklesham Group	Groundwater	Quantitative	Good	Good	Good
		Chemical	Poor	Poor	Good
Sussex Lambeth Group	Groundwater	Quantitative	Poor	Good	Good
		Chemical	Good	Good	Good
Littlehampton Anticline West	Groundwater	Quantitative	Poor	Good	Good
		Chemical	Good	Good	Good

The Broad Rife had an overall 'bad' ecological status in 2015. The Environment Agency (EA) has identified saline intrusion affecting invertebrates as a main contributor to the 'bad' status. A 'poor' to 'moderate' ecological status for the Broad Rife has been identified as being due to dissolved oxygen and phosphates in continuous sewage discharge from wastewater treatment sources. However, phosphates in rivers can also be due to run-off from agricultural land and leaking septic tanks. The Sidlesham Wastewater Treatment Works discharges into the Broad Rife and further work is required to understand the source of phosphates and dissolved oxygen and how Southern Water can assist in improvements to the Broad Rife.

The Bremere Rife had a 'bad' ecological status in 2015 which the EA has identified as being probably due to pollution in rural areas from agricultural sources.

The Pagham Rife had a 'failed' chemical status in 2015 which is probably due to diffuse sources of pollution from rural areas, towns, cities and transport (EA, 2016). Partnership working is key to achieving the higher environmental standards required under the Water Framework Directive (WFD).

4.2 Protection of groundwater sources

West Sussex has a high number of groundwater sources which provide clean, healthy drinking water that Southern Water and Portsmouth Water supplies to customers in the region. This groundwater is vulnerable to contamination from natural and man-made pollutants on the ground surface which pass down through thin soils and fissures into the chalk aquifers.

Groundwater source protection zones show the risk of contamination from any activities that might cause pollution in the area and can be seen on maps at the EA's 'What's in your backyard' website. There are no protection zones in the Manhood Peninsula apart from a small zone 1 (inner) which is just south of Fishbourne and is outside the Sidlesham wastewater catchment. The main protection zones are in the chalk downlands to the north of Chichester.

Under the WFD, the South East Hants Bracklesham groundwater body had a 'poor' chemical status in 2015 which the EA identified as probably due to pollution from landfill leaching and industry.

4.3 Bathing waters

The Manhood Peninsula has four designated bathing water sites which have weekly assessments of bathing water quality during the bathing season from May to September. Table 6 shows the historical and current annual assessment for each of these bathing waters.

Blue Flag award

Seaside award

Table 6. Bathing waters classification for the Manhood Peninsula (Based on EU Bathing Waters Directive 2006/7/EC)

	Defra's four-year rolling assessment					
Bathing Water	2009–12	2010–13	2011–14	2012–15	2013–16	2014–17
Bracklesham Bay	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Pagham	Excellent	Excellent	Excellent	Good	Good	Good
Selsey	Good	Good	Sufficient	Good	Good	Good
West Wittering	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent

West Wittering beach has been assessed as having 'excellent' bathing water quality over the last five years and was awarded a Blue Flag for its beach in 2017. In Bracklesham Bay and Pagham, bathing water quality has also been consistently 'excellent' or 'good' over the last five years.

Over the last 20 years, Southern Water has invested significantly to meet the requirements of the EU Urban Wastewater Treatment Directive (91/271/EEC) to improve the quality of treated wastewater that we discharge into the sea. This investment has included the provision of additional treatment at Sidlesham WTW and at two large wastewater treatment works (Ford near Arundel and Budds Farm, Havant) which discharge into the sea in the vicinity of the Manhood Peninsula.

Bathing water is affected by various sources of pollution such as:

- *the release of surface water after heavy rain which contains contaminated rainwater run-off from roads*
- *diluted, partially-treated wastewater from combined sewer overflows or pumping stations that has been released to prevent heavy rainfall overwhelming the sewerage system and flooding properties*
- *misconnections of foul sewage into surface water sewers which discharge into watercourses without treatment*
- *wastewater from private treatment works and leaking septic tanks which are not owned by Southern Water*
- *decaying seaweed and algae reaching nuisance levels*
- *heavy rainfall run-off from agricultural land into rivers*
- *animals and seabirds on or near beaches*
- *waste from boats.*

Our business plan for 2015–20 was developed through the biggest programme of customer research in our history. During this process, our customers indicated that clean bathing waters and beaches are a priority and they are willing to contribute more towards improvements where these are required. We are committed to maintaining the number of our bathing waters with 'excellent' water quality at 54 beaches across Hampshire, Isle of Wight, Kent and Sussex.

We are working with local authorities, the EA and other organisations over the next five years to find and fix sources of pollution preventing seven bathing waters in our region from achieving 'excellent' standard – this is one measure required for bathing waters to gain 'Blue Flag' status. This added benefit is over and above our statutory duties, which water companies are normally only funded to meet.

We have undertaken a rigorous selection process to shortlist 21 bathing waters from the 83 in our region for further investigation. Based on the Department for Environment, Food & Rural Affairs' (Defra's) four-year rolling assessment, table 6 shows that the Selsey bathing water has generally been of 'good' quality over the last five years, although it was assessed as 'sufficient' in 2014. As Selsey's bathing water has failed to reach 'excellent' quality in recent years, it was included in the 21 shortlisted bathing waters.

We spent a year carrying out a range of detailed investigations including watercourse sampling, DNA analysis and CCTV surveys of sewers to understand the causes of pollution at each of the shortlisted bathing waters. We also held a series of customer focus groups and have surveyed more than 3,600 customers and 300 businesses across the Southern Water region to get a better understanding of the views and needs of the communities at each location.

In May 2017, seven bathing waters including Selsey were selected for improvements to enable them to reach 'excellent' quality by 2019–20. An action plan has been developed which provides an overview of the issues our investigations uncovered at Selsey and the steps required to improve bathing water quality.

This project is part of our long-term plan to improve bathing water quality in our region. As part of this, we have committed to work with other agencies, local communities and landowners to bring all coastal waters at bathing beaches in the region up to the standard required to achieve Blue Flag status by 2040, provided there is continued support from our customers and regulator to do so..

4.4 Shellfish waters

There is a shellfish water protected area in Chichester Harbour (Thornham Channel) to the west of the Manhood Peninsula (Defra, 2016) which is harvested for oysters, clams and cockles. Further information is available in the Local Action Plan for Shellfish Harvesting Beds in Chichester Harbour (Chichester District Council and Havant Borough Council, 2015).

Sidlesham WTW discharges into the Broad Rife which flows into Bracklesham Bay approximately 9km east of Chichester Harbour.

4.5 Flooding

The Manhood Peninsula is at risk of flooding from groundwater, surface water, river and tidal sources. The EA's 'What's in your backyard' website provides maps which show the flood risk in the region.

It is Southern Water's responsibility to ensure our customers can continue to use their wastewater services in the event of a flooding incident. We will work alongside local councils, the EA and others to help alleviate the effects of flooding on the community.

As a flood risk management authority, Southern Water has the following responsibilities:

- *adopting new-build sewers*
- *managing public sewer flooding*
- *being scrutinised by the democratic processes of the lead local flood authority*
- *acting in accordance with the national and local strategies for flooding performing as a Category 2 responder to flood incidents under the Civil Contingencies Act.*

Southern Water's management of public sewer flooding is discussed later in this section.

Further information on groundwater, surface water and river flooding risk in the Manhood Peninsula and West Sussex can be found in the following documents:

- *Arun and Western Streams Catchment Flood Management Plan (EA, 2009)*
- *Strategic Flood Risk Assessment of West Sussex (Capita Symonds for WSCC, 2010)*
- *West Sussex Preliminary Flood Risk Assessment (WSCC, 2011)*
- *West Sussex County Council Report on June 2012 Flood Event (WSCC, 2012)*
- *West Sussex Local Flood Risk Management Strategy 2013 to 2018 (WSCC, 2014)*
- *Manhood Peninsula Surface Water Management Plan (ch2m for WSCC, 2015)*

Groundwater flooding

The geology of the Manhood Peninsula determines whether the region is vulnerable to groundwater flooding. The chalk South Downs are immediately north of Chichester from which groundwater emerges at Fishbourne Springs in the northern extremity of the Manhood Peninsula. It is believed that the groundwater flow in the South Downs may contribute to the baseflow (the level of ground water that seeps into the banks of a river or riverbed) in the upper reaches of the Pagham Rife.

In the central region of the Manhood Peninsula, the chalk layer is much deeper and is confined below thick layers of impermeable 'London Clay' and 'Reading Beds' so that groundwater in the chalk is generally unable to flow to the surface. At the southern end of the peninsula, around Selsey, Earnley and Wittering, the underlying geology is the 'Bracklesham Group'. This formation comprises a mixture of silt, sand and clay and may contain some groundwater in the more permeable areas.

The underlying strata are generally not exposed at the surface and are covered by thin superficial drift deposits. These deposits may contain coarse sands and gravels which can contain groundwater which is recharged relatively quickly following rainfall. This 'shallow' groundwater will then generally discharge into drainage ditches that flow into the rifes (rivers) on the peninsula.

Consequently, groundwater may increase flows in ditches and rifes which can contribute to the risk of river flooding when surface water from heavy rainfall is added to the flow. Direct groundwater flooding from emerging springs is unlikely to occur in the Manhood Peninsula.

High groundwater levels can prevent surface water dispersing from sewers into the ground in soakaways which can result in surface water flooding. There have been reports of flooding around soakaways in Stockbridge which is just south of the A27 (CH2M for West Sussex County Council, 2015).

High groundwater levels can also cause infiltration of sewers which is discussed further in section 6.5.

River and tidal flooding

The Manhood Peninsula is a low lying coastal area which is artificially drained by a series of main rivers known as 'the rifes' which are fed by the ditch network. The rifes discharge into Chichester Harbour, Pagham Harbour, the area protected by the Medmerry scheme or directly into the sea.

In 2005, tidal flooding occurred to the west of Selsey when coastal defences were overtopped. Since then, the Medmerry coastal flood defence scheme has been completed between Selsey and Bracklesham and protects over 300 properties from tidal flooding. The low lying nature of the area means it is at particular risk from tidal flooding due to potential sea level rises as a result of climate change.

High tides can prevent the rifes from draining into the sea which can create back-up in the rifes and inland flooding. The EA is currently reviewing the operation of its Ferry Road pumping station which pumps flows from the Broad Rife when it is tide-locked. Southern Water is currently considering options to ensure that treated effluent can continue to be discharged from Sidlesham WTW when the Broad Rife is tide-locked.

During extreme rainfall events or following prolonged wet winters, flooding can occur from the rifes and the ditch network as they do not have the capacity to drain away the surface water. Further information is provided in the following section on surface water flooding.

The management of river and tidal flooding risk is primarily the responsibility of the EA, district and borough councils and internal drainage boards. The EA has recently completed the Bookers Lane Flood Alleviation Scheme which was partly funded by West Sussex County Council and local residents to reduce the risk of river flooding of properties in Earnley. Southern Water will co-operate with the other relevant authorities in the exercise of their flood and coastal erosion risk management functions.

Southern Water's main responsibility is to provide a resilient wastewater service in the event of river or tidal flooding. We assess the risk of flooding at our wastewater treatment works and pumping stations and whether flooding could affect critical assets. If potential loss of service is identified and it is cost-beneficial to do so, we can provide permanent flood protection measures such as bunding (retaining walls), flood walls, watertight doors and raising the height of critical equipment.

We also have a stock of temporary flood barriers and mobile generators which can be used to ensure that our sites can continue to operate at normal output if the site should be flooded.

Sidlesham WTW is in a high risk EA flood zone 3 for river flooding (greater than 1% annual probability) or sea flooding (greater than 0.5% annual probability). However, the Medmerry coastal flood defence scheme provides some protection to the works from tidal flooding.

Surface water flooding

Significant flooding has occurred on several occasions in the Manhood Peninsula due to the incapacity of the drainage ditches and rifes to drain surface water flows during prolonged wet winters – such as those experienced in 2012–13 and 2013–14.

In June 2012, extreme rainfall resulted in the flooding of approximately 110 properties on the Manhood Peninsula in the villages of East Wittering, Bracklesham, Almodington, Earnley, Birdham and Somerley (WSCC, 2012). The likelihood of this volume of rainfall is around once every 200 years and it overwhelmed the Manhood Peninsula land drainage system which is typically designed to withstand rainfall levels that occur between once in 25 to 100 years.

Surface water flooding in the Manhood Peninsula is the result of several factors:

- *the low-lying nature of the area with little gradient to drainage ditches*
- *inadequate capacity of the drainage system which is not designed to drain the surface water flows resulting from extreme rainfall*
- *inconsistency in the ditch network such as large ditches leading into small pipes or no pipes at all*
- *poor maintenance of the network that leads to blockages and collapses of ditches and culverts which remain unfixed*
- *impermeable clay soils which lead to ground saturation and results in ponds of surface water.*

Surface water can overload combined sewers which can result in flooding of diluted wastewater or controlled releases to the river. Surface water can also inundate foul sewers by entering the sewer through unsealed manholes in flooded areas.

Surface Water Management Plans (SWMP) are used to identify and assess flood risks from surface water and also local flooding due to groundwater and ordinary watercourses as defined in the Flood and Water Management Act 2010. A SWMP will also include actions to reduce local flooding that have been agreed by the drainage partners. Progress on the actions is reviewed periodically. These partners include the lead local flood authority, highways authorities, EA, sewerage undertaker and others.

In 2015, the Manhood Peninsula Surface Water Management Plan was completed (CH2M for West Sussex County Council, 2015) based on the following objectives:

- *to understand the surface water drainage in the area and gather additional data to reduce gaps in knowledge*
- *to identify pinch points in the network and connectivity issues*
- *to identify potential improvement works to reduce flood risk to communities in the peninsula including capital and maintenance measures, building on the work already undertaken by communities, partnerships and other organisations*
- *to produce up-to-date geographic information data of the ditch network.*

The SWMP assessed flooding data from the WSCC Highways Authority, Southern Water's sewer flooding DG5 Register, key stakeholder meetings and meetings with local residents. Based on flooding history, seven high priority locations were identified at Birdham & Westlands, East Wittering & Bracklesham, Hunston, Selsey, Sidlesham, Somerley and West Wittering. A further five medium priority locations were identified at Crouchers (A286), Runcton, South Mundham, Stockbridge and West Itchenor. Potential measures were identified for each location and actions were assigned to key stakeholders.

The SWMP identified five principles which are key to ensuring the long-term management of the drainage system on the Manhood Peninsula

- *ditch clearance remains the responsibility of riparian (waterside property) owners and landowners under the Land Drainage Act of 1991*
- *local communities have a key role to play through local flood action groups etc*
- *run-off into the ditch network needs to be controlled including run-off from new developments and glass houses*
- *the continuity of the ditch network is critical. Land drainage consents are important in preventing culverting or infilling of watercourses where it will increase the flood risk*
- *a consequence-based approach should be adopted which focuses on the most critical parts of the drainage network.*

Southern Water is fully participating in the development and implementation of the Manhood Peninsula Surface Water Management Plan with our drainage partners. Actions include:

- *ongoing maintenance of the public sewerage network, pumping stations and combined sewer overflows to ensure surface water flows can flow freely to treatment works and/or controlled releases*
- *the removal of properties which have been listed on a register called the DG5 (see glossary) as having experienced sewer flooding from water-pressure overloads caused by excessive surface water entering the sewerage system*
- *the identification of misconnections of surface water sewers to foul sewers (and vice-versa)*
- *promoting the use of sustainable drainage systems (SuDS) to reduce surface water entering the sewers.*

Southern Water's main responsibility is to provide a resilient wastewater service in the event of surface water flooding.

Sidlesham WTW is in a low risk zone (0.1% to 1% annual probability) for surface water flooding. However, some wastewater pumping stations such as Memorial Hall, Itchenor are in high risk zones (greater than 3.3% annual probability) for surface water flooding. Southern Water will assess flood risk and protect our sites from surface water flooding using the same principles outlined above for river and tidal flooding.

Sewer flooding (DG5 Register)

Properties can be flooded internally or externally if there is insufficient capacity in the sewers to transfer flows caused by surface water due to rainfall. After a sewer flooding, we investigate to establish whether it was the result of an overload of water pressure or other causes, such as blockages or sewer collapses. We then work to identify events caused by floods beyond our control. If appropriate, properties are added to the DG5 Register which records properties at risk of flooding under a classification based on the number of times they are likely to be flooded in a 10 or 20-year period.

The DG5 Register is managed by Southern Water and is regularly reviewed and updated. Further information may allow us to remove properties from the register or to downgrade the risk of sewer flooding by transferring the property from, for example, a two in 10 to a one in 10-year register or from the one in 10 to one in 20-year register.

Figure 5 shows that there have been two internal flooding incidents due to 'hydraulic overloading' (excessive water) in the Sidlesham catchment over the last five years. In 2012–13 and 2013–14, there were a high number of external flooding incidents due to hydraulic overloading which were related to rainfall. There have been significantly fewer external flooding incidents in the last three years.

Within the Sidlesham catchment, there are currently five properties on the DG5 Register which are at risk of internal flooding and 102 locations at risk of external flooding with a return period categorisation shown in table 7.

Table 7: DG5 Register for the Sidlesham catchment

Flood Risk	Internal Flooding	External Flooding
2 in 10 Years	0	10
1 in 10 Years	2	6
1 in 20 Years	3	86
Total	**5**	**102**

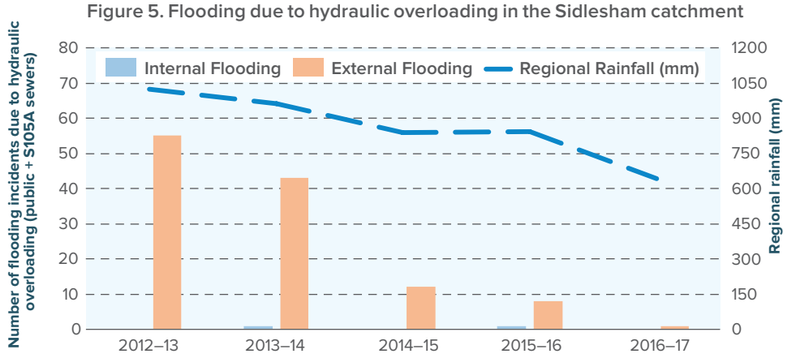
DAP flooding needs and options

Our drainage area plan (DAP) for the Sidlesham catchment (Southern Water/MWH, 2015) is primarily focused on a hydraulic appraisal of the drainage network. It includes an assessment of properties that are at risk of internal or external flooding due to hydraulic overload and are currently on the DG5 Register.

The properties and locations at risk of flooding in the Sidlesham catchment have been grouped into nine priority flooding clusters

- *Selsey*
- *Memorial Hall, Itchenor*
- *Church Road, East Wittering*
- *Highleigh*
- *East Bracklesham*
- *Almodington*
- *West Wittering*
- *Rookery Lane*
- *Pinks Lane, Birdham*

Figure 5. Flooding due to hydraulic overloading in the Sidlesham catchment



For each of these flooding clusters, a hydraulic modelling assessment has been carried out as part of the DAP and the results have been verified by flow monitoring. Properties at risk of flooding were assessed using a predictive model based on a one in 30-year flood scenario and allowed for a 20% increase in extreme rainfall that might reasonably be expected to accompany climate change. An allowance for groundwater infiltration of the sewerage network has also been included in the model. Asset surveys and impermeable area surveys have been commissioned for this assessment.

For each flooding cluster, a position statement identifies the flooding mechanisms and provides a high-level review of the current preferred solutions based on the following short-term and long-term options:

- *Do nothing*
- *Isolation – disconnection of properties from the public sewer network. Flows are transferred to offline storage and then pumped to the public sewer.*
- *Get the best from the existing system (eg make improvements to the pumping station)*
- *Re-direct flows to parts of the network with sufficient capacity*
- *Provide additional storage within the network*
- *Increase the size of storm tanks at the treatment works*
- *Expand the existing sewer network*
- *Increase the size of existing pumping stations or provide new ones*
- *Provide or make changes to the combined sewer overflow*
- *Separate surface water from wastewater (eg install separate drainage systems and/ or removal of misconnections)*
- *Put in place sustainable drainage systems*
- *Adopt other solutions such as infiltration reduction*

For all flooding problems, surface water separation has been considered as the first option for flood alleviation. However, the Sidlesham catchment is predominantly separately drained and infiltration removal is the recurring first step in addressing many of the needs. Infiltration reduction would be highly beneficial to the performance of the sewer network and will be likely to reduce the need to expand capacity or introduce storage schemes designed to address flooding and growth needs in the catchment. Costs will be developed to enable a full appraisal to be made of all the options.

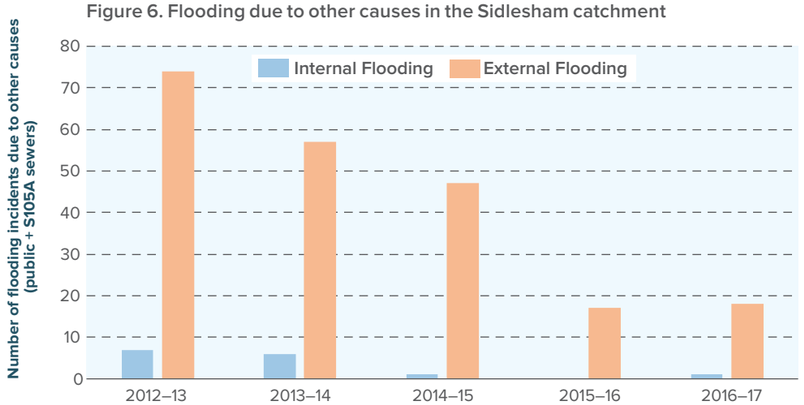
The Sidlesham DAP action plan in appendix B provides a summary of the flooding issues in the catchment, proposed schemes to resolve the flooding, and the current status of these schemes.

Further long-term strategies are considered in section 7.10 and appendix A.

Sewer flooding (other causes)

Around 85% of internal flooding incidents are due to other causes such as sewer blockages, sewer collapses, or equipment failure. Figure 6 shows a peak in 2012–13 in the number of external flooding incidents due to other causes which have reduced significantly in the last four years.

Figure 6. Flooding due to other causes in the Sidlesham catchment



5. Wastewater services in the Sidlesham catchment

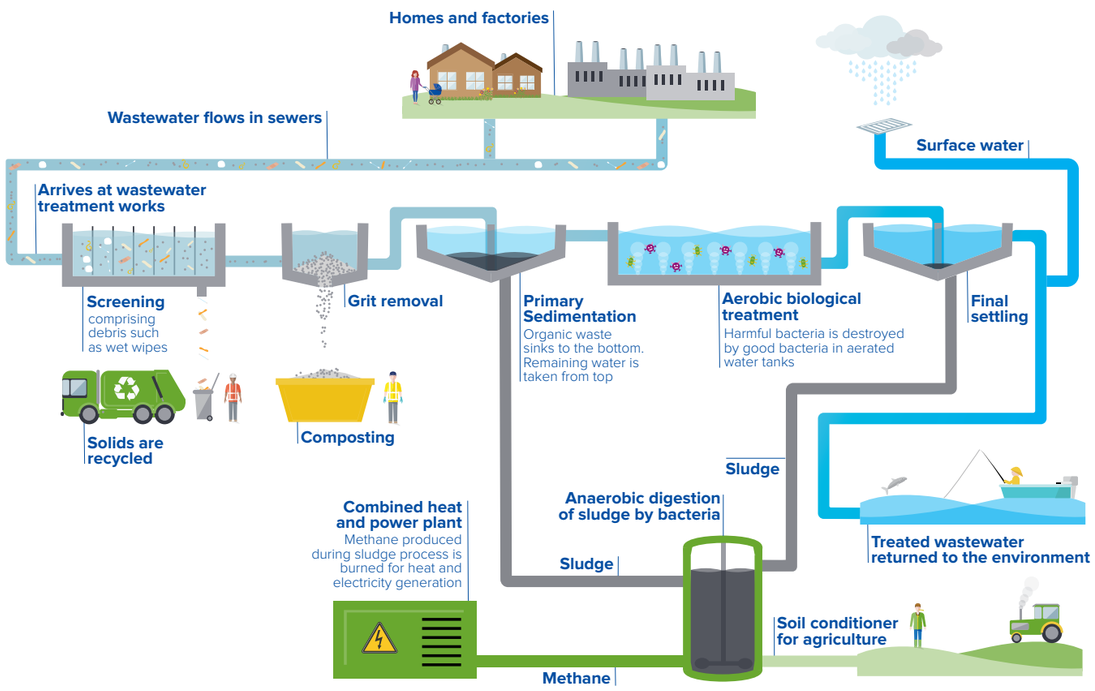
5.1 Wastewater collection and treatment process

Southern Water recycles wastewater from almost two million homes in Kent, Sussex, Hampshire and the Isle of Wight. Every day we treat and recycle an average of 717 million litres of wastewater at our 365 treatment works after it has been pumped through a sewer network 39,600 kilometres long.

Wastewater comes from water used in homes, businesses and factories as well as some of the surface water run-off from rain falling on roofs or roads which ends up in our sewer network.

The wastewater flows by gravity through smaller drains and sewers to large diameter trunk sewers that carry wastewater flows from whole villages or suburbs of towns. Where required, the wastewater is pumped from a low level to a higher level using pumps at a wastewater pumping station (WPS). Figure 7 provides a simple diagram showing how the wastewater is collected, screened and processed at a wastewater treatment works before the treated water is returned to rivers or the sea. Further information on the wastewater process can be found at **southernwater.co.uk/the-wastewater-process.**

Figure 7. The wastewater treatment process



5.2 Wastewater catchment map and schematic

Southern Water collects and treats wastewater from the Sidlesham catchment on the Manhood Peninsula. Figure 8 shows how wastewater flows to the treatment works from the sewerage network.

The Sidlesham catchment has a total of approximately 167km of public sewers which primarily comprise foul sewers that transfer waste flows only. Less than 1% of the network is combined sewers which transfer waste and surface water flows together in the same pipe.

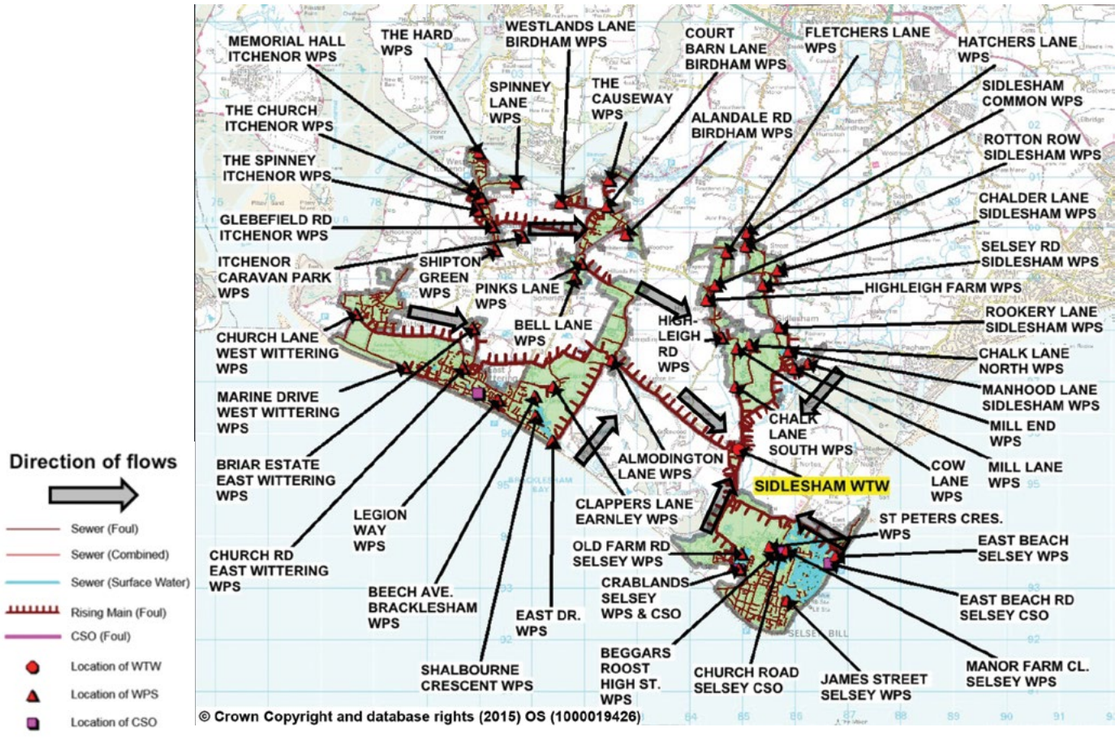
There are 46 wastewater pumping stations in the Sidlesham catchment which have 36km of rising mains associated with them. This is a relatively high number of pumping stations for the size of catchment and they generally operate in sequence, pumping flow from one station sub-catchment to another. The performance of the pumping stations is monitored remotely through a telemetry link.

In Selsey, there are combined sewer overflows (CSO) at East Beach Road, Crablands and Church Road. If the flows exceed the capacity of the network in these locations then there will be a controlled release of excess diluted screened flows to a watercourse, so that properties are protected from flooding. These overflows are approved by the EA's permit team and none are currently classed as 'unsatisfactory' by the EA (Southern Water/MWH, 2015).

Southern Water also manages approximately 26km of separate surface water public sewers mainly in Selsey and a small network in Bracklesham. The surface water sewers in Selsey flow into a pond at East Beach before discharging into the sea. Private systems for surface water drainage may exist but are unrecorded and may drain into soakaways or potentially discharge, as illegal connections, to the foul sewerage network.

In most villages there is a positive highway drainage system via gullies and pipes which

Figure 8. Sidlesham Wastewater Catchment



drain into the ditch network, and surface water flows which run into the rifes. West Sussex County Council is responsible for managing and maintaining the highway drainage network.

Sidlesham Wastewater Treatment Works serves approximately 10,500 properties in the villages of Almodington, Birdham, Bracklesham, Selsey, Sidlesham, West Itchenor, East and West Wittering. The treatment works is located approximately 2km south-west of Sidlesham.

The inlet to the works receives wastewater flows from pumped rising mains located at Crablands Selsey WPS, East Beach Selsey WPS, Almodington Lane Earnley WPS, Chalk Lane Sidlesham South WPS and Manhood Lane Sidlesham WPS. Flow is discharged into the inlet screen chamber where screens remove non-biological items such as wet wipes. During storms, excessive flow is diverted into two storm storage tanks which have an overflow should the storm tanks be filled to capacity. The wastewater is pumped from the inlet works to primary settlement tanks. This is followed by biological treatment to break down organic matter and further treatment to reduce nitrogen.

The final treated effluent is discharged into the Broad Rife which, in turn, discharges into the sea to the west of Selsey.

In some locations on the Manhood Peninsula, there are private sewage treatment plants or septic tanks which are not owned or maintained by Southern Water.

5.3 Wastewater service performance

We routinely monitor, analyse and report the performance of our wastewater sewerage networks and treatment processes to enable us and our regulators to assess the service provided to our customers and the impact of our activities on the environment.

Sewer blockages

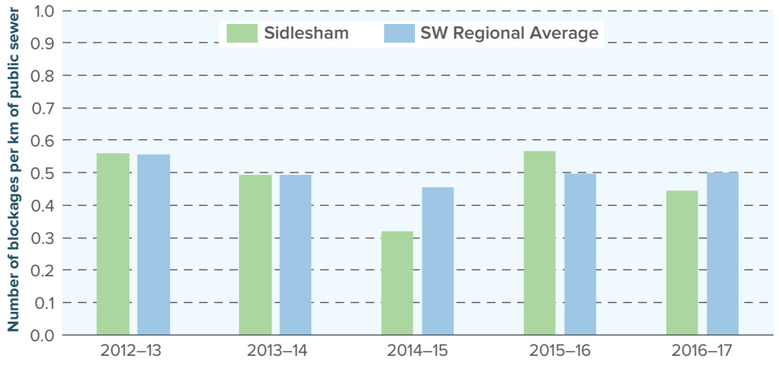
Every year there are thousands of avoidable blockages in our sewers caused by people flushing the wrong things down the toilet or by pouring fat, oil and grease down the sink. Sewer blockages can result in flooding to customers' properties or pollution.

Figure 9 shows that the number of blockages recorded per km of public sewer in the Sidlesham catchment has generally been close to the Southern Water regional average. In the Sidlesham catchment, 85% of blockages occurred in Selsey with a high proportion on the High Street. We use high-powered water jets to clear blockages and ensure our sewers are running freely. In 2015, we launched our 'Keep it Clear' campaign which involves teams visiting 'blockage hotspot' areas to educate customers on how to safely dispose of items.

Sewer collapses and rising main bursts

The Sidlesham DAP (Southern Water/MWH, 2015) has identified seven sewer collapses of public sewers in the Sidlesham catchment over the last five years. We have an ongoing programme to replace or refurbish ageing sewers at high risk of collapse.

Figure 9. Blockages in the Sidlesham catchment



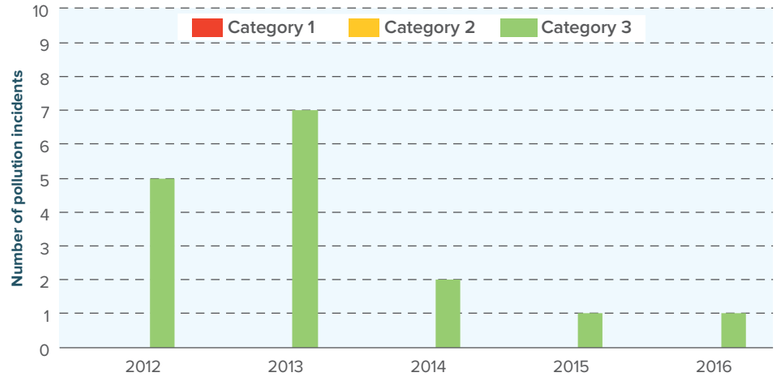
Rising mains contain wastewater that is pumped under pressure from our wastewater pumping stations. A burst will often result in pollution of the environment or flooding. There have been two rising mains bursts per year on average over the last five years in the Sidlesham catchment.

Pollution incidents

Pollution incidents due to a failure of our wastewater assets are reported to the EA. The severity of the pollution is agreed and categorised as 1 (major), 2 (significant), 3 (minor) or 4 (no pollution).

Figure 10 shows that there have been no serious pollution incidents (Categories 1 and 2) in the Sidlesham catchment over the last five years. Following a peak in 2013, there has been a significant drop in Category 3 pollution incidents in the last three years.

Figure 10. Pollution incidents in the Sidlesham catchment



Wastewater treatment works compliance with permits

As part of the wastewater treatment process, we must comply with permits issued by the EA to release treated wastewater into watercourses. For 2010–15, the Sidlesham Wastewater Treatment Works was compliant with its permits.

6. Risks to wastewater services

We have assessed the future risks to the delivery of an effective and reliable service in the Sidlesham wastewater catchment. Our risk assessment is based on a 'do nothing' scenario where we do not carry out any activity to reduce the risk.

Table 8: Growth in wastewater connections in the Sidlesham catchment (Source: Office for National Statistics and local plan)

Wastewater catchment	Number of properties connected to the public sewers	% change in properties connecting to our wastewater service from a 2015 baseline		
	2015	2020	2025	2040
Sidlesham	10,500 approx.	+2.3%	+4.8%	+11.6%

6.1 Growth

Over the next 25 years, population growth in the Sidlesham catchment is expected to result in a 12% increase in domestic properties connecting to our sewers as detailed in table 8.

6.1.1 Network capacity for growth

An assessment of the impact of growth on the sewerage network has been carried out for the drainage area plan. To understand the impact of population growth, the forecast number of new wastewater connections between 2015 and 2040 has been added to hydraulic computational models of the sewerage system. The location of new connections over the next 25 years is unknown. However, from local authority plans we know the potential locations and number of new connections over the next five years or so. Based on this, an informed judgment has been made on the location and number of new connections in the catchment to 2020 and 2040.

Table 9: Network capacity for the growth in wastewater connections in the Sidlesham catchment

Year	Assumed number of new developments	% of new wastewater connections which can be accommodated
2020	12	30%
2040	19	53%

For each new development, an assessment has been made on whether there is sufficient capacity in the sewerage system to accommodate the new wastewater connections to 2020 and 2040. This assessment is based on the modelled change in sewer surcharge and flooding from manholes and whether there is an unacceptable deterioration in the hydraulic performance of the network. Table 9 shows the percentage of new wastewater connections which can be accommodated by the sewerage network without unacceptable deterioration in our wastewater service. This percentage should be considered an approximate value as it is dependent on the assumed location and size of developments. In addition, the results of hydraulic modelling are conservative to ensure that we do not under predict the impact of both flooding and growth.

The sewerage network in the Sidlesham catchment has sufficient capacity to accommodate only 53% of the forecast new development over the next 25 years depending on location. This should not be seen as a constraint to development but as an indicator that investment may be required to meet demand. Our customers have a right to connect to the sewerage network irrespective of sufficient sewerage capacity. Where hydraulic issues have been identified, we would look to the application of planning conditions that require a customer to agree a suitable solution for drainage with ourselves or another supplier. If a connection is made under these circumstances then we will look to address the hydraulic issues in accordance with our prioritised investment programme.

DAP growth needs and options

The hydraulic modelling in the DAP has identified 12 new developments which would create an unacceptable deterioration in the performance of the network. A series of options have been assessed to improve the network to accommodate this growth. In general, the preferred options to meet growth needs in the catchment are similar to the flooding options and include:

- *Reducing the amount of groundwater getting into the sewer network (infiltration reduction)*
- *Increased storage*
- *Expand sewer capacity and send a higher volume of wastewater for treatment to the works by installing bigger, more powerful pumps*

It should be noted that carrying out infiltration reduction first would reduce the scope and cost of capital schemes such as providing extra offline storage or upsizing sewers and pumps.

Costs are to be developed to enable a full appraisal to be made of the options identified in the DAP. These options would only resolve the forecast deterioration in sewer surcharge and flooding back to 2015 levels and would not remove the 2015 baseline flooding.

The Sidlesham DAP action plan in appendix B provides a summary of the growth issues in the catchment, proposed schemes to manage growth and the current status of these schemes.

Further long-term strategies are considered in section 7.10 and appendix A.

Effect of growth on releases

During periods of intense rainfall, high volumes of surface water can quickly enter our sewers. In these circumstances, we may have to carry out a controlled release of diluted screened wastewater from combined sewer overflows or sea outfalls into watercourses, to protect properties from flooding. We monitor the number and duration of these releases against our consent for these overflows. We also have alarms to notify us of releases into sensitive areas such as bathing or shellfish waters.

Table 10 lists three consented network overflows within the Sidlesham catchment and a storm tanks overflow at Sidlesham WTW. The DAP reports that none of these are currently classed as 'unsatisfactory' by the EA (Southern Water, 2015).

In addition to an increase in surcharged sewers and flooding, the growth in new wastewater connections can also result in an increase in releases from overflows. In our DAP, we have modelled the increase in releases due to the forecast growth in new connections to the network as shown in table 10.

Table 10: Overflow releases due to the growth in wastewater connections in the Sidlesham catchment

Overflow	Receiving water	Annual overflow releases (m^3)	% change in annual overflow releases from 2015	
		2015	2020	2040
Sidlesham WTW Storm Tank	Broad Rife	56,134	+7.2%	+18.2%
East Beach Road, Selsey	English Channel (East Selsey)	34	+6%	+6%
Crablands, Selsey	Minor watercourse	None	0%	0%
Church Road, Selsey CSO	Minor watercourse	None	0%	0%

Table 11. Network growth risk assessment for the Sidlesham catchment – a 'do nothing' scenario

Wastewater catchment	2020 to 2025	2040	Comments
Sidlesham	Medium	Medium to high	The Sidlesham sewerage network can accommodate approximately 53% of the forecast new wastewater connections over the next 25 years without an unacceptable deterioration in our wastewater service. Additional capacity could be delivered in parallel with development.

Network growth risk assessment

If we do nothing to accommodate the forecast new connections to our sewerage network, table 11 shows the risk that this would create for delivery of a reliable wastewater service in the Sidlesham catchment.

It is our statutory duty to provide the required sewer capacity for new developments as they are built, and to protect our customers and the environment from additional flooding or pollution that could arise. We will work in collaboration with developers and the planning authority to understand the location and timing of new developments. However, we should only deliver new capacity where there is a demonstrable need to deliver this for growth. Developer contributions may be required in line with the regulatory framework for the water industry.

6.1.2 Treatment capacity for growth

Process treatment growth is the increase in hydraulic (water) and organic load, which may require additional investment at wastewater treatment works to maintain existing levels of service to customers and to protect the environment. We measure growth in terms of the predicted rise in 'population equivalent' and 'dry weather flow' (DWF). Our statutory obligation is to allow timely connection of new developments and ensure we maintain compliance with the works' permit conditions.

Population equivalent

The capacity of a sewage treatment works is measured in terms of the 'population equivalent' served by the works and is based on the amount of organic material that can be treated (see glossary). The total population equivalent served by a works is primarily based on the permanent resident population in the catchment but also includes non-permanent visitors to the region. Trade effluent generally makes up less than 1% of the load treated at the Sidlesham WTW and is less significant. The population equivalent served by the Sidlesham WTW is predicted to increase in line with the forecast growth in properties connected to the public sewers.

We have assessed the capacity of our process treatment assets at our Sidlesham WTW in terms of the population equivalent load that can be treated. Sidlesham WTW is currently operating at the limit of its treatment capacity. It is likely that an increase in treatment capacity will be required in line with the anticipated demand. As part of our business plan for 2015–20, we have plans to boost the treatment capacity at Sidlesham WTW when there is certainty that new developments will be constructed.

Dry Weather Flow (DWF)

Wastewater treatment works are issued with a discharge consent to limit pollution of the watercourse receiving the treated effluent. The EA sets DWF consents for each works which are based on the flow of the receiving watercourse being at its lowest after a long period of dry weather. After a dry period, the treated effluent will have minimal dilution and maximum potential pollution impact on the receiving watercourse. We monitor the DWF and report any breaches of the DWF consent conditions to the EA.

Table 12. Process growth risk assessment for the Sidlesham catchment – process growth risk assessment for a 'do nothing' scenario

Wastewater catchment	2020 to 2025	2040	Comments
Sidlesham	Medium to high	High	Sidlesham WTW is currently at its treatment capacity and is likely to require an increase in population equivalent capacity and DWF consent in line with the anticipated growth in new connections.

Table 13. Climate change risk assessment for the Sidlesham catchment – a 'do nothing' scenario

Catchment	2020 to 2025	2040	Comments
Sidlesham	Low to medium	Medium	More intense storms and higher sea levels due to climate change are likely to have an effect on our sewerage network in the area.

Sidlesham WTW is operating at the limit of its DWF consent and it is likely that we will need to apply to the EA to increase the dry weather flow consent at Sidlesham WTW in line with the anticipated demand. However, based on flow data, it is estimated that groundwater infiltration comprises 37% of winter DWF and 24% of summer DWF (Southern Water/MWH, 2015). A reduction in infiltration may provide sufficient headroom to accommodate additional wastewater flows within the current DWF consent.

6.2 Climate change

Climate change is likely to result in changes in rainfall, sea level and temperature. Southern Water has recently assessed the risks from climate change and identified actions to reduce them in our report on 'Adapting to Climate Change 2015' (Southern Water, 2015). The report found the following:

- *Less rainfall is likely to result in:*
  - *increased demand for water for agriculture, horticulture, gardening etc*
  - *longer dry periods and potential for increased blockage rates in sewers.*
- *Increase in extreme rainfall intensity is likely to result in:*
  - *surcharging of combined/surface water sewers which can result in flooding of properties*
  - *increase in controlled releases from combined sewer overflows potentially affecting bathing/shellfish water quality*
  - *direct flooding of critical assets at wastewater treatment works and pumping stations*
  - *loss of power supply, logistic and transport difficulties caused by extreme weather.*
- *A sea-level rise is likely to result in:*
  - *direct flooding of customers' properties, wastewater treatment works and pumping stations*
  - *higher groundwater levels resulting in increased sewer infiltration by groundwater and a potential increase in saline intrusion*
  - *increased sea level preventing the free discharge of surface water from outfalls.*
- *An increase in temperature is likely to result in:*
  - *increased demand for water for drinking, agriculture, horticulture etc*
  - *demographic change (a redistribution of population across the region due to water stress)*
  - *increased microbial action and consequential increase from H_2S attack on sewers and mains*
  - *a potential detrimental effect on wastewater treatment processes*
  - *ground movement that can damage sewers and other wastewater assets*
  - *potential increased impact on receiving waters due to lower river flows.*

Based on advice by the EA (2010), the increase in extreme rainfall intensity by the 2050s is predicted to be 5%, 10% and 20% for lower, average and upper forecasts respectively. When assessing network capacity for new developments or schemes to relieve hydraulic overloading, Southern Water uses an upper forecast of a 20% increase in extreme rainfall to model the affect of climate change. We will work in collaboration with developers and planning authorities to ensure that the risk caused by climate change is not a constraint to new development.

Climate change is generally considered to create a medium risk to the long-term performance of our wastewater services in the Manhood Peninsula. This is due to the following reasons:

- *An increase in intense storms will result in more surface water run-off which we already know is a cause of historic flooding issues in the area.*

Table 14. Urban creep risk assessment for the Sidlesham catchment – a 'do nothing' scenario

Catchment	2020 to 2025	2040	Comments
Sidlesham	Low to medium	Medium	The area is mainly rural but urban creep will occur due to new development and extensions of existing properties.

- *New developments will increase the impermeable area in the catchment and surface water run-off entering the sewers.*
- *The projected rise in sea-level would result in more tide-locking of outfalls and discharges from the land drainage system which would cause the back up of flows in the rifes and potential flooding.*
- *Tidal flooding risk is likely to increase due to higher sea levels and the low lying nature of the peninsula.*
- *Higher sea levels would also increase groundwater levels that could result in more infiltration.*
- *The uncertainty in the effects of climate change makes it difficult to predict the potential impact on, and degree of risk to, our sewerage system.*

6.3 Urban creep

'Urban creep' describes the gradual change of permeable land areas to impermeable areas within the urban environment. Typical 'urban creep' activities include new developments, the creation of impermeable hard-standings for vehicles in front gardens, the laying of patios in back gardens or the building of house extensions and conservatories. The resulting loss of permeable land in urban areas results in more rainwater and surface water run-off entering the surface water or combined drainage system. This increases the risk that the capacity of the drainage system will be exceeded during storms with an increased potential for flooding or pollution.

Research has found that urban creep is related to the density of housing in an area (Allitt & Tewkesbury, 2009). For low to medium density housing, the average urban creep would be approximately 0.8m^2/house/year for detached housing and 0.4m^2/house/year for semi-detached housing. For high density housing such as terraced houses, which have smaller gardens, the average urban creep would be approximately 0.15 to 0.2m^2/house/year.

In Southern Water's design standards, we currently allow for creep in new properties of 0.4 square metres per year per property up to a maximum of 4 square metres per property. This allowance for creep is currently under review.

There is some uncertainty regarding the relationship between urban creep and the volume of surface water run-off entering the sewerage system. Further work is required to understand this relationship and to model the effect of urban creep on network models.

Urban creep is considered to create a medium risk to the long-term performance of our wastewater services in the Manhood Peninsula. This is due to the following reasons:

- *The area is predominantly rural with a low density of properties that could be extended.*
- *New developments in the region will increase the impermeable area in the catchment with more potential for further urban creep as homeowners improve their properties.*

Southern Water will work in collaboration with developers and planning authorities to ensure that the risk caused by urban creep is not a constraint to new development.

6.4 Asset deterioration

The deterioration of our wastewater assets is an ongoing risk to the wastewater service we provide to our customers both now and in the future. These assets include pumps, process treatment equipment and all mechanical and electrical equipment. It also includes the sewers and rising mains which deteriorate over time depending on the material type and age, the soil type etc.

We reduce the risk of asset deterioration by identifying which assets will require maintenance, refurbishment or replacement in the short, medium and long term. We use deterioration modelling which is a risk-based system that identifies optimal future investment to achieve a specified level of service at least cost.

Table 15. Asset deterioration risk assessment for the Sidlesham catchment – a 'do nothing' scenario

Catchment	2020 to 2025	2040	Comments
Sidlesham	Low to medium	Medium	An average % of long-life vitrified clay sewers and a below average % of short-life pitch-fibre sewers. An above average % of PVC rising mains laid in the 1970s are at risk.

For the purposes of this drainage strategy, we have carried out an assessment of the age and material types of sewers and rising mains to be found in the Sidlesham wastewater catchment. This has been compared with the sewerage system in the county of West Sussex and the entire Southern Water region which also includes Hampshire, East Sussex, Kent and the Isle of Wight. This enables us to identify any particular risks in these catchments and whether there will be a requirement for significant investment to manage risks due to sewer deterioration.

In general, we have found that the risk of deterioration of our infrastructure assets affecting long-term performance is generally a medium risk in the Sidlesham catchment compared with other areas of the Southern Water region. This is due to the following reasons:

- *An average percentage of vitrified clay sewers which have high integrity and long life.*
- *A below average percentage of pitch fibre sewer pipes which have a short life.*
- *An above average percentage of asbestos cement pipes which have a limited life.*
- *An above average percentage of PVC rising mains laid in the 1970s. PVC pipes have a short life and are vulnerable to bursts.*
- *The sewers in the Sidlesham catchment were laid in the 1970s on average, which compares to the 1950s as the average laying date across the entire Southern Water region.*

6.5 Infiltration

Infiltration of groundwater into sewers generally occurs through cracks or joints. In areas where the groundwater level is high following prolonged rain, then groundwater infiltration can be significant and fill the sewers to their capacity which can cause restricted toilet use or sewer flooding of properties.

In recent winters, groundwater infiltration has caused significant issues to our customers in a number of villages across Hampshire, Sussex and Kent. In West Sussex, these include villages in the Lavant Valley to the north of Chichester and Maudlin and Westhampnett to the east of Chichester. In many areas, it has been necessary to protect our customers from flooding by removing additional groundwater flows from our sewers by tanker or over-pumping dilute screened wastewater into watercourses.

Our DAP study has identified that the Sidlesham catchment suffers from significant groundwater infiltration (Southern Water/MWH, 2015). During the winter, sewers can remain surcharged for long periods between rainfall events. Based on flow data, it is estimated that groundwater infiltration comprised 37% of winter DWF and 24% of summer DWF to the treatment works (Southern Water/MWH, 2015).

In the village of Sidlesham, groundwater infiltration of the sewerage network has resulted in six incidents of external flooding and six incidents of restricted toilet use between 2000 and 2016. During the winter of 2013–14, the wettest winter on record, flows in the sewers exceeded their capacity in Sidlesham and unfortunately it was necessary to make discharges from the sewers to the local

Table 16. Infiltration risk assessment for the Sidlesham catchment – a 'do nothing' scenario

Catchment	2020 to 2025	2040	Comments
Sidlesham	Medium	Medium to high	Sources of infiltration in the Sidlesham catchment have been identified and repaired. Based on flow data, there are likely to be other areas which require infiltration reduction. There is a risk that further deterioration of the sewers may result in future groundwater infiltration.

Table 17. Per capita consumption for the Portsmouth Water region				
Portsmouth Water region	2015	2020	2025	2040
Per capita consumption (PCC) (litres/head/day) for a dry year (annual company average)	157	155	152	149
Percentage change in PCC from 2015		-1%	-3%	-5%

watercourse to maintain sewerage services to Southern Water customers.

In areas where high infiltration has caused flooding or restricted toilet use, we carry out:

- *CCTV sewer surveys*
- *'lift and look' manhole surveys*
- *monitoring of flows including comparison to borehole data on groundwater levels*
- *techniques for infiltration investigations (eg electrical resistance techniques)*
- *sewer rehabilitation or replacement*
- *sealing/repairs of sewers and lateral connections*

In 2013, we surveyed approximately 1.4km of sewers for groundwater infiltration in Sidlesham and consequently repaired 170m of sewer in the Fletchers Lane/Rotten Row area of the village. We have recently carried out some sewer sealing in Itchenor to reduce infiltration.

The EA's Regulatory Position Statement (Environment Agency, 2014) requires water and sewerage companies who are aware of sewerage systems in their area that are vulnerable to infiltration, to submit infiltration reduction plans (IRP) to the EA for approval. An IRP has been prepared for Sidlesham and was submitted to the EA for approval in the summer of 2016.

The Sidlesham IRP is not yet ready for general publication but it will be similar to the IRP for St Mary Bourne near Andover which can be found at **www.southernwater.co.uk/st-mary-bourne-infiltration-reduction-plan**.

Southern Water has invested £14 million between 2013 and 2016 to improve the performance of the sewer network in the 60 towns and villages affected by high groundwater levels across the company's region. Due to the number of villages affected by groundwater infiltration issues, we prioritise the catchments that require infiltration reduction plans, sewer investigations and repairs.

The removal of groundwater infiltration from the network has the following benefits:

- *Protection of customers' properties and public areas from sewer flooding*
- *Reduction in the scope and cost of solutions to resolve flooding issues due to hydraulic overloading (eg smaller offline storage tanks)*
- *Increased capacity in the foul and combined sewer network and treatment works which can be used to accommodate additional wastewater flows due to the growth in connected properties*
- *Increased capacity in combined sewers to accommodate additional surface water flows due to more intense storms resulting from climate change*
- *Reduction in pumping and treatment costs which affect customers' bills*

Southern Water will work in collaboration with developers and planning authorities to ensure that the risk caused by infiltration is not a constraint to new development.

6.6 Clean water consumption

The volume of wastewater in the sewerage system is directly related to the volume of clean drinkable water supplied for domestic, business, industrial, agricultural and horticultural use. In general, we assume that 92.5% of the clean water supplied to a domestic property is disposed of as wastewater through the sewerage system. The remaining 7.5% is used for watering the garden, car washing, etc.

Portsmouth Water supplies clean water to the Manhood Peninsula. The average water consumption per person in the region is called 'per capita consumption' or PCC. Based on the Water Resources Management Plan (Portsmouth Water, 2014), table 17 shows that PCC is forecast to reduce across the Portsmouth Water region over the next 25 years. This is due to water efficiency measures and customers opting for a water meter.

Table 18. Clean water consumption risk assessment for the Sidlesham catchment – a 'do nothing' scenario			
Catchment	2020 to 2025	2040	Comments
Sidlesham	Low	Low	PCC is forecast to reduce with a corresponding reduction in wastewater.

It should be noted that the Southern Water region has a lower forecast PCC (144 l/h/d in 2020 and 138 l/h/d in 2040) than the Portsmouth Water region. This is mainly due to Southern Water's universal metering programme which has resulted in more than 90% of households being metered. If a similar level of metering is achieved in the Sidlesham catchment then there is scope for a further reduction in PCC which would reduce wastewater flows. A reduction in PCC would also free up capacity in the sewerage network to acccommodate the predicted growth in wastewater flows from new developments.

6.7 Environmental legislation

Over the last 25 years, the UK water environment has been significantly improved through the introduction of tightened environmental legislation implemented by the UK government and the European Commission. For example, the environment has been protected from the adverse effects of discharges of urban waste water through the Urban Waste Water Treatment Directive (91/271/EEC) introduced in the early 1990s. This has resulted in cleaner seas and bathing waters in our region.

The introduction of the Water Framework Directive has established a strategic approach to managing the water environment. It takes a common approach to setting environmental objectives for groundwater, dependent wetlands and surface water bodies. It also manages compliance with standards and objectives for protected areas and the implementation of programmes to meet those objectives.

To understand current and future legislation and policies, Southern Water liaises closely with agencies including the Environment Agency (EA), Department for the Environment, Food and Rural Affairs (Defra) and the Drinking Water Inspectorate (DWI) who are responsible for developing and implementing legislation in the UK. This provides us with a view of potential changes to legislation in the short to medium term. For the long-term, 25-year view, it is difficult to predict changes in legislation that would need to be considered in this drainage strategy.

Where required to meet more stringent environment legislation, Southern Water will seek investment to improve the quality of the effluent through traditional or alternative solutions and at the same time allow new development to connect to our services in line with our statutory obligations.

Table 19. Environmental legislation risk assessment for the Sidlesham catchment – a 'do nothing' scenario			
Catchment	2020 to 2025	2040	Comments
Sidlesham	Low to medium	Medium	Southern Water will seek investment to comply with changes in environmental legislation where applicable.

7. Strategic assessment

7.1 Outcomes for the Sidlesham catchment (Manhood Peninsula)

Our Five-year Business Plan 2015 to 2020 (Southern Water, 2013) sets out details of the improved water and wastewater services we will provide in the future. It was developed as a result of the company's biggest ever consultation programme which included feedback from more than 34,000 customers and stakeholders.

The plan is built around the delivery of six outcomes which our customers and stakeholders told us were their priorities. For each outcome we have developed a clear set of promises that detail what we will achieve for our customers. Three of these outcomes are relevant to the Drainage Strategy for Sidlesham (Manhood Peninsula) and are shown in figure 11 alongside the relevant promises associated with them.

Figure 11. Outcomes of relevance to the Drainage Strategy for Sidlesham (Manhood Peninsula)

Removing wastewater effectively

- *Minimising flooding from our sewers with a 25% reduction in internal sewer flooding incidents by 2020*
- *No increase in the number of incidents of sewer flooding affecting outside areas*
- *Maintaining stable asset health which includes our performance for sewer collapses and external flooding due to other causes*
- *No increase in the number of blockages in our sewer network*
- *A 5% reduction in complaints about smells from our wastewater treatment works and pumping stations by 2020*

Looking after the environment

- *Minimising wastewater pollution so that by 2020 there will be no serious (Category 1 & 2) pollution incidents caused by our operations. We are also aiming to halve the number of minor (Category 3) incidents from 2017 onwards*
- *Maintaining wastewater treatment works compliance by ensuring that any releases to the environment comply with permit conditions*
- *Maintaining 'excellent' bathing water quality and improving other bathing waters*

Better information and advice

- *Improved advice on how to prevent blocked drains to help reduce blockages*

In the medium term (five to 10 years) and long term (10 to 25 years), our outcomes have been developed during the preparation of outcome delivery strategies for key promises and outcomes. In table 20, we have identified the outcomes for the Sidlesham catchment to be achieved by 2020, 2025 and 2040. These include generic outcomes applicable to the entire Southern Water region and outcomes specifically related to the drainage issues identified for the Sidlesham catchment.

Table 20. Key outcomes for the Sidlesham catchment (Manhood Peninsula)

Year to achieve key outcome	Minimise flooding due to wastewater	Minimise flooding due to surface water and groundwater	Minimise pollution from wastewater	Maintain compliance at wastewater treatment works	Improve water bodies (groundwater, river, estuarine and shellfish waters)	Clean seas (bathing waters)
2020	Reduce internal sewer flooding incidents by 25% and no increase in external flooding incidents	Complete agreed actions for Southern Water in the Manhood Peninsula Surface Water Management Plan	Aim for zero Cat 1 & 2 pollution incidents and reduce Cat 3 incidents by more than half	Maintain population equivalent compliance at 99.9% or above and numeric compliance at 97.7% or above	Aim to achieve 'good' status for all water bodies by 2021 or 2027 in partnership with others	Maintain current 'excellent' classification of bathing waters in the region and improve Selsey bathing water to 'excellent'
2025	Reduce internal and external sewer flooding incidents further	Minimise flooding due to surface water and groundwater in collaboration with our drainage partners	Aim for zero Cat 1 & 2 pollution incidents and reduce Cat 3 incidents further	Aim for 100% compliance	Aim to achieve 'good' status for all water bodies by 2021 or 2027 in partnership with others	Maintain current 'excellent' classification of bathing waters in the region and potentially improve others to 'excellent'
2040	Aim for zero internal and external sewer flooding incidents	Minimise flooding due to surface water and groundwater in collaboration with our drainage partners	Aim for zero Cat 1, 2 & 3 pollution incidents	Aim for 100% compliance	Aim to achieve 'good' status for all water bodies in partnership with others	All designated bathing waters in region to meet the 'excellent' classification

7.2 Key outcomes at risk

In section 6, we assessed the current and future risks to the delivery of an effective and sustainable wastewater service in the Sidlesham catchment. In table 21, we have assessed these risks against delivery of our key outcomes if we do nothing.

Table 21. Key outcomes at risk in the Sidlesham catchment (Manhood Peninsula) if we do nothing

Key outcome	Risk of not delivering the outcome by;		Comments
	2020-25	2040	
Maintain compliance at wastewater treatment works	Medium to high	High	Sidlesham WTW is currently operating at its treatment capacity and is likely to require an expansion of treatment capacity and DWF consent in line with the anticipated growth in new connections. Additional capacity could be delivered in parallel with development.
Minimise flooding due to wastewater	Medium	Medium to high	The Sidlesham network can accommodate approximately 53% of the forecast new wastewater connections over the next 25 years without an unacceptable deterioration in our wastewater service. Additional capacity could be delivered in parallel with development.
Minimise flooding due to surface water and groundwater	Medium	Medium to high	Groundwater infiltration is considered to be significant across the catchment and has been an issue in the village of Sidlesham where repairs have been carried out. Groundwater levels may get higher as a consequence of rising sea levels due to climate change. Surface water flooding has been a significant issue due to the limited capacity of the land drainage system. Flooding is likely to increase due to more intense storms caused by climate change and more run-off due to urban creep.
Minimise pollution	Low	Low to medium	The number of pollution incidents in 2015 and 2016 were relatively low. The likelihood and severity of pollution incidents may increase due to additional wastewater, surface water and groundwater in the sewerage system.
Improve water bodies (river, lake, coastal groundwater)	Medium	Medium	Nine out of 11 water bodies on the Manhood Peninsula are predicted to achieve 'good' status by 2027 with the remaining two at 'moderate' status. Partnerships will be key to achieving the higher environmental standards required under the WFD.
Maintain 'excellent' bathing water quality	Low to medium	Low to medium	Three out of four bathing waters in the region have generally 'excellent' bathing water quality. At Selsey, we are working with partners to improve bathing water quality to 'excellent' by 2019–20.

The risk assessments in section 6 and table 21 were based on a 'do nothing' scenario. However, these risks will be identified, assessed and reduced through our 'business as usual' activities which are detailed in section 7.3.

7.3 Strategies: Business as usual activities

We carry out 'business as usual' activities to identify and reduce risks to delivery of our short and medium term outcomes as detailed in table 22.

Table 22. Business as usual activities to manage risk

Future risk	Identification and assessment of risk	Activities to reduce risk
Growth	Working closely with planners and developers to understand the location and timing of new developments	Where there is an identified need, deliver the required network and treatment capacity to accommodate growth. Developer contributions may be required in line with the regulatory framework for the industry
	Forecasts of growth at catchment level based on data from local plans and the Office for National Statistics	
	Hydraulic modelling of the impact of growth on our wastewater service	
Climate change and urban creep	Review published research and participate in industry research projects	When upgrading the network to accommodate growth, make an allowance for an uplift in extreme rainfall intensity due to climate change
	Partnership-working on surface water management plans and flood risk management strategies	
	Hydraulic modelling of the impact of additional surface water flows	
Asset deterioration	Modelling of asset deterioration to optimise maintenance programmes	Maintenance programmes to repair, refurbish or replace sewers, rising mains, pumping station or process equipment
Infiltration	Survey of networks with known infiltration issues in the catchment	Sealing of sewers and manholes to minimise infiltration in catchments with known issues
	Preparation and implementation of infiltration reduction plans	
Clean water consumption	Measurement and assessment of per capita consumption (PCC) in each Water Resource Zone	Provision of water meters to 92% of Southern Water customers through the Universal Metering Programme
	Forecasts of PCC	Education of customers on water efficiency
Environmental legislation	Close liaison with the Environment Agency, Department for Environment, Food and Rural Affairs, Drinking Water Inspectorate on environmental legislation and policy	Identification and implementation of schemes to meet our statutory obligations under the EA National Environment Programme
	Review of EU and UK government legislation on environmental issues	Upgrade of wastewater treatment assets to meet the requirements of environmental legislation

7.4 Strategies: Least whole life cost approach

The risks to delivery of our key catchment outcomes (objectives) can be reduced by traditional solutions to upgrade the sewerage network or wastewater treatment works. However, the cost of traditional solutions can be high and the benefits may be limited. To deliver our outcomes, we will always seek to implement the least whole life cost solution such as elimination or education before we carry out more expensive activities such as fabrication as illustrated in table 23.

Table 23. Strategies to achieve outcomes at least whole life cost

Strategy	Definition	Examples
Investigate	Understand better ways to achieve improved outcomes or reduce the whole life cost	Impact of climate change, improvements in growth planning, use of 'big data', investigations for the National Environmental Programme, opportunities for CSO removal, measurement of infiltration
Eliminate	Remove the root cause	Surface water separation, Integrated Water Cycle Management (IWCM), sustainable drainage systems (SuDS), improved targeting of blockages in sewer jetting programme
Engage and educate	Change behaviours to reduce demand for improved service levels	Educate customers on fat, oil and grease (FOG) and wet wipe disposal, identification of misconnections, trade effluent control, reduce diffuse agricultural pollution through engagement with landowners and diffuse urban pollution by engagement with customers and local authorities
Optimise	Operational or maintenance solution to extend asset life/ improve performance	Optimal operational maintenance with capital maintenance, optimisation supported by fault cause analysis
	Leverage of asset capability and unused headroom	Real time network control, reconfiguration of works control/ process, flood reduction measures
	Management action to reduce risk/improve performance	Lean processes, standards, risk management, capability, swifter response to failures
Work in partnership	Partnership with others, finding synergies to meet overall service	Drainage Strategies, SWMPs, flood management plans, infiltration reduction plans, improving bathing waters in conjunction with others
Fabricate	Design and construct new assets	Lean design and build of physical assets

Alternative long-term strategies such as the use of innovation, sustainable drainage systems, surface water separation and integrated water cycle management are described in Sections 7.5 to 7.8 respectively.

7.5 Strategies: Innovation

A key driver for improving our capabilities is the use of innovative techniques. Between 2015 and 2020, we will be investing significantly in research and development to investigate and implement innovative techniques that will enable a significant improvement in our capabilities and performance.

We will be bringing leading edge new approaches and technology to operational use. We will also develop solutions to support outcome delivery strategies and our technology roadmap. Our innovation priorities include the following:

- **Real time control systems (RTS)** *to monitor the sewerage network (sewer/wet well levels and flow) to detect blockages, collapses, equipment failures and hydraulic overloading. Alarms will provide warning to control centres and intelligent systems can automatically control flows to prevent flooding. Real time control systems could also be used to manage high flows during storm events and enable the transfer of flows to areas with available capacity.*
- **Network modelling and optimisation and predictive analytics** *to drive more responsive management and better targeted intervention to reduce the frequency of asset and service failure and improve resilience to extreme events.*
- **Plant and process optimisation** *to reduce the use of power and chemicals, lower costs and improve water and wastewater compliance.*
- **Energy efficiency and renewables** *to reduce our carbon footprint and energy costs.*
- **Recovering value from wastewater** *by seeing wastewater as a potential resource rather than as waste.*
- **Integrated Water Cycle Management** *(IWCM) to provide strategic direction in the management of water and environment pressures through strong partnership working and collaboration.*

7.6 Strategies: Sustainable drainage systems

Sustainable drainage systems (SuDS) can be used to manage the quantity of surface water run-off from new and existing developments in a natural way by replicating natural processes. The implementation of SuDS can have a significant impact on reducing the peak flows of surface water being discharged through drains and sewers following intense rainfall. The primary benefits from the use of SuDS include:

- *reduced flooding risk from surface water*
- *reduced surface water in combined sewers which releases capacity for wastewater flows*
- *reduced carbon emissions and energy costs due to less pumping and wastewater treatment*
- *reduced 'urban heat island' effect*
- *improved water quality of water bodies due to reduced diffuse urban pollution and combined sewer overflow (CSO) releases*
- *the recharging of aquifers in water-stressed areas such as Southern England*
- *the enhancement of urban spaces to improve the quality of life for local residents*
- *increased biodiversity.*

There are a range of SuDS techniques that are suitable for various ground conditions, topography etc. Infiltration SuDS techniques allow the surface water to infiltrate the ground in a controlled manner, reducing the risk of surface water flooding. Examples of infiltration SuDS techniques include filter strips, permeable pavement, soakaways, swales (shallow channels which lead surface water overland away from the drained surface to storage or a different point of discharge), infiltration basins and wetlands.

In some areas, infiltration techniques are not suitable due to pollutants in the surface water or soil, high groundwater levels or unavailability of land for swales or wetlands etc. There are other SuDS techniques which involve non-infiltration or attenuation (temporary storage of surface water) such as green roofs, rainwater harvesting, water butts, detention basins and underground storage tanks.

There are no Groundwater Source Protection Zones in the Manhood Peninsula apart from a small Zone 1 (inner) which is just south of Fishbourne. However, it has been identified that high groundwater levels in the area are likely to be preventing surface water flows from discharging to ground through soakaways. Therefore, infiltration SuDS techniques may not be suitable in parts of the Manhood Peninsula. As an alternative, the discharge of surface water to non-infiltration SuDS options or watercourses is considered more appropriate than a discharge to combined sewers.

A land drainage study of the Manhood Peninsula (Royal Haskoning for Chichester District Council, 2006) concluded that:

- *The viability of using SuDS on the peninsula as a method for reducing existing problems is limited due to the difficulty of retrofitting.*
- *SuDS would be effective and should be included in all future development whatever the scale. The inclusion of SuDS techniques should be viewed as a valuable asset to any development.*
- *Suitable ongoing management and maintenance of SuDS are essential to their continued effectiveness and therefore future responsibilities must be fully agreed at the time of implementation.*

7.7 Strategies: Surface water separation

In the Victorian age and the first half of the 20th century, most sewers were designed to carry wastewater and surface water run-off together in combined sewers. During storms, the rainwater in combined sewers can be up to 25 times the volume of wastewater which is carried in all weathers. Extreme rainfall intensity increases the risk of dilute wastewater flooding, pollution or overflows from combined sewers.

In more modern developments, separate networks have been provided for wastewater and surface water. In areas with a high density of combined sewers, it is possible to separate some of the surface water from the wastewater by providing a separate surface water network. However, retrofitting a new surface water sewerage system in an urban environment is expensive and may require the construction of new pumping stations and outfalls to watercourses.

Between 2012 and 2014, Southern Water invested £20 million in a surface water separation scheme in Portsmouth. The project has been successful and has reduced the risk of sewer flooding for thousands of properties and businesses in the city.

7.8 Strategies: Removal of misconnections

Illegal connections of surface water drainage to foul sewers can cause hydraulic overloading of sewers during heavy storms or prolonged rainfall. Foul drainage can also be illegally connected to surface water sewers which flow into watercourses or into the ground without treatment and consequently cause pollution.

These misconnections can occur during the construction of new developments or when extensions or improvements are made to properties. It is the responsibility of local authorities to monitor construction to prevent misconnections and to enforce private individuals to rectify their drainage.

Southern Water can work collaboratively with local authorities, construction firms and property owners to reduce misconnections through:

- *collaborative inspection teams with local authorities*
- *post-construction sewer flow monitoring*
- *educating property owners, local building firms etc*
- *providing rainwater harvesting equipment such as water butts.*

7.9 Strategies: Integrated Water Cycle Management

The South-East faces a number of challenges including water stress, stringent environmental needs, high population growth, and a risk of drought or flooding and climate change. To meet our long-term challenges, Southern Water needs to develop a more integrated approach to managing the water environment. We will work across the whole water cycle rather than seek individual solutions that only address specific environmental aspects in certain geographical areas. This is an innovative approach and will show leadership in the region. Greater collaboration and working with third parties, as well as enhanced technical understanding, will be required to realise the expected benefits.

Integrated water cycle management (IWCM) recognises that issues related to water are complex and that the main causes of negative impacts are inter-linked. IWCM requires the integration of all elements of the water cycle such as water resources, water use, natural water processes and treatment of wastewater.

Between 2015 and 2020, we will pilot IWCM in two catchments in Kent and West Sussex with a combined catchment area of over 3,200 km^2, 108 wastewater treatment works and over 130 water bodies. These catchments have been selected on the basis of the environmental circumstances, a mix of stakeholders and responsibilities and representation of varied water cycle challenges. We will be identifying world-wide best practice and emerging methodology including catchment management and restoration, sensitive urban design, surface water management, wastewater re-use, changes in customer behaviour and adopting new technology. By 2040, we intend to be operating a fully integrated water environment and working seamlessly with all water users.

7.10 Strategic assessments for the delivery of key catchment outcomes

Table 24 summarises the key outcomes that have been identified as requiring a strategic approach to reduce the risk. We are currently assessing a range of traditional engineering and alternative strategies to reduce these risks which are listed in table 24. The strategic assessment is based on a SWOT (strength, weakness, opportunities, threats) analysis where each strategy has been assessed under the following criteria, described in more detail in table 27 of appendix A:

These are:

- *Residual risk*
- *Whole life costs (capital and operational expenditure)*
- *Environmental impact*
- *Input required from other stakeholders*
- *Other constraints*
- *Programming*
- *Uncertainty.*

Tables 28 to 31 in appendix A provide the detailed assessment for each of the strategies to reduce the key outcomes at risk.

Table 24. Key outcomes at risk and potential solutions for the Sidlesham catchment (Manhood Peninsula)

Key outcomes at risk	Risk	Potential strategies	Detailed strategic assessment in Appendix A
Maintaining compliance with permits at our treatment works	Insufficient headroom in treatment capacity and dry weather flow consent to accommodate growth in excess or ahead of our forecast	• Collaboration with the local authority and developers to understand the timing, size and location of developments with planning certainty • Reduce groundwater infiltration of foul sewers • Provide additional treatment capacity at the works as required • Transfer wastewater to other treatment works with spare capacity	Table 28
Minimising flooding and pollution due to wastewater	Insufficient network capacity to accommodate forecast new wastewater connections due to growth in excess or ahead of our forecast	• Collaboration with the local authority and developers to understand the timing, size and location of developments with planning certainty • Upsize foul/combined sewers, pumps and rising mains as required • Reduce groundwater infiltration of foul sewers • Transfer wastewater to other treatment works with spare capacity • Construct offline storage tank/s to attenuate high flows • Reduce surface water flows in combined sewers	Table 29
Minimise flooding and pollution due to surface water and groundwater	Insufficient network capacity to accommodate groundwater infiltration and surface water flows which may increase due to climate change and urban creep	• Remove misconnections of surface water to foul sewers • Maintain public sewers, highway drains and land drainage system • Upsize surface water/combined sewers and pumps as required • Construct offline storage tank/s to attenuate high flows • Installation of sustainable drainage systems • Separation of surface water from foul water in combined sewers • Reduce groundwater infiltration of sewers	Table 30
Improving water bodies to 'good' status by 2021 or 2027 and improving bathing waters	Diffuse and point urban and rural pollution	• Implementation of integrated water cycle management and working with external stakeholders to reduce the pollution of water bodies	Table 31
Maintain 'excellent' bathing waters		• Minimise pollution due to additional wastewater, surface water and groundwater flows using the potential strategies described above	

8. Next steps

The Drainage Strategy Framework (Environment Agency et al., 2013) recommends a four-stage planning process when preparing a drainage strategy as discussed in section 2.

The Drainage Strategy for Sidlesham (Manhood Peninsula) is currently at stage 3 (options appraisal) and we are consulting with customers and key stakeholders in the region to identify and agree:

- *current drainage issues, future risks and shared outcomes for the region*
- *potential strategies to reduce risk in the short, medium and long-term*
- *a preferred strategy to achieve the outcomes required by Southern Water and key stakeholders*
- *actions to be carried out by Southern Water and key stakeholders which will be added to the action plan provided in section 9.*

It is proposed that the development and implementation of this drainage strategy will follow the timeline shown in figure 12. This will enable the strategy to be in line with the water industry's regulatory framework that requires each water company to submit an investment business plan to Ofwat for a price review on a five-yearly cycle.

When preparing business plans, we undertake surveys of our customers to determine their priorities. This could be clean drinking water, cleaner beaches, sewer flooding etc. As part of the survey, customers are asked how much they would be willing to pay to improve these service levels. All schemes to enhance the existing level of service afforded by sewerage systems are subject to cost-benefit analysis. In determining the cost-benefit of individual schemes against the results of the 'willingness to pay' survey, analysis is undertaken to determine the monetary benefit of improvements (eg reducing flooding risk results in less damage to properties and cleaning up) in comparison with the cost of delivering that improvement.

Figure 12. Timeline for development and implementation of a drainage strategy

2016 to 2017
Stakeholder engagement

Discuss the risks and solutions. Agree a preferred strategy

2017 to 2018
Investment Planning

In line with the preferred strategy and following customer consultation, develop cost-beneficial schemes to be included in Southern Water's business plan for 2020 to 2025 to be submitted to Ofwat for approval

2020 to 2025
Investment Delivery

Deliver the approved schemes/strategy

2021 to 2023
Review the Drainage Strategy

Review the current strategy and realised benefits. Review potential changes to the strategy. Further stakeholder engagement. Prepare the strategy for the next investment planning stage

9. Action plan

Table 25. Action plan for the Drainage Strategy for Sidlesham (Manhood Peninsula)

No.	Action	Lead action owner	Supporting action owners	Due date	Action delivery status
1	**Through the drainage strategy, identify current drainage issues, key risks, shared outcomes and potential actions**	SW	WSCC, EA, CDC	End of 2016	A draft drainage strategy was issued to external stakeholders in November 2016 for comment and discussion. Feedback has been received from WSCC, CDC and the EA during the winter of 2016–17.
2	**Publish the drainage strategy on the Southern Water website**	SW	All stakeholders	Following receipt of comments from external stake-holders	The drainage strategy will be updated with feedback from external stakeholders before publication.
					Customers and other stakeholders will have the opportunity to provide feedback on the final drainage strategy.
3	**Improve Selsey's bathing water quality to 'excellent'**	SW	WSCC, EA, CDC	2019–20	In May 2017, Selsey was named as one of seven bathing waters to be improved to 'excellent' as detailed in the action plan for the bathing water.
4	**Review the needs and options identified in the Sidlesham DAP**	SW	WSCC, EA, CDC	End of 2017	In March 2015, a meeting was held with external stakeholders to identify risks in the Sidlesham catchment to inform the DAP.
					Structural, operational, growth, flooding and environmental needs and potential options have been identified and are being reviewed.
5	**Produce an action plan following completion of the Sidlesham DAP**	SW	WSCC, EA, CDC	Summer 2017	A Sidlesham DAP action plan is provided in appendix B of this drainage strategy.
6	**Complete the Pagham DAP which covers part of the Manhood Peninsula**	SW		2018	The Pagham DAP will be produced as part of Southern Water's ongoing 2015 to 2020 DAP programme before updating the drainage strategy for the Manhood Peninsula.
7a	**Identify sewerage flooding issues and remedial measures in Selsey (SWMP Ref. SELS_004)**	SW		Not stated in SWMP	An investigation of the sewer flooding issues in the eastern part of Selsey has been carried out as part of the Sidlesham DAP using hydraulic modelling of the sewerage system. A potential cause of sewer flooding has been identified as a lack of capacity in parts of the sewerage system. Possible options to reduce sewer flooding have been identified and will be considered during the assessment of all options identified in the DAPs in the Southern Water region.
7b	**Identify sewerage flooding issues and remedial measures in Sidlesham. Local residents have reported concerns about foul flows in Jury Lane. (SWMP Ref. SIDL_009)**	SW		Not stated in SWMP	As part of the Sidlesham DAP, sewer flooding issues have been investigated in property flooding clusters to the south and west of Sidlesham village. The flooding mechanism has been identified as possibly being due to groundwater infiltration or surface water inundation of the foul sewer network.
					Southern Water carried out surveys and repairs for groundwater infiltration in the village of Sidlesham in 2013. Ongoing monitoring of flow levels are to be carried out to check whether the repairs have been successful or whether further infiltration reduction is required. Southern Water does not manage sewers in Jury Lane, Sidlesham.
7c	**The foul pumping station on Pound Road in West Wittering is thought to be the cause of sewer flooding (SWMP Ref. WWIT_004)**	SW		Not stated in SWMP	An investigation of sewer flooding issues in West Wittering was included in the Sidlesham DAP. Hydraulic modelling has predicted potential flooding in Pound Road. Groundwater infiltration of the foul sewer network may be a cause of the flooding and requires further investigation using long term flow monitoring and possible CCTV surveys of the sewers.
8	**Investigate the use of SuDS to manage surface water issues**	SW	WSCC, EA, CDC	2018	Consultants have been appointed to carry out a study on the benefits of SuDS for Southern Water and its customers. Drainage partners are to be consulted on SuDS policy and implementation in each region.
9	**Provide support and funding for Operation Watershed Active Communities Fund**	WSCC	Community groups, town and parish councils	Ongoing	Communities are being encouraged to prepare for and reduce the risk and impacts of flooding in West Sussex through the provision of funding of £1.25m in 2013, £1.1m in 2014–15 and £0.5m in 2016–17

(SW=Southern Water, EA =Environment Agency, WSCC=West Sussex County Council, CDC=Chichester District Council, DAP=drainage area plan, SuDs=sustainable drainage systems)

10. Glossary of terms

Table 26: Glossary of terms

Term	Description
Attenuate	The process of retaining water on site and slowly releasing it in a controlled discharge to a surface water or combined drain or watercourse.
Big data	Large and complex external data sets that can be analysed to provide information that may not be available from routine company performance data.
Combined sewer/ emergency overflow (CSO/CEO)	Enables a release of wastewater and storm water into a watercourse or the sea to protect properties from potential flooding.
Defra	Department for Environment, Food and Rural Affairs.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Drainage Area Plan (DAP)	Modelling of wastewater catchments to identify hydraulic overloading and other issues due to new developments, climate change etc. The DAP provides outline solutions to resolve flooding issues and accommodate growth.
Drainage Strategy Framework (DSF)	Long-term (25-year) strategies to provide a reliable and sustainable wastewater service in a catchment while accommodating growth, climate change and improving water bodies, bathing and shellfish water quality etc.
Dry Weather Flow (DWF)	The average daily flow to a wastewater treatment works during seven consecutive days without rain.
EA	Environment Agency.
FOG	Fat, oil and grease (FOG) that is poured down kitchen sinks and harden in sewers which restricts flow and can cause blockages.
Headroom	Spare capacity in a sewerage network or wastewater treatment works.
Hydraulic overload	Too much water in the system.
Infiltration reduction plan (IRP)	Infiltration is the ingress of groundwater into sewers through cracks and joints. IRPs are an EA requirement for water and sewerage companies to report on the activities being carried out to reduce infiltration.
Integrated water cycle management (IWCM)	An integrated approach to managing the water environment to meet long-term challenges of water stress, stringent environmental needs, high population growth, risk of drought or flooding and climate change.
Lead Local Flood Authority (LLFA)	LLFA are county councils and unitary authorities that have a number of flood management responsibilities including the local flood risk management strategy.
Offline	Refers to water which is diverted from its course and stored in a separate area
Ofwat	Ofwat is the economic regulator of the water sector in England and Wales.
Outcomes	Objectives
Online	Refers to water which is temporarily stored at points within the water channel
Per capita consumption (PCC)	Generally refers to the volume of water consumed by a person. The units for PCC are normally measured in litres per day.
Population equivalent	One population equivalent is the biodegradable load (matter) in wastewater having a five-day biochemical oxygen demand (BOD) of 60g of oxygen per day. Population equivalent does not necessarily reflect the actual population of a community and will include effluent from industrial or commercial premises.
Preliminary Flood Risk Assessment (PFRA)	Similar to a SFRA and provides a high level overview of flood risk in a county.
Preliminary treatment	A simple treatment which will typically involve screening to remove rags and other similar large solids, maceration of solids and grit removal.
Primary treatment	Primary treatment involves a physical and/or chemically-enhanced settlement of suspended solids that is not removed by preliminary treatment.
Private sewers	The ownership of private sewers and lateral drains was transferred to water and sewerage companies on 1 October 2011. Private pumping stations ownership was transferred on 1 October 2016 subject to certain criteria.
Secondary treatment	Secondary treatment involves biological treatment where bacteria are used to break down the biodegradable matter in wastewater.

Table 26: Glossary of terms – *continued*

Term	Description
Strategic Flood Risk Assessment (SFRA)	A study carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources in a district. The SFRA reviews the impact of climate change, and to assess the impact that land use changes will have on flood risk.
Sustainable drainage systems (SuDS)	Techniques used to manage the quantity of surface water run-off from new and existing developments by replicating natural processes. An SAB is a SuDs approval body to ensure that SuDS schemes meet requirements.
Surface Water Management Plan	A SWMP is used to assess the flood risks due to local flooding by surface water, groundwater and ordinary watercourses using a partnership approach.
Swale	A valley-like intersection of two slopes in a piece of land that can be used to store and manage surface water run-off.
Tertiary treatment	Tertiary treatment can involve disinfection to reduce pathogenic bacterial and viral organisms by treating wastewater with ultra violet light. It can also involve nutrient removal to help prevent the dense growth of algae and other organisms.
Upsize	Expand
Urban Waste Water Treatment Directive (UWWTD)	This European Union Directive was agreed in 1991 and sets standards for sewage treatment. The general principle of the directive is to provide treatment of sewage from the largest discharges first and to protect sensitive waters.
Water Framework Directive (WFD)	The EU Water Framework Directive is aimed at ensuring the sustainability of all activities that impact on water, thereby securing the availability of good quality water for sustainable and equitable water use

11. References

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Appendix A – Strategic assessments

Table 27: Key to strategic assessments

Strategic Assessment Level	Residual Risk	Whole Life Costs		Environmental Impact (due to implementation of the strategy)	Input Required from Other Stakeholders	Other Constraints	Programming	Uncertainties
		Capital Expenditure (Capex)	Operational Expenditure (Opex)					
Low	The strategy reduces the original risk to an acceptable level within the required time frame	**Low** = < £1 Million (estimate)	Minimal additional operational expenditure	Minimal environmental impact due to construction or operational activities resulting in; • *insignificant increase in carbon emissions* • *temporary noise, odours or traffic disruption.*	Southern Water would lead on the strategy with minimal input required from other stakeholders	Zero or minimal other constraints against successful implementation of the strategy	**Short term** The strategy could be implemented within the next 5 years	Minimal uncertainty in the data or methods used to evaluate the risk or strategy
Medium	The strategy would not fully reduce the original risk to an acceptable level within the required time frame. The strategy would either: • *be effective in the long term but insufficient for short to medium term* • *effective in the short to medium term but insufficient for the long term*	**Medium** £1 Million to £10 Million (estimate)	A significant increase in operational expenditure (power, labour etc) due to additional: • *pumping* • *operation of treatment assets* • *cleaning and maintenance* • *education campaigns* • *stakeholder/customer engagement plans* • *Analysis and modelling.*	There would be a significant impact on the environment as a result of the strategy due to; • *a permanent increase in carbon emissions (eg increased pumping or major construction)* • *an increased risk of pollution* • *an increase in discharge of treated/untreated effluent* • *significant traffic disruption, noise, odours etc.*	Some input would be required from other stakeholders such as; • *partnership to develop and implement the strategy* • *joint development and management of policies* • *provision of land or planning permission for construction* • *review of permit consents (DWF, discharges).*	Other constraints which would need to be considered in the strategic assessment such as; • *customer behaviour* • *potential changes to legislation* • *approval by other stakeholders* • *availability of land for construction* • *ease of access to land for construction/ operational activities* • *potential upgrading of associated assets as a result of the strategy.*	**Medium term** The strategy could be implemented within the next 5 to 10 years	Some uncertainty in the data or methods used to evaluate the risk or strategy. The uncertainties would affect the assessment of the risks and/ or strategic assessment. Work is required to increase the quality and/or quantity of data to improve our understanding.
High	The strategy would be ineffective at reducing the original risk to an acceptable level in the short, medium and long term	**High Capex** £10 Million to £30 Million (estimate) **Very high Capex** => £30 Million (estimate)	The strategy would result in a high increase in operational expenditure which would significantly affect the whole life total expenditure (totex).	The strategy would result in a very high impact on the environment which would be unacceptable. Additional investment would be required to reduce the environmental impact to an acceptable level.	High input would be required from other stakeholders to enable the strategy to be successful. Activities would include; • *activities listed above for the medium level* • *partnerships to share risks, costs and resources* • *implementation of additional actions and activities by stakeholders which are essential to successful achievement of the strategy.*	A high number of additional constraints which would have a significant impact on successful implementation of the strategy	**Long term** The strategy could be implemented within the next 10 to 25 years	A high level of uncertainty in the data or methods used to evaluate the risk or strategy. This uncertainty significantly affects the quality of the risk/ strategic assessment. Significant work is required to improve the quality and/or quantity of data.

Appendix A – Strategic assessments continued

Table 28: Strategic assessment for maintaining compliance with permits at our treatment works

Outcome: Maintaining compliance with permits at our treatment works					Risk: Insufficient headroom in treatment capacity and dry weather flow consent to accommodate growth				
Strategy description	Residual risk	Whole life costs		Environmental impact	Input required from other stakeholders	Other constraints	Environmental and societal benefits	Programming	Uncertainties
		Capital expenditure (Capex)	Operational expenditure (Opex)						
1) Reduce groundwater infiltration of foul sewers to reduce DWF	**Medium** Reduces the risk of breaching the DWF consent but doesn't increase treatment capacity and change the risk of breaching treated effluent consents at the works.	**Low to medium** • *Sewer repairs.* • *Manhole sealing.*	**Low to medium** • *CCTV surveys.* • *Look and lift surveys.* • *Flow surveys.* *(Costs of surveys would be offset by reduced costs for pumping and processing groundwater.)*	**Low** • *Reduced carbon emissions due to reduced pumping and processing.* • *Less risk of pollution or controlled releases if groundwater flows are reduced.* • *Some traffic disruption during survey and repair work.*	**Low** • *Minimal input required from other stakeholders.*	**Medium** • *Surveys require optimal conditions of high groundwater level and low flows in the sewer.* • *Available funding in infiltration reduction budget which will be prioritised for a number of villages across the region.* • *This strategy would need to be combined with an expansion in treatment capacity to reduce overall risk.*	• *Reduction in flooding and pollution incidents.* • *Enables economic development of the region.*	**Short to medium** Benefits could be realised by 2020 if funding is available, or 2025 if funding requires external approval.	**Low to medium** • *Percentage of DWF attributable to groundwater infiltration.* • *Location of groundwater infiltration.*
2) Provide additional treatment capacity at the works as required	**Low to medium** Reduces the risk of breaching treated effluent consents at the works but doesn't change the risk of breaching the DWF consent .	**Medium** • *New treatment assets.* • *There is a potential scheme to uplift population equivalent capacity at Sidlesham WTW in our business plan for 2015 to 2020 if anticipated growth takes place.*	**Medium** • *Operation of additional assets.*	**Medium to high** • *Additional treated effluent would be discharged to the Broad Rife which needs to be improved from 'bad' to 'good' status by 2027.* • *Increased carbon emissions from construction and operation of new assets.*	**Medium** • *Requires EA consent for additional discharges to the Broad Rife.* • *Requires EA consent for change to DWF.* • *Planning permission may be required to extend the works.*	**Medium** • *Availability of land to construct new assets.* • *Approval of funding for the scheme in the next business plan.* • *This strategy would need to be combined with a DWF consent change or infiltration reduction to reduce overall risk.*	• *Enables economic development of the region.*	**Medium** Benefits could be realised by 2025 if the scheme is approved.	**Low to medium** • *Population equivalent capacity of Sidlesham WTW.* • *Growth in region to 2040.* • *Environmental impact.*
3) Transfer wastewater to other treatment works with spare capacity	**Low to medium** Reduces the risk of breaching DWF and treated effluent consents at Sidlesham WTW but increases the risk at neighbouring WTW.	**Medium** • *Construct new pumping station or install new transfer pumps at an existing WPS.* • *Construct a new rising main to a neighbouring wastewater catchment with spare capacity.*	**Medium** • *Additional pumping cost to a neighbouring catchment.* • *Additional process costs at the neighbouring WTW.*	**Medium** • *Additional treated effluent discharged to a watercourse in the neighbouring catchment.* • *Increased carbon emissions due to construction and pumping to a neighbouring catchment.*	**Medium** • *May require changes to consents for the neighbouring WTW.* • *Planning permission for potential new pumping station.*	**Medium** • *Availability of land for construction work.* • *Approval of funding for the scheme in the next business plan.*	• *Reduction in flooding and pollution incidents.* • *Enables economic development of the region.*	**Medium** Benefits could be realised by 2025 if the scheme is approved.	**Medium to high** • *Capacity of network and treatment works in the neighbouring catchments to be confirmed by the DAP.*

Appendix A – Strategic assessments continued

Table 29: Strategic assessment for minimising flooding and pollution due to wastewater

Outcome: minimising flooding and pollution due to wastewater				Risk: insufficient network capacity to accommodate forecast new wastewater connections due to population growth					
Strategy description	Residual risk	Whole life costs		Environmental impact	Input required from other stakeholders	Other constraints	Environmental and societal benefits	Programming	Uncertainties
		Capital expenditure (Capex)	Operational expenditure (Opex)						
1) Upsize foul/combined sewers, pumps and rising mains as required	**Low** Reduces the original risk of flooding and pollution due to additional wastewater flows.	High • *Upsize trunk and strategic sewers.* • *Upsize pumps and rising mains at pumping stations.*	**Medium to high** • *Additional pumping costs.* • *Additional process costs at the works.*	**Medium** • *Increase in carbon emissions due to construction and additional pumping/ processing.* • *Traffic disruption.*	**Medium** • *Requires changes to consents due to treatment of additional wastewater.*	**Low to medium** • *Access to land to upgrade/install new sewers.* • *Approval of funding for the scheme in next business plan.*	• *Reduction in flooding and pollution incidents.* • *Provide capacity in the network accommodate new wastewater connections.*	**Medium** Benefits could be realised by 2025 if scheme is approved.	**Low** Check capacity of existing network to accommodate growth in sewer flows.
2) Reduce groundwater infiltration of foul sewers	**Low to medium** If infiltration is identified as a major component of DWF in foul sewers then repairs should provide capacity for additional wastewater flows.	**Low to medium** • *Sewer repairs.* • *Manhole sealing.*	**Low to medium** • *CCTV surveys.* • *Look and lift surveys.* • *Flow surveys.* *(Costs of surveys would be offset by reduced costs for pumping/processing of groundwater.)*	**Low** • *Reduced carbon emissions due to reduced pumping and processing.* • *Less risk of pollution or controlled releases if groundwater flows are reduced.* • *Some traffic disruption during survey/repair work.*	**Low** • *Minimal input required from other stakeholders.*	**Medium** • *Surveys require optimal conditions of high groundwater level and low sewer flows.* • *Available funding in infiltration reduction budget.*	• *Reduction in flooding and pollution incidents.* • *Provide capacity in the sewerage network and treatment works to accommodate new wastewater connections.*	**Short to medium** Benefits could be realised by 2020 if funding is available.	**Medium** • *Percentage of DWF attributable to groundwater infiltration.* • *Location of groundwater infiltration.*
3) Transfer wastewater to other treatment works with spare capacity	**Low to medium** Reduces the risk of flooding/ pollution in the Sidlesham catchment but increases the risk in neighbouring catchments.	**Medium to high** • *Construct new pumping station on the edge of the catchment.* • *Construct a new rising main to a neighbouring wastewater catchment.*	**Medium** • *Additional pumping cost to neighbouring catchment.* • *Additional process costs at the neighbouring WTW.*	**Medium** • *Additional treated effluent discharged to a watercourse in the neighbouring catchment.* • *Increased carbon emissions due to construction/pumping.*	**Medium** • *May require changes to consents for neighbouring WTW.* • *Planning permission for new pumping station.*	**Medium** • *Availability of land for construction work.* • *Approval of funding for the scheme in the next business plan.*	• *Reduction in flooding and pollution incidents.* • *Provide capacity in the sewerage network and treatment works to accommodate new wastewater connections.*	**Medium** Benefits could be realised by 2025 if the scheme is approved.	**Medium to high** Capacity of network and treatment works in neighbouring catchments to be confirmed by DAP.
4) Construct offline storage tanks to attenuate high flows	**Low to medium** Reduces the risk of hydraulic overloading of the sewers but may not have the capacity to accommodate high infiltration or surface water flows	High • *Construction of one or more large concrete underground tanks*	**Medium** • *Additional cleaning and maintenance costs in confined space.* • *Additional pumping costs to/from storage tank.*	**Medium** • *Impact during construction of underground storage tank/s.* • *Increase in carbon emissions from construction and additional pumping.*	**Medium** Planning permission required for underground tank/s.	**Medium to high** • *Availability of land for construction work.* • *Approval of funding for the scheme in the next business plan.*	• *Reduction in flooding and pollution incidents.* • *Provide capacity in the sewerage network and treatment works to accommodate new wastewater connections.*	**Medium** Benefits could be realised by 2025 if scheme is approved.	**Low to medium** • *Required size of the tank to accommodate groundwater and surface water flows.*
5) Reduce surface water in combined sewers	**Medium to high** Combined sewers are a small percentage of Sidlesham's sewerage network.	See table 30							

Appendix A – Strategic assessments continued

Table 30: Strategic assessment for minimising flooding and pollution due to surface water and groundwater

Outcome: minimising flooding & pollution due to surface water and groundwater									Risk: insufficient network capacity to accommodate groundwater infiltration and surface water flows
Strategy description	Residual risk	Whole life costs		Environmental impact	Input required from other stakeholders	Other constraints	Environmental and societal benefits	Programming	Uncertainties (to be investigated)
		Capital expenditure (Capex)	Operational expenditure (Opex)						
1) Remove misconnections of surface water to foul sewers	**Low to medium** Removes the direct connection of surface water drains to foul sewers. The residual risk depends on the extent of the misconnections.	**Low** • *Property owners would pay the cost of removing misconnections and connecting to the correct sewer.* • *Some property owners may be provided with water butts to reduce surface water drainage.*	**Low to medium** • *Cost of impermeable area survey.* • *Cost of surveys to identify. misconnections (eg flow survey, dye tracing).* • *Education of property owners, local building firms etc.*	**Low** Little environmental impact.	High • *Local authorities may need to enforce the removal of misconnections as Southern Water does not have the power to enforce.* • *Local authorities may need to lead on education through building controls etc.*	**Medium to high** • *Property owners may refuse to remove misconnections.*	• *Reduces the risk of surface water flooding of properties and pollution of water bodies.*	**Short to medium** A campaign to remove misconnections could be started reasonably quickly if funds are available.	**Medium** Volume of surface water in foul sewers due to mis-connections and the potential success of the strategy.
2) Maintain public sewers, highway drains and land drainage system	**Medium** Partially reduces the risk of surface water flooding but may require additional work to reduce long term risks due to climate change.	**Medium** • *Complete actions in the SWMP.* • *Repair or renew sewers and rising mains in poor condition.* • *Maintain/renew equipment at pumping stations and CSOs for optimal performance.*	**Medium** • *Complete actions in SWMP.* • *Jetting of sewers to prevent blockages.* • *Root removal.* • *Education of customers to reduce FOG in sewers.*	**Low to medium** • *Traffic disruption during the replacement of sewers.* • *Low impact from sewer jetting or other routine maintenance.*	High • *Maintenance of highway gullies, drainage ditches, watercourses by others.* • *Enforcement of Land Drainage Act by others.* • *Others to complete flood reduction actions.*	**Medium to high** • *Riparian owners may not maintain watercourses.* • *Customers may continue to dispose of inappropriate objects in the sewerage system.*	• *Reduces risk of flooding of properties.* • *Reduces risk of pollution leading to improved water bodies.*	**Short to medium** Ongoing benefits realised as actions are completed in SWMPs and routine maintenance is carried out.	**Low to medium** Quantity of additional surface water flows due to climate change and urban creep etc.
3) Upsize public surface water/combined sewers as required	**Medium** Surface water and combined sewers are a low percentage of the sewerage network.	**Medium** • *Upsize existing public surface water sewers.*	**Low to medium** • *Surface water flows by gravity to watercourses.* • *Maintenance and cleaning costs.*	**Low to medium** • *Increase in carbon emissions due to construction work.* • *Traffic disruption during construction work.*	**Medium to high** • *Highways drains to be maintained or improved by local authorities to reduce surface water flooding risk.*	**Low to medium** • *Access to land to upgrade/install new sewers.* • *Approval of funding for the scheme in the next business plan.*	• *Reduction in flooding and pollution incidents.*	**Medium** Benefits could be realised by 2025 if scheme is approved.	**Low to medium** • *Quantity of additional surface water flows due to climate change and urban creep etc.*
4) Construct offline storage tank/s to attenuate high flows	**Low to medium** Reduces the current risk of hydraulic overloading of the sewers but may not have the capacity to reduce the increased risk due to climate change.	**High** • *Construction of one or more large concrete underground tanks.*	**Medium** • *Additional cleaning and maintenance costs in confined space.* • *Additional pumping costs to/from storage tank.*	**Medium** • *Impact during construction of underground storage tank/s.* • *Increase in carbon emissions from construction and additional pumping.*	**Medium** • *Planning permission required for underground tank/s.*	**Medium to high** • *Availability of land for construction work.* • *Approval of funding for the scheme in the next business plan.*	• *Reduction in flooding and pollution incidents.* • *Provide capacity in the sewerage network and treatment works to accommodate new wastewater connections.*	**Medium** Benefits could be realised by 2025 if scheme is approved.	**Low to medium** • *Required size of the tank to accommodate groundwater and surface water flows.*
5) Encourage take up of SuDS by others through; • *adopting SuDS in public open spaces* • *reducing bills for partial/ full disconnection of domestic surface water flows* • *provision of water butts to customers*	**Medium** Removes some surface water flows in the sewers. Would not be sufficient to reduce the risk of additional surface water flows due to climate change & urban creep.	**Medium** • *Low cost for each water butt.* • *Costs depend on number of properties provided with water butts etc.*	**Low to medium** • *Cleaning and maintenance of adopted SuDS* • *Reduced pumping costs.*	**Low** Minimal environmental impact	**Medium** Partnership working on SuDS adoption policy	**Low to medium** • *Potential changes in legislation on SuDS adoption etc* • *Obtaining Ofwat support for investment in SuDS.*	• *Reduces some risk of flooding, pollution, releases.* • *Reduces bills for property owners who install SuDS.* • *SuDS improves public spaces.* • *Reduces carbon emissions from pumping.*	**Short to medium term** Policy adoption could realise benefits in the short term.	**Medium** • *Quantity of additional surface water flows due to climate change etc.* • *Quantity of flows removed by SuDS.*

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Appendix A – Strategic assessments continued

Table 30: Strategic assessment for minimising flooding and pollution due to surface water and groundwater – *continued*

Outcome: minimising flooding & pollution due to surface water and groundwater				Risk: insufficient network capacity to accommodate groundwater infiltration and surface water flows					
Strategy description	Residual risk	Whole life costs		Environmental impact	Input required from other stakeholders	Other constraints	Environmental and societal benefits	Programming	Uncertainties (to be investigated)
		Capital expenditure (Capex)	Operational expenditure (Opex)						
6) Large scale retrofitting of SuDS	**Low to medium** Reduces the risk of additional surface water flows causing flooding and pollution.	**Medium to high** • *Retrofitting of basins, swales, planters, permeable surfaces.* • *Costs may be shared with other stakeholders.*	**Low to medium** • *Cleaning and maintenance of adopted SuDS.* • *Reduced pumping costs.*	**Low** • *Some environmental impact during the construction of SuDS.* • *The strategy will improve the environment significantly.*	**High** • *Partnerships to share risks, costs and resources.*	**Medium to high** • *High groundwater level restricts infiltration SuDS techniques.* • *Availabilty of land for swales, planters etc.* • *Obtaining Ofwat support for investment in SuDS.*	• *Reduces some risk of flooding, pollution, releases.* • *Improves public open spaces.* • *Reduces carbon emissions.*	**Medium to high** Initial benefits could be realised by 2030.	**Medium** • *Quantity of surface water flows due to climate change etc.* • *Quantity of flows removed by SuDS.*
7) Separation of surface water from foul water in combined sewers	**Medium to high** Sidlesham has mainly separate foul and surface water networks. Less than 1% of the sewerage network is combined sewers.	**Medium to high** • *Construction of new surface water sewers, pumping stations and outfalls.*	**Low to medium** • *Additional surface water pumping costs offset by reduced pumping of combined flows.* • *Additional surface water sewers to maintain and clean.*	**Medium** • *Impact during construction work of new sewers and pumping stations.* • *Increase in carbon emissions from construction.*	**Medium** • *Partnership working to separate surface water from combined sewers.* • *Planning permission for new pumping stations, outfalls etc.*	**Medium** • *Availability of land to construct new surface water pumping stations or outfalls.* • *Availability of suitable discharge points.*	• *Reduces risk of flooding of properties.* • *Reduced pollution leading to improved bathing & shellfish waters and watercourses.*	**Medium** Benefits could be realised by 2025 to 2030.	**Medium** • *Quantity of surface water flows due to climate change etc.*
8) Reduce groundwater infiltration of foul sewers	**Low** If groundwater infiltration is identified as a major component of flow then repairs should reduce the risk of flooding due to hydraulic overloading by groundwater.	**Low to medium** • *Sewer repairs.* • *Manhole sealing.*	**Low to medium** • *CCTV surveys.* • *Look and lift surveys.* • *Flow surveys.* *(Costs of surveys would be offset by reduced costs for pumping and processing groundwater.)*	**Low** • *Reduced carbon emissions due to reduced pumping and processing.* • *Less risk of pollution or controlled releases if groundwater flows are reduced.* • *Some traffic disruption during survey and repair work.*	**Low** • *Minimal input required from other stakeholders.*	**Medium** • *Surveys require optimal conditions of high groundwater level and low flows in the sewer.* • *Available funding in infiltration reduction budget to be prioritised for a number of villages across the region.*	• *Reduction in flooding and pollution incidents.* • *Provide capacity in the sewerage network and treatment works to accommodate new wastewater connections.*	**Short to medium** Benefits could be realised by 2020 if funding is available or 2025 if funding requires external approval.	**Medium** • *Percentage of flow attributable to groundwater infiltration.* • *Location of groundwater infiltration.*

Appendix A – Strategic assessments continued

Table 31: Strategic assessment for improving water bodies to 'good' status by 2021 or 2027

Outcome: improve water bodies to 'good' status by 2021 or 2027 and maintaining 'excellent' bathing waters		Risk: diffuse urban and rural pollution. Increase in pollution and releases due to insufficient capacity						
Strategy description	**Residual risk**	**Whole life costs**		**Environmental impact**	**Input required from other stakeholders**	**Other constraints**	**Environmentaland societal benefits**	**Programming**	**Uncertainties (to be investigated)**
		Capital expenditure (Capex)	**Operational expenditure (Opex)**						
1) Implementation of integrated water cycle management and working with external stakeholders to reduce the pollution of water bodies	**Medium** IWCM is a long-term strategy and may not achieve the required improvements by 2021.	**Low to medium** • *Requires investment in research and development of innovative solutions to aid the delivery of IWCM.* • *May require improvements to wastewater treatment.*	**Medium** • *Collection and analysis of data to assess sources of pollutants.* • *Modelling of catchments.* • *Use of decision analysis tools.* • *Ongoing engagement with all stakeholders.*	**Low** • *The strategy will improve the environment significantly.*	**High** • *Requires significant engagement and input from other stakeholders including local authorities and landowners.* • *Requires a change in practice and behaviour of all polluters of water bodies.*	**Medium** • *IWCM requires the development of an institutional and legal framework.*	• *Improve biodiversity.* • *Improve the wellbeing of residents and visitors.* • *Increase recreational use of water bodies.* • *Increase tourism and improve the local economy.*	**Medium to long** Benefits from pilot schemes could be realised between 2020 and 2025 and from other catchments in the longer term.	**Medium to high** • *Will IWCM be effective? (Use trials to investigate).* • *Willingness of other stakeholders to change their behaviour.*
2) Minimise pollution and sewerage network releases due to additional wastewater, surface water and groundwater flows using the potential strategies described in tables 29 and 30.	See tables 29 and 30								

Appendix B – Sidlesham DAP Action Plan

Table 32: Sidlesham DAP Action Plan

DAP ref	Location	Capital/ Maintenance	Issue Flooding/Growth	Location of growth	Location of flooding	Outline scheme description	Proposed scheme	Status	Action owner	Programme
5	**Itchenor and Birdham**	Capital Maintenance	Sewer condition	Itchenor and Birdham	Various	Sewer replacement	Sewer lining	Complete	SW	Complete
10.3	**Selsey**	Capital	Flooding to properties (internal & external)		Flooding Manor Lane, Maresfield Place, Gainsborough Road, Grafton Road and James Street	Option 1: upgrade WPS and upsize network	New up-rated WPS. New rising main Upsize 1,935m of gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.3	**Selsey**	Capital	Flooding to properties (internal & external)		Flooding Manor Lane, Maresfield Place, Gainsborough Road, Grafton Road and James Street	Option 2: upgrade CSO and upsize network	New overflow structure New outfall Upsize 1,665m of gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.3	**Selsey**	Capital	Flooding to properties (internal & external)		Flooding Manor Lane, Maresfield Place, Gainsborough Road, Grafton Road and James Street	Option 3: offline storage and upsize network	Upgrade WPS. New rising main Upsize 1,513m of gravity sewer Offline storage tank	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.3	**Selsey**	Capital	Flooding to properties (internal & external)		Flooding Manor Lane, Maresfield Place, Gainsborough Road, Grafton Road and James Street	Option 4: new WPS at Holford Green	New WPS New rising main Upsize 1,340m of gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.3	**Selsey**	Capital	Flooding to properties (internal & external)		Flooding Manor Lane, Maresfield Place, Gainsborough Road, Grafton Road and James Street	Option 5: separation of flows	Removal of all hard standing area (roads and roofs) from the Selsey model	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.4	**East Bracklesham**	Capital	Flooding to properties (internal & external)		East Bracklesham Drive and Bracklesham Lane	Option 1: offline storage	Off-line storage tank with pumped return New 180m rising main 180m of new gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.5	**West Wittering**	Capital	Flooding to properties (external)		Pound Road, Seaward Drive & Rookwood Road	Option 1: offline storage and sewer reinforcement	Off-line storage tank with pumped return New 70m rising main 370m of new gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.6	**East Wittering**	Capital	Flooding to properties (internal & external)		Solent Road, Church Road, Shore Road & Marine Drive	Option 1: Offline storage and sewer reinforcement	Offline storage tank with pumped return New 70m rising main Upsize 547m of gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.7	**Birdham**	Capital	Flooding to properties (external)		Florence Close & Crooked Lane	Option 1: Offline storage (gravity return)	125m of twin box culvert New weir arrangement in existing chamber	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.7	**Birdham**	Capital	Flooding to properties (external)		Florence Close & Crooked Lane	Option 2: Offline storage (pumped return)	Storage tank with pump return New 70m rising main Upsize 250m of gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.8	**Itchenor**	Capital	Flooding to properties (external)		Memorial Hall Itchenor	Option 1: Offline Storage (Pumped Return) and Upsizing	Storage tank with pump return. New 25m rising main. New 25m gravity sewer.	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.8	**Itchenor**	Capital	Flooding to properties (external)		Memorial Hall Itchenor	Option 2: surcharge relief	New bifurcation Chamber 285m of new gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.9	**Almondington**	Capital	Flooding to properties (external)		Almondington Lane & Third Avenue	Option 1: sewer upsize	Upgrade WPS Extend rising main 202m Upsize 825m of gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.9	**Almondington**	Capital	Flooding to properties (external)		Almondington Lane & Third Avenue	Option 2: flow transfer	Upgrade WPS Extend rising main 202m Upsize 300m of gravity sewer New gravity sewer 450m	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.9	**Almondington**	Capital	Flooding to properties (external)		Almondington Lane & Third Avenue	Option 3: online Storage	Upgrade WPS New gravity sewer 95m (including online storage) Upsize gravity sewer 200m	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
10.9	**Almondington**	Capital	Flooding to properties (external)		Almondington Lane & Third Avenue	Option 4: offline storage (pumped return)	Storage tank with pumped return Upsize 566m of gravity sewer	Feasibility	SW	Dependant on willingness to pay and cost benefit analysis
11.3	**Highleigh Road**	Capital Maintenance	Flooding to properties (external)		Highleigh Road WPS	Infiltration reduction	Sewer Sealing	Feasibility	SW	Investigate when conditions arise
11.3	**Rookery Lane**	Capital Maintenance	Flooding to properties (external)		Rookery Lane WPS	Infiltration reduction	Sewer Sealing	Feasibility	SW	Investigate when conditions arise

Appendix B – Sidlesham DAP Action Plan continued

Table 32: Sidlesham DAP Action Plan *continued*

DAP ref	Location	Capital/ Maintenance	Issue Flooding/Growth	Location of growth	Location of flooding	Outline scheme description	Proposed scheme	Status	Action owner	Programme
11.3	**Rookery Lane**	Capital Maintenance	Flooding to properties (external)		Rookery Lane WPS	Infiltration reduction	Sewer Sealing	Feasibility	SW	Investigate when conditions arise
11.3.1	**Highleigh**	Capital	Growth	Braemere Lane, Highleigh		To be determined on receipt of planning application approval	Options to be considered: surface water removal, sewer upsize, storage	Feasibility	SW	Timing dependent on planning certainty
11.3.5	**Bracklesham**	Capital	Growth	Off Barton Way, Bracklesham		To be determined on receipt of planning application approval	Options to be considered: surface water removal, sewer upsize, storage	Feasibility	SW	Timing dependent on planning certainty
11.3.3	**Birdham**	Capital	Growth	Rowan Nursery, Bell Lane, Birdham		To be determined on receipt of planning application approval	Options to be considered: surface water removal sewer upsize and storage	Feasibility	SW	Timing dependent on planning certainty
11.3.2	**Birdham**	Capital	Growth	Crooked Lane, Birdham		To be determined on receipt of Planning Application Approval	Options to be considered: surface water removal sewer upsize and storage	Feasibility	SW	Timing dependent on planning certainty
11.3.2	**Birdham**	Capital	Growth	Coppice Barn, Church Lane, Birdham		To be determined on receipt of planning application approval	Options to be considered: surface water removal sewer upsize and storage	Feasibility	SW	Timing dependent on planning certainty
11.3.2	**Birdham**	Capital	Growth	Church Lane, Birdham		To be determined on receipt of planning application approval	Options to be considered: surface water removal sewer upsize and storage	Feasibility	SW	Timing dependent on planning certainty
11.3.4	**Selsey**	Capital	Growth	Park Farm, Selsey		To be determined on receipt of planning application approval	Options to be considered: surface water removal sewer upsize and storage	Feasibility	SW	Timing dependent on planning certainty